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### CHANGE RECORD

Issue	Date	Sheet	Description of Change	Release
0.1	September 2007	All	First Draft of Document	0.1
0.2	September 2007		Deeper analysis on AMB002 data: updated plots	0.2
1.0	October 2007		1Hz analysis added	1.0
2.0	January 2008		Other features paragraph completed (RCA 2501; DAE later tray sensors, Voltage fluctuation) Appendix added with full 1Hz analysis.	2.0



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## 1 ACRONYMS

AIV	Assembly, Integration, Verification
ASW	Application Software
BEM	Back End Module
BEU	Back End Unit
CCS	Central Check-out System
CDMU	Central Data Management Unit
DAE	Data Acquisition Electronics
DPU	Digital Processing Unit
EGSE	Electrical ground Support Equipment
FEM	Front End Module
I-EGSE	Instrument EGSE
IST	Integrated Satellite Test
OBC	On Board Clock
RAA	Radiometer Array Assembly
REBA	Radiometric Electronic Box Assembly
S/C	Spacecraft
SCOE	Spacecraft Control and Operation System
SPU	Signal Processing Unit
SUSW	Start- Up Software
SVM	Service Module
TBC	To Be Checked
TBW	To Be Written
TC	Telecommand
TM	Telemetry
UFT	Unit Functional Test



## 2 INTRODUCTION

This document has been issued in the frame of ASI contract that has been released for the activities of Planck-LFI Phase E2

### 2.1 Purpose and Scope

Scope of this document is to give a first quick look analysis response of the functionality of the LFI instrument during its first SFT Functional Test (SFT) performed in TAS F Cannes on September the 13<sup>th</sup>. The document is divided in two sections. The first section is related to the description of the work done that is to say the description of the LFI Log Book and the description of the performed tests. The second section is the summary of the results of each test coming from both real time and offline data analysis.

### 2.2 Test configuration

The test configuration is the following

SCOS 2 K HPCCS Version 2.0.787  
LFI Gateway Version V0R9P1  
TQL 3.1.2  
LIFE Machine version OM 3.00

LFI Personnel involved during the test is:

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## **3 APPLICABLE AND REFERENCE DOCUMENTS**

### **3.1 Applicable Documents**

[AD01] LFI Short Functional Test Procedure (SFT)  
HP-LFI-PST-PR\_018 Issue 3.0

### **3.2 Reference Documents**

- RD 1. LFI Short Functional Test Procedure (SFT)
- RD 2. HP-LFI-PST-PR\_018 Issue 3.0
- RD 3. PL-LFI-PST-TN-0082 (1.0) Analysis of Signal Swap in output of Channel 2510 (Action#4 H-PTASF-MN-9737)
- RD 4. PL-LFI-PST-TN-080 (1.0) Proposal for LFI test dedicated to characterize New Spikes in the FFT spectrum of Scientific Data





## 4 Short functional test Execution

For each modular block of procedure test results and conclusions are presented.

### 4.1 Up to DAE set up with REBA redundant

#### 4.1.1 Procedure/ Test sequence

Test Sequence	LFI Single Operation: Full Warm Functional test (Redundant Unit)				0.43.00
TS1	<b>Switch ON LFI</b>				<b>0.39.00</b>
	Switch ON REBA R	OFF to standby	0.22.00	0.32.00	
	Switch ON RAA	Standby to DAE set up	0.05.00	0.07.00	
	<b>Switch OFF LFI</b>				<b>0.04.00</b>
	Switch OFF RAA	DAE set Up to Stand By	0.02.00	0.02.00	
	Switch OFF REBA	Stand By to OFF	0.02.00	0.02.00	

#### 4.1.2 Results and Conclusions

The procedure has run on the 13<sup>th</sup> of September without any problem and the test has finished successfully.

Pass and Fail Criteria

No errors from the REBA HW Self check	PASSED
No un-expected event Packets	PASSED
REBA Power Consumption within the ranges of expected values	PASSED
EEPROM Check Sum passed	PASSED
REBA synchronization achieved	PASSED
DAE Power Consumption within the ranges of expected values	PASSED
DAE Synchronization achieved	PASSED

### 4.2 Up to DAE set up with REBA Nominal and Science acquisition

#### 4.2.1 Procedure/ Test sequence

TS2	<b>Switch ON LFI</b>				<b>0.39.00</b>	
	Switch ON REBA	OFF to standby	0.22.00	0.32.00	1.15.00	
	Switch ON RAA	Standby to DAE set up	0.07.00	0.07.00	1.22.00	
	<b>LFI in Normal Science (Warm test Config..)</b>				<b>0.17.00</b>	
	Event Packet Enabling		0.02.00	0.02.00	1.24.00	
	Setting Telemetry Rate (Room test Values)		0.02.00	0.02.00	1.26.00	
	Changing Processing Type to 1		0.02.00	0.02.00	1.28.00	
	Definition of science Processing Parameters		0.02.00	0.02.00	1.30.00	
	<b>SPU Connection</b>		<b>0.02.00</b>	<b>0.02.00</b>	<b>1.32.00</b>	
	<b>Science Activation Type 1</b>		<b>0.05.00</b>	<b>0.05.00</b>	<b>1.35.00</b>	
	Configure DAE		0.02.00	0.02.00	1.37.00	

#### 4.2.2 Results and Conclusions

The procedure has run on the 13<sup>th</sup> of September and the test has finished successfully.

Pass and Fail Criteria



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No errors from the REBA HW Self check	PASSED
No un-expected event Packets	
REBA Power Consumption within the ranges of expected values	PASSED
EEPROM Check Sum passed	PASSED
REBA synchronization achieved	PASSED
DAE Power Consumption within the ranges of expected values	PASSED
DAE Synchronization achieved	PASSED
Science Telemetry is arriving to I-EGSE	PASSED



### 4.3 AMB 02

#### 4.3.1 Procedure/Test sequence

		Radiometric functional tests		3.14.00
TS4		RCA Activation		0.05.00 0.05.00
		Wait for thermalization of the power group		0.30.00 0.30.00
		Configure DAE (Switch ACA on)		0.02.00 0.02.00
		Wait for thermalization of the FPU		0.15.00 0.15.00
		Acquiring data		0.10.00 0.10.00
		Enable 4Khz switching ON A/C		0.02.00 0.02.00
		Acquiring data		0.30.00 0.30.00
		change P/S status on B/D to 1		0.02.00 0.02.00
		Acquiring data		0.30.00 0.30.00
		Disable 4Khz switching ON A/C		0.02.00 0.02.00
		change P/S status on A/C and B/D to 0		0.02.00 0.02.00
		Enable 4Khz switching ON B/D		0.02.00 0.02.00
		Acquiring data		0.30.00 0.30.00
		Conf. Polar : change the A/C Status to 1		0.02.00 0.02.00
	Acquiring data		0.30.00 0.30.00	

#### 4.3.2 Results and Conclusions

Session saved in test file AMB\_0098 and AMB\_0099

Pass and Fail Criteria

No un-expected event Packets	PASSED
REBA Power Consumption within the ranges of expected values	PASSED
DAE Power Consumption within the ranges of expected values	PASSED
The FEM I Drain Currents obtained from Telemetry are within the ranges expected (5%)	PASSED
The DC voltages Outputs (Science Telemetry) are within the ranges expected. (10%)	PASSED
No unexpected features in FFT spectrum (Spike, Pop corn noise, currents drops...)	Analysis on going

NCR	Description
	There was a mistake in test scrip corrected on line. There was no wait for thermalization of the power group and warm temperature biases were applied without waiting 30 minutes requested from procedure. The test script was corrected in real time and the test could continue.
	During the thermalization of power groups the TQL/TMH crashed and new test (0099) has been started.
	During the test there was mechanical activity around PLM. The was requested to stopped at 9:45.
	The grounding was not in flight condition. Thermal links between waveguide and V-Grooves were removed to integrate MLI on RAA.



Id w.r.t RAA				
CH	<00>	<01>	<10>	<11>
CH27	0.45	0.26	0.38	0.40
CH24	0.24	0.28	0.31	0.37
CH21	0.30	0.62	0.39	0.57
CH22	0.84	0.70	0.64	0.75
CH23	0.84	0.73	0.73	0.66
CH25	0.19	0.30	0.33	0.32
CH28	0.23	0.30	0.18	0.42
CH20	0.51	0.66	0.61	0.70
CH19	0.58	0.71	0.46	0.30
CH18	0.71	0.44	0.49	0.73
CH26	0.48	0.30	0.26	0.26

Figure 1 Current consumption of ACA from AMB-02 respect to FM level. The values are expressed in percentage

Id w.r.t WFT				
CH	<00>	<01>	<10>	<11>
CH27	0.39	0.93	0.32	0.33
CH24	0.38	0.35	0.41	0.44
CH21	0.25	0.28	0.28	0.41
CH22	0.52	0.32	0.21	0.43
CH23	0.33	0.36	0.34	0.55
CH25	0.30	0.42	0.40	0.43
CH28	0.29	0.18	0.12	0.30
CH20	0.10	0.20	0.31	0.20
CH19	0.21	0.20	0.30	0.15
CH18	0.27	0.22	0.18	0.17
CH26	0.52	0.38	0.45	0.38

Figure 2 Current consumption of ACA from AMB-02 respect to WFT performed in August 2007. The values are expressed in percentage



LFI ON VOUT (w.r.t RAA-FM)						
	B/D SW		A/C SW		average B/D	average A/C
	SKY	REF	SKY	REF		
CH27	1.61	-0.74	3.03	0.82	0.84	2.34
	2.01	-0.13	3.70	1.38		
	2.14	0.19	3.62	1.63		
	1.82	-0.16	3.20	1.32		
CH24	0.00	0.00	2.82	0.00	1.17	-2.53
	1.25	0.00	0.00	0.00		
	-1.85	0.00	-7.41	-7.41		
	5.71	4.29	-4.11	-4.11		
CH21	0.34	4.29	-4.11	-4.11	0.52	-1.99
	-1.10	0.00	0.00	0.00		
	1.36	-0.34	-1.00	-1.67		
	0.71	-1.08	-2.53	-2.48		
CH22	0.26	1.37	0.35	0.52	-0.05	-0.56
	-0.69	0.71	-0.18	-3.84		
	-0.72	0.00	0.00	0.00		
	-1.31	0.00	-0.66	-0.67		
CH23	0.31	-0.90	-1.64	-2.26	-0.52	-1.20
	0.31	-1.32	-2.02	-2.51		
	-0.06	-1.18	1.20	-2.35		
	-1.33	0.00	0.00	0.00		
CH25	3.14	-3.43	-0.22	-0.74	-0.03	-1.17
	2.81	0.13	-0.61	-0.80		
	-1.02	-0.49	-2.03	-1.98		
	0.00	-1.34	-1.49	-1.51		
CH28	3.03	0.00	0.00	0.00	1.88	1.66
	2.22	4.05	3.71	3.88		
	0.52	2.89	3.20	3.48		
	1.27	1.02	-1.02	0.00		
CH20	1.90	0.00	1.23	0.12	0.62	1.98
	0.65	0.00	0.00	0.00		
	-0.31	1.00	4.83	2.95		
	0.52	1.17	4.19	2.56		
CH19	0.70	-3.24	2.71	0.75	0.36	1.56
	0.66	-0.40	2.79	0.99		
	2.36	0.00	0.00	0.00		
	1.68	1.14	2.95	2.27		
CH18	2.99	0.64	1.67	5.38	0.97	1.55
	2.11	-0.87	1.03	0.55		
	1.11	0.59	1.87	1.92		
	1.19	0.00	0.00	0.00		
CH26	1.57	-0.12	1.54	0.72	1.51	2.10
	1.84	0.32	1.45	1.20		
	2.46	1.71	3.45	3.08		
	2.63	1.66	2.70	2.69		

**Figure 3**

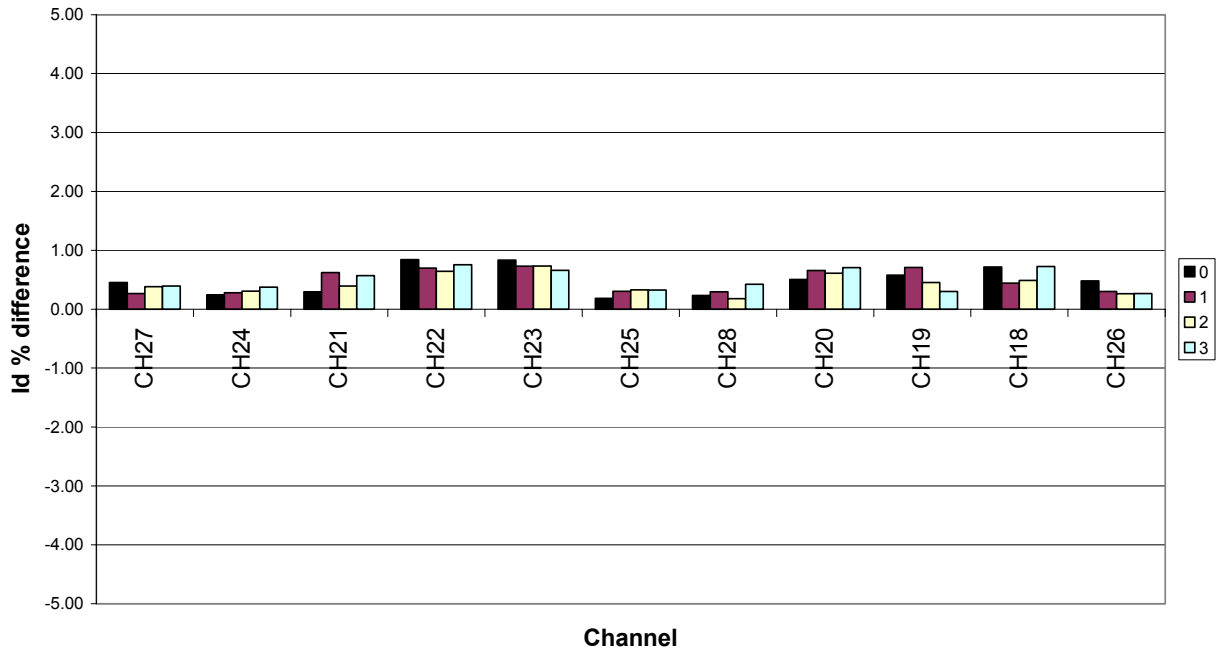


LFI ON VOUT (w.r.t WF1)						
	B/D SW		A/C SW		average B/D	average A/C
	REF	Remarks	Remarks	Remarks		
CH27	3.63	3.66	3.03	0.82	3.63	2.34
	3.82	3.86	3.70	1.38		
	3.52	3.52	3.62	1.63		
	3.50	3.52	3.20	1.32		
CH24	4.35	2.82	4.29	4.29	2.29	2.52
	2.53	2.56	2.53	2.53		
	0.00	1.89	1.89	1.89		
	2.78	1.39	1.37	1.37		
CH21	1.02	0.69	1.02	0.68	1.48	1.58
	1.12	1.47	1.12	1.48		
	2.23	2.08	2.30	2.31		
	1.62	1.61	1.86	1.85		
CH22	1.06	2.08	0.35	0.52	1.30	-0.56
	1.41	1.61	-0.18	-3.84		
	1.48	0.00	0.00	0.00		
	1.84	0.94	-0.66	-0.67		
CH23	0.85	0.84	1.52	1.43	1.07	2.06
	1.27	1.22	1.56	1.57		
	1.52	1.51	1.44	1.88		
	0.68	0.68	2.14	4.94		
CH25	7.44	7.54	8.68	8.70	5.44	6.19
	7.02	7.55	8.56	8.51		
	2.11	4.21	4.30	3.16		
	3.80	3.85	3.80	3.85		
CH28	4.64	4.55	5.64	5.64	3.94	5.32
	4.43	4.35	5.41	5.48		
	4.06	1.17	4.97	5.05		
	4.20	4.12	5.12	5.23		
CH20	1.46	1.40	3.49	3.35	1.52	4.00
	1.40	1.47	3.20	7.24		
	1.44	1.45	3.64	3.50		
	1.73	1.79	3.66	3.92		
CH19	1.18	1.08	3.38	3.21	1.74	3.81
	1.10	1.09	3.06	3.23		
	2.45	2.39	4.63	4.54		
	2.29	2.36	4.11	4.29		
CH18	1.16	1.18	3.41	3.37	1.50	3.39
	1.22	1.26	3.45	3.43		
	1.79	2.78	3.45	3.73		
	1.29	1.30	3.03	3.27		
CH26	5.74	6.35	6.61	8.94	6.52	7.69
	7.10	6.54	9.93	6.54		
	6.12	6.47	6.12	7.54		
	6.85	6.98	8.84	6.98		

Figure 4

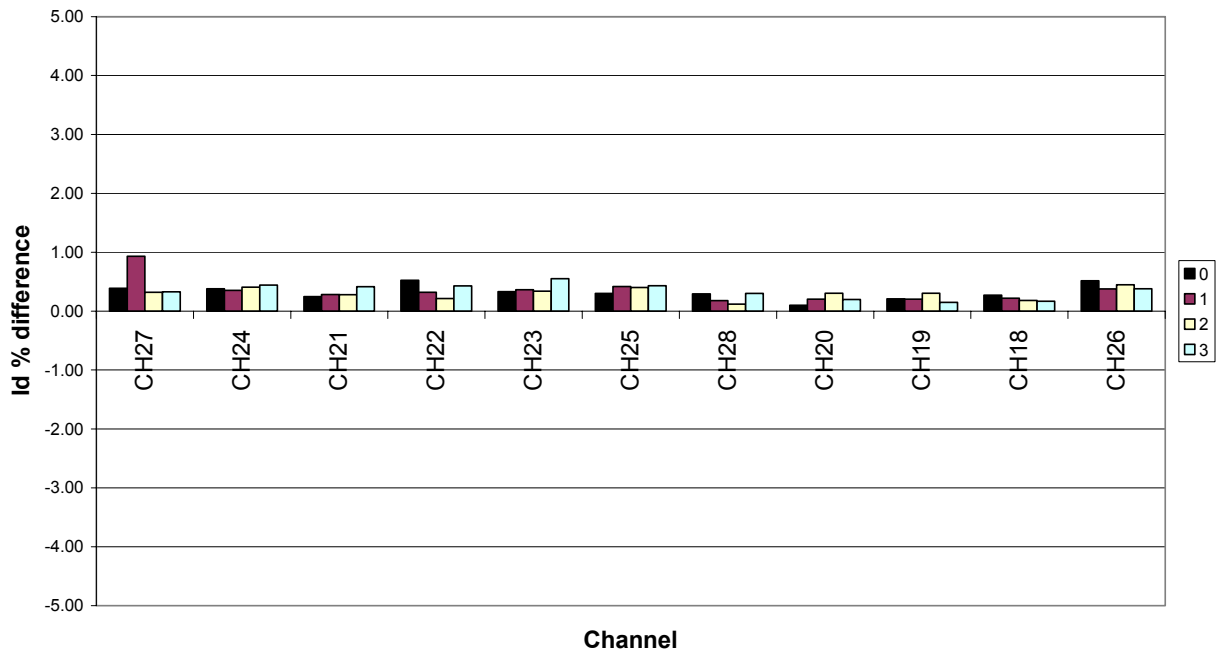


LFI ON: drain currents w.r.t. RAA



1. Current consumption of ACA from AMB-02 respect to FM level. The values are expressed in percentage

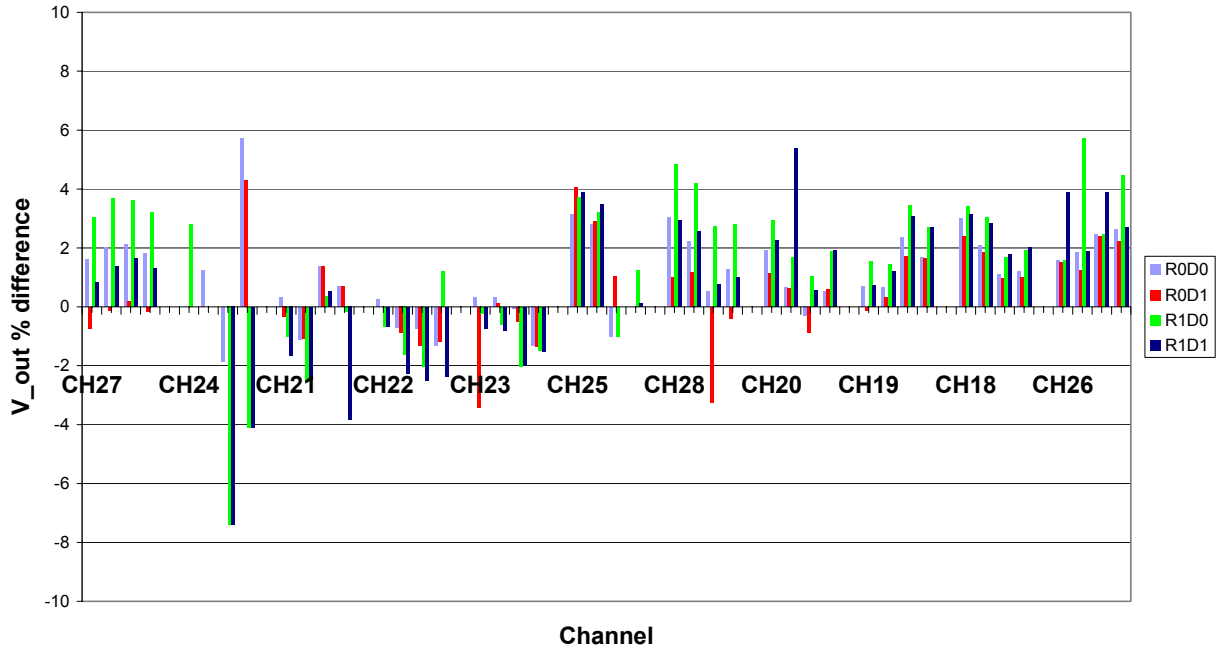
LFI ON: drain currents w.r.t WFT



2. Current consumption of ACA from AMB-02 respect to WFT performed in August 2007. The values are expressed in percentage

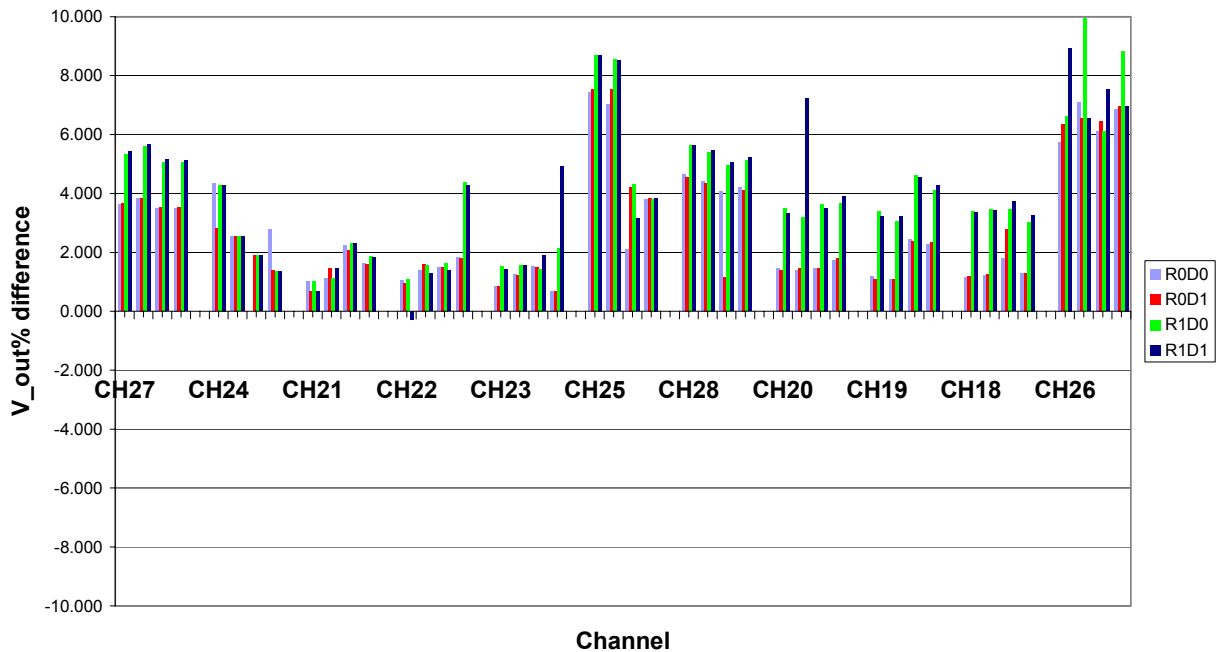


LFI ON: scientific output w.r.t. RAA



3. Output Voltage variation of AMB-02 respect to FM tests, the values are expressed in percentages.

LFI ON: scientific output w.r.t. WFT



4. Output Voltage variation of AMB-02 respect to WFT performed in August 2007, the values are expressed in percentages.



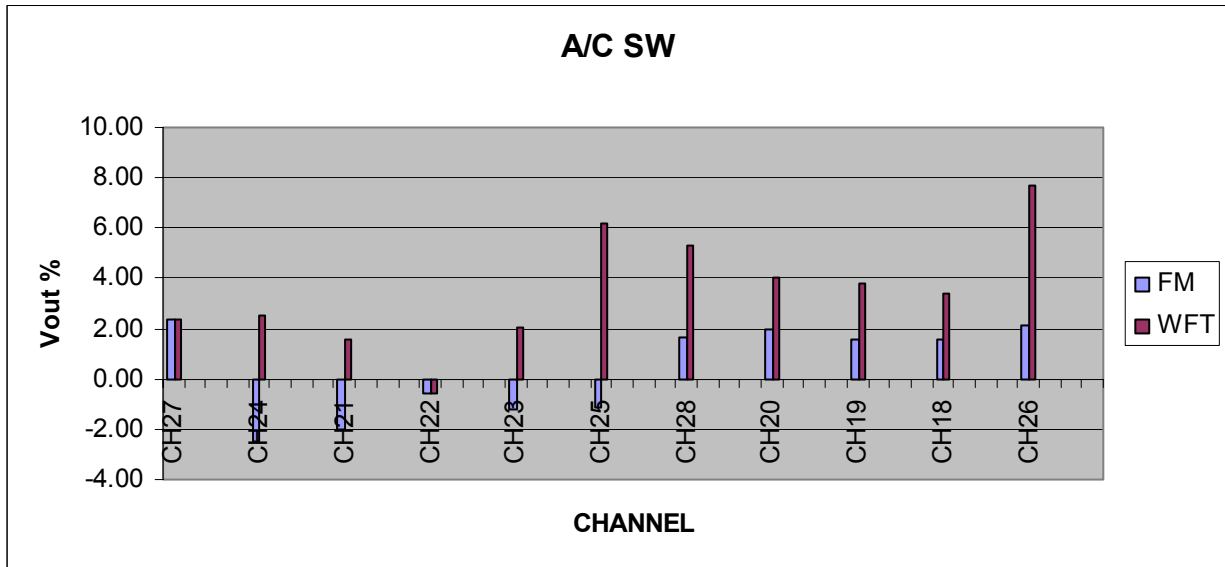


Figure 5

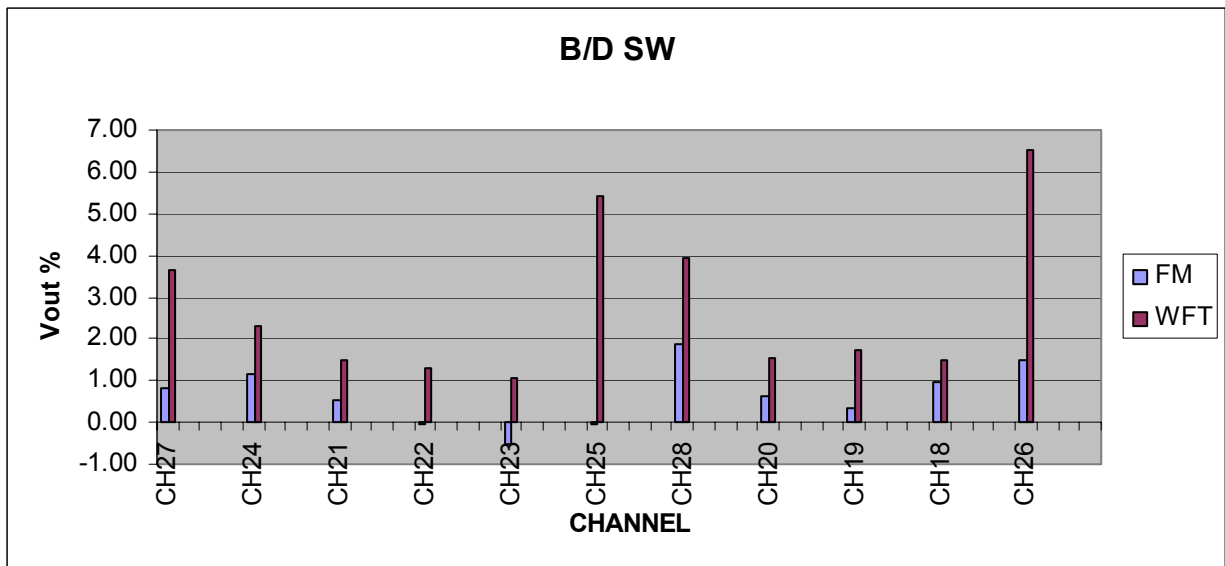


Figure 6



4.4 LFI in Normal Science

4.4.1 Procedure/Test sequence

Table with 5 columns: Test Step, Description, Duration, and Total. Row 1: Normal science and Start channel swiching (0.55.00). Rows 2-9: Science de-activation, Setting Telemetry Rate 48 Kbps, Changing Processing Type to nominal (T5), Definition of science parameters, Science activation, Start channel switching, Aquisition in stable condition, Save Configuration.

4.4.2 Results and Conclusions

Session saved in test file AMB\_100
Pass and Fail Criteria

Table with 2 columns: Criteria, Result. Rows: No un-expected event Packets (PASSED), REBA Power Consumption within the ranges of expected values (PASSED), DAE Power Consumption within the ranges of expected values (PASSED).

Table with 2 columns: NCR, Description. Row: Connection between CCS and spacecraft went down because of a CCS system overload.

4.5 Fall Back

4.5.1 Procedure/Test sequence

Table with 5 columns: Test Step, Description, Duration, and Total. Row 1: Test Ancillary functions - LFI Go back to stand by (Fall Back) (0.19.00). Rows 2-6: Stop calibration channel, Configure RCA to 0, Science déactivation, RCA Déactivation, Switch OFF RAA, Restart REBA.

4.5.2 Results and Conclusions

Session saved in test file AMB\_100
Pass and Fail Criteria

Table with 2 columns: Criteria, Result. Rows: No un-expected event Packets (PASSED), REBA Power Consumption within the ranges of expected values (PASSED), DAE Power Consumption within the ranges of expected values (PASSED).



## 5 Other Features

### 5.1 Fluctuations in scientific output

From the TQL quick look real time analysis, a deeper analysis was suggested, although it was not strictly required to verify a specific requirement. Actually, a strange modulation was observed in scientific output of all channels as in most of the BEU thermal sensors.

A real time check was made in the clean room, to verify if some activities, possibly affecting measurements, were performed on the instrument during tests: actually some persons were performing mechanical activities on the satellite. However, this thing does not necessary explain the signature observed and, up to the present analysis, can not directly be connected with it.

Additional data, on environment temperature (clean room, SVM, ...) are needed to better investigate this behaviour.

The experimental evidence is a modulation on scientific output from all chains, represented in the following pictures:

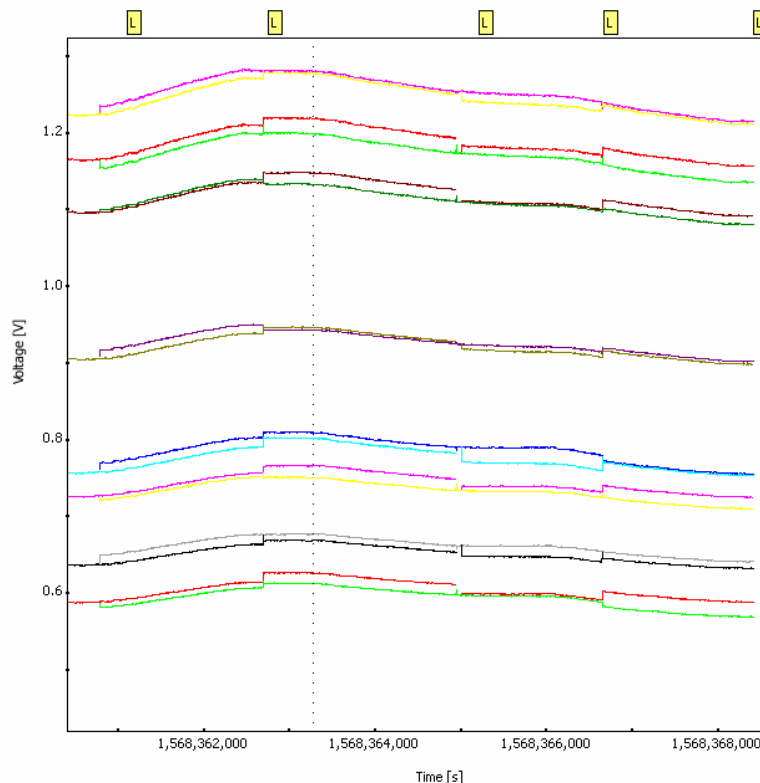


Figure 7 Radiometric Output from 30 GHz Channels. It is visible in the radiometric signals the trend from thermal contribution.

This modulation seems to be strongly correlated with FEM drain currents, as displayed in the following two plots. Drain currents follow for all the channels a common behaviour. This feature could be related with a thermal variation in the FEU.

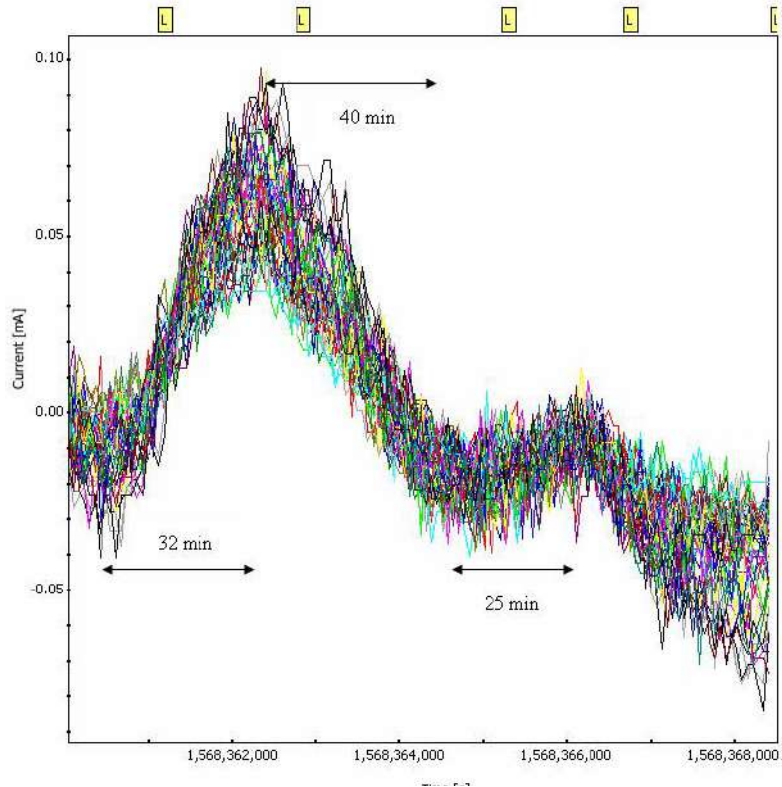


Figure 8 drain current variation for all LFI channels. the change w.r.t. the average value is displayed.

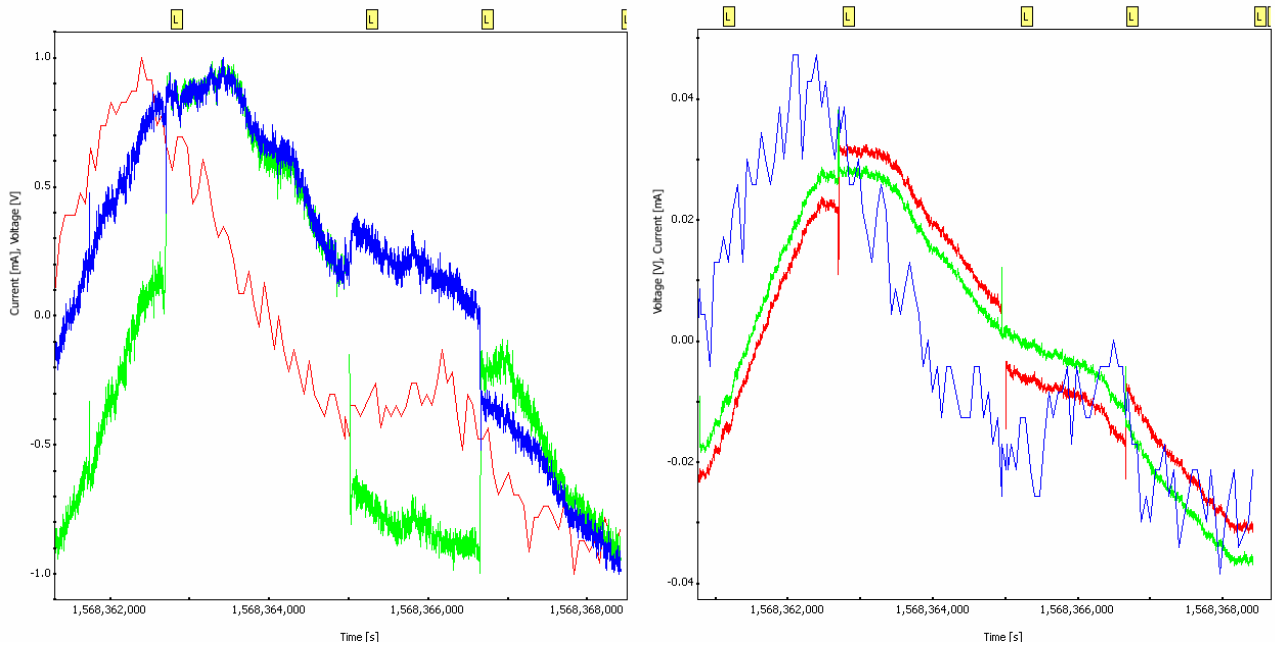


Figure 9 RCA 24 (left side) and RCA 27 (right side) : drain current variation (mA) is plotted against output variation (Volts)



However, cause thermometer on the FPU are out of scale in warm conditions ( that is above 100 K ), it is not possible to crosscheck the voltage and currents with the FEM temperature. An attempt to crosscorrelate with BEM temperature was done, without providing significative results. Comparison is shown in the plot below.

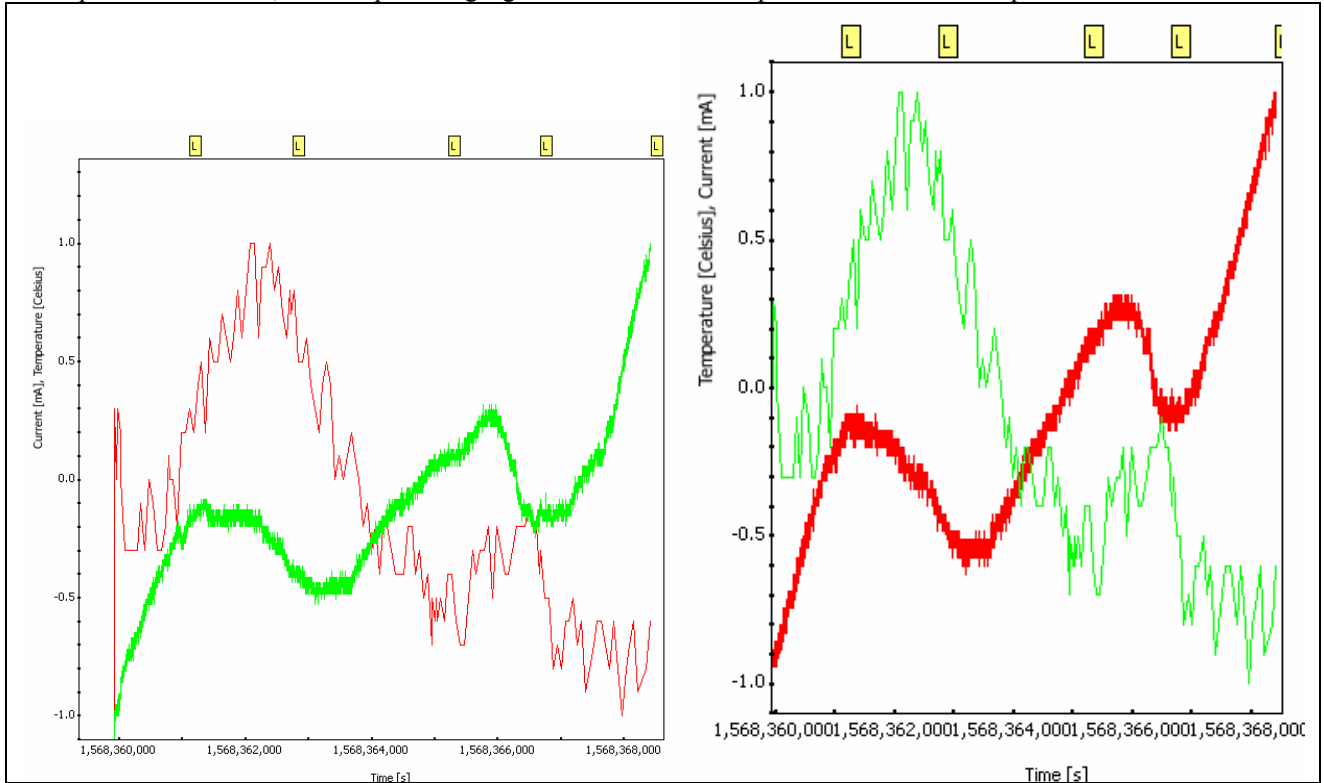


Figure 10 RCA 27: comparison between Id and LBEM1 (left) and RBEM2 (right) sensors. Changes w.r.t. average values are displayed.

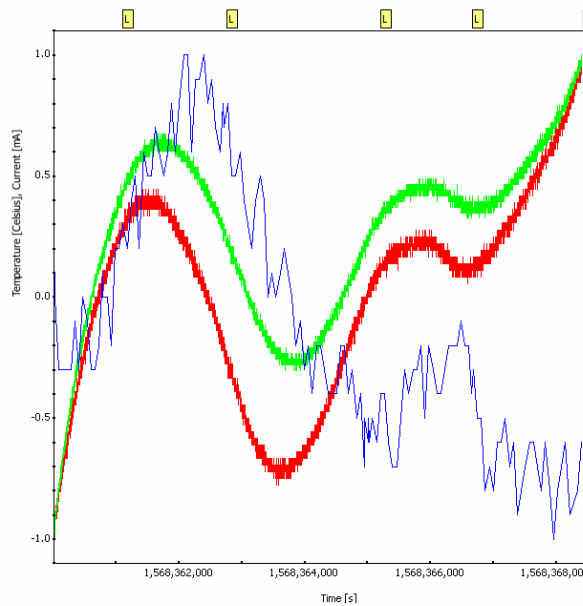


Figure 11 RCA 27 : comparison between Id and Science 3,4 (AMB 0099)



During the WFT performed on last August 2007, fluctuations were much smaller in amplitude, although a sensible variation in time was already present. Comparison is displayed by the picture below.

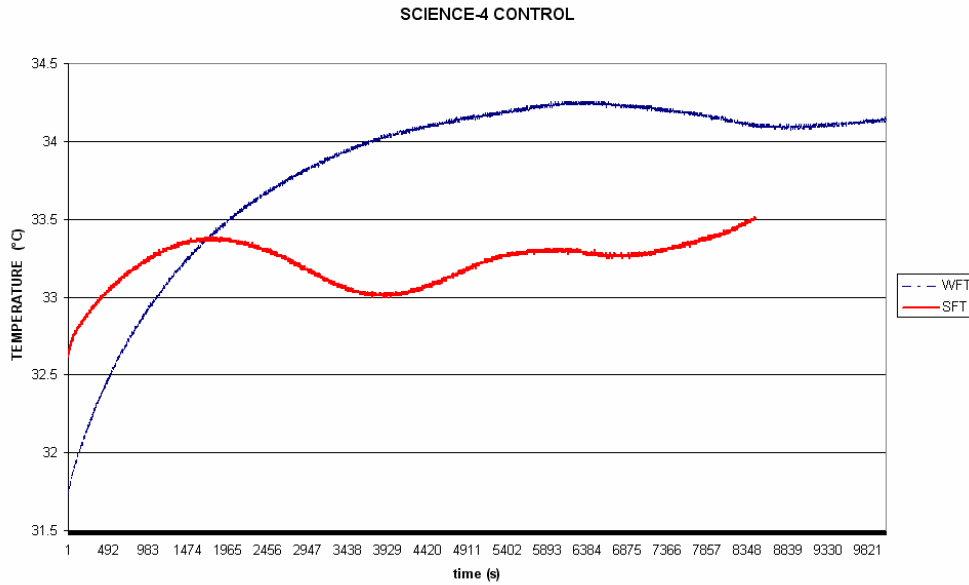


Figure 12 sensor on SCI4-control: comparison between WFT and SFT

However, during WFT this thermal drift was not able to produce a sensible change in drain currents and scientific outputs, as shown by the next picture.

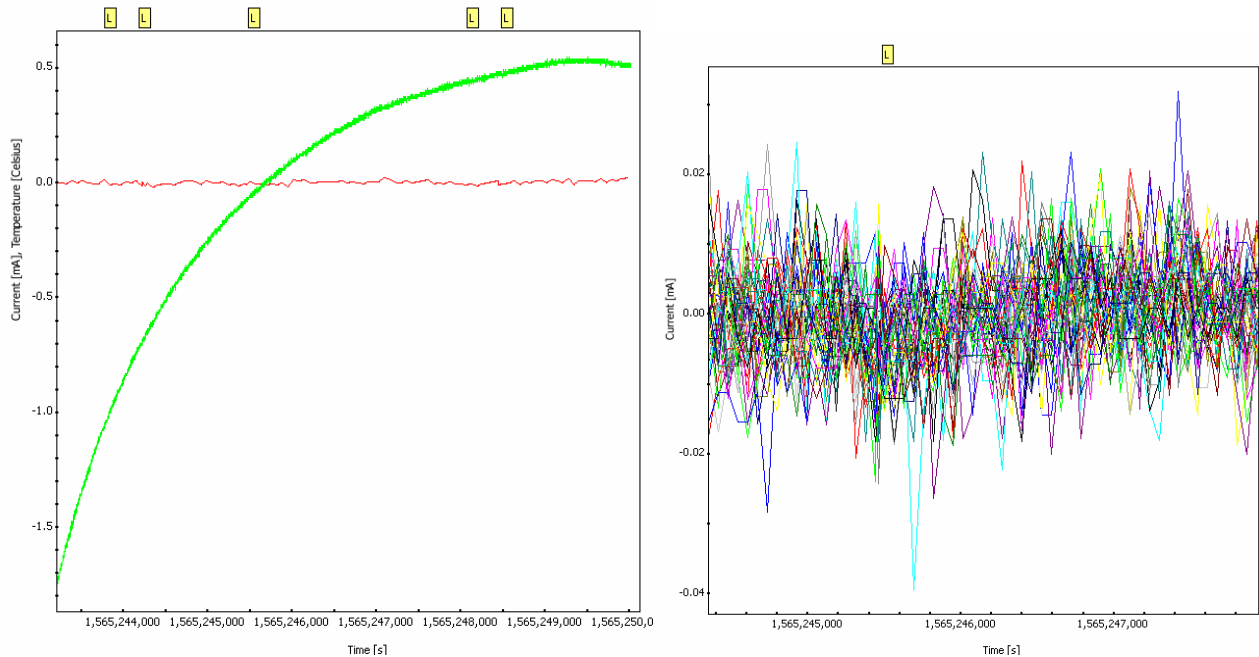
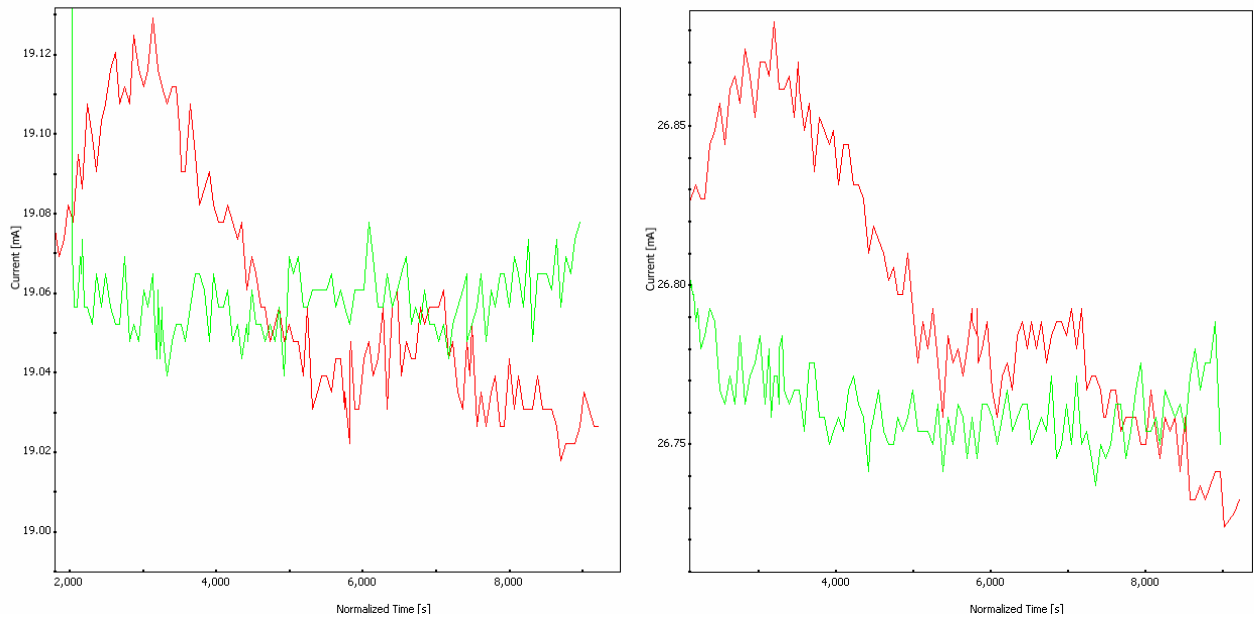


Figure 13 WFT : Left panel: RCA 19 science 4 Vs Id S2 variation; right panel: current variation for all channels



**Figure 14 WFT (green) vs. SFT (red): drain currents are compared for RCA 19 (left) and 25 (right)**

The easiest way to explain this behaviour is to compare with the environmental temperature (that is the temperature of the payload), considering that the final result on currents will be driven by the combined effect from heating due to environmental changes and electronics (inside the FEMs).

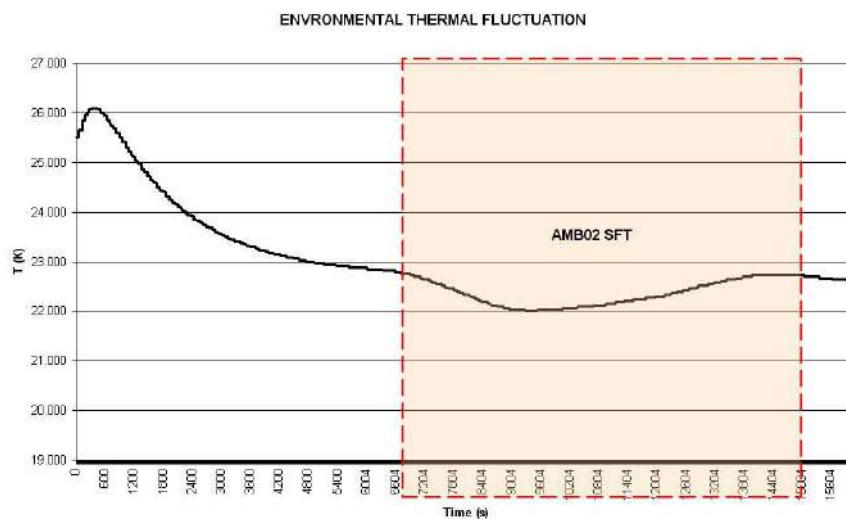
Here follows a possible comparison between the behaviour of a sensor put on the Interface between REBA and ??? and the scientific output ( that is the same of considering currents).

Since the gain of radiometer is anticorrelated with the FEM temperature ( voltage decreases as LNA's temperature increases ) , it is possible to guess the Voltage variation just induced by the FEM temperature variation.

Just by imposing the coincidence between the extrapolated (from temperature) curve and the measured data at time  $t=0$  , the best fit extrapolated curve was obtained just applying expected relation:

$$V(T) = V(T_0) + \sigma (V/K) \cdot \Delta T$$

Where  $V(T_0)$  is the initial voltage corresponding to  $T_{FEM}=T_0$



**Figure 15**

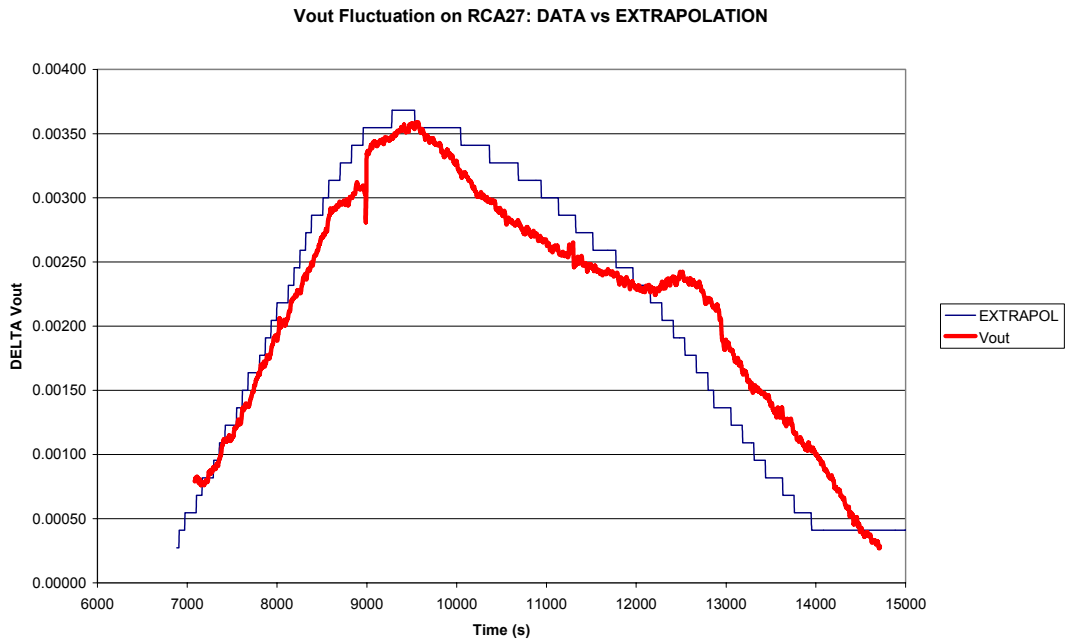


Figure 16 extrapolated data from thermal fluctuation vs. measured data averaged between sky and ref

$\sigma$  (V/K) is the radiometer susceptibility to changes in the FEM temperature: it is a negative term, and, in order to fit data, in the case of RCA27 it holds 0.0045 V/K . From the THF test it comes out that , in cold conditions, gain changes with FEM changes as  $-0.09\text{dB}/\text{K}_{\text{FEM}}$  while  $T_{\text{noise}}$  changes as 1K/K ; this is why, at 300K , A voltage decrease with Fem temperature increasing is expected ( Gain decreases by about 3% when T increases by about 0.3%) . However, these are just qualitative considerations since at warm temperature the FEM behaviour was never characterised and results from cold THF can not be extended straight.

At the end, we can just consider that the voltage ( and drain ) changes in FEM have features in some way expected when produced by a change in FEM temperature.

## 5.2 Jumps in Lateral tray temperature control

### 5.2.1 When the nominal science is activated/ deactivated an abrupt change in some Left tray temperatures is observed: this feature is traced by NC14372

In correspondence of the science activation or deactivation, a change in the temperature (T) appears in some sensors of the L tray (usually L BEM1, L BEM2, L FEM2). It was observed that, when science is switched on (off), instantaneously the temperature decreases and turns up to the previous value when science is switched off (on) again.

This phenomenon has been investigated in more detail, considering also data coming from previous WFT test (August 2007) and from following SIT test (October 2007): the files analysed are: AMB0092, AMB0093, AMB0094, AMB0095, AMB0096, AMB0097, AMB0098, AMB0099, AMB0110.

This feature, as observed during SFT , is represented in Figure 17. This feature is very strange since the change in temperature is unusual, being instantaneous and seeming not corresponding to a true thermal change.



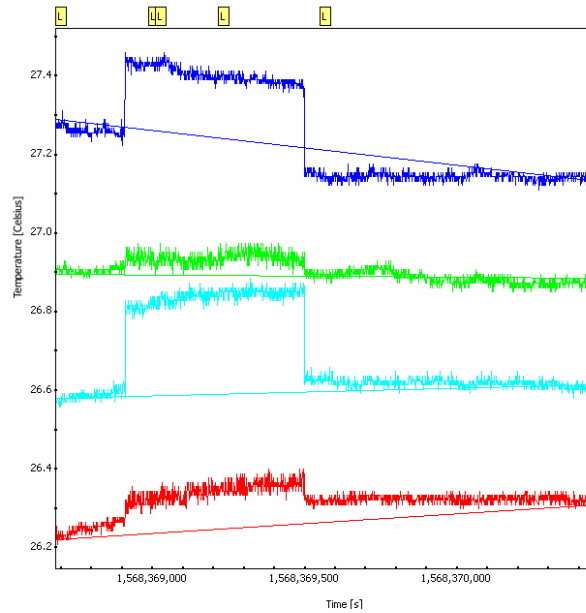


Figure 17 temperature changes on Lateral tray sensors. To be noted that the change is instantaneous.

A very short summary of the observed results is reported below

- T jump appears when science is switched on/off either in COM5 or in AVR1 mode.
- Acquiring data in RAW0 mode produce a further effect (“double T jump”, see below), but RAW0 data in AMB0094 and AMB0095 are not visible with LAMA.
- T jump is visible only if science is switch on/off on all channels.
- Science on/off correspond to two different states in temperature, i.e. it seems that the temperature jumps between two different and well defined level.

A quick description of the main features observed in every single test analyzed is reported below.

### 5.2.2 FROM WFT:

Test AMB 0092 08/08/2007

LFI on, science on/off all channels. Data acquired in AVR1(left) and COM5(right) for all channels

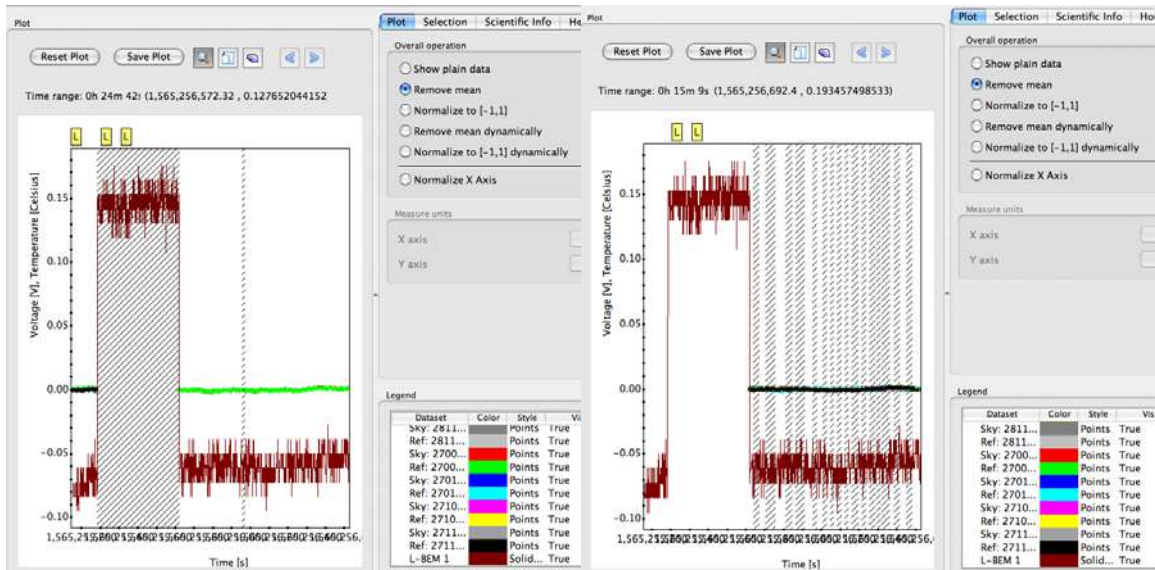


Figure 18

Test AMB 0093 08/08/2007  
LFI on, science on/off just on RCA25 00.

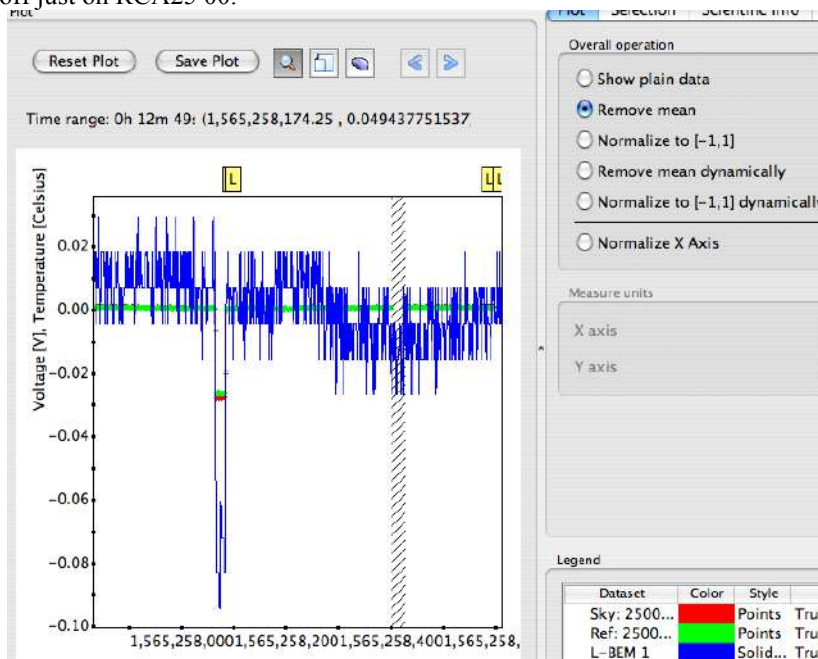


Figure 19

Data acquired in COM5 mode on all channels, except RCA 27, ( COM5 and AVR1). The temperature keeps constant when science is switched off on RCA 25 00, while the relevant temperature change corresponds to LFI switch off.

Test AMB 0094 08/08/2007

LFI on. Temperature jumps when science is switched on/off on all channels. something seems happening also in correspondence of operator log “science on RCA 27” (double jump) but RAW0 data are not visible with lama. Data acquired in COM5 mode on all channels, except RCA 27, acquired in AVR1 (left), COM5 (right) and RAW0 mode.

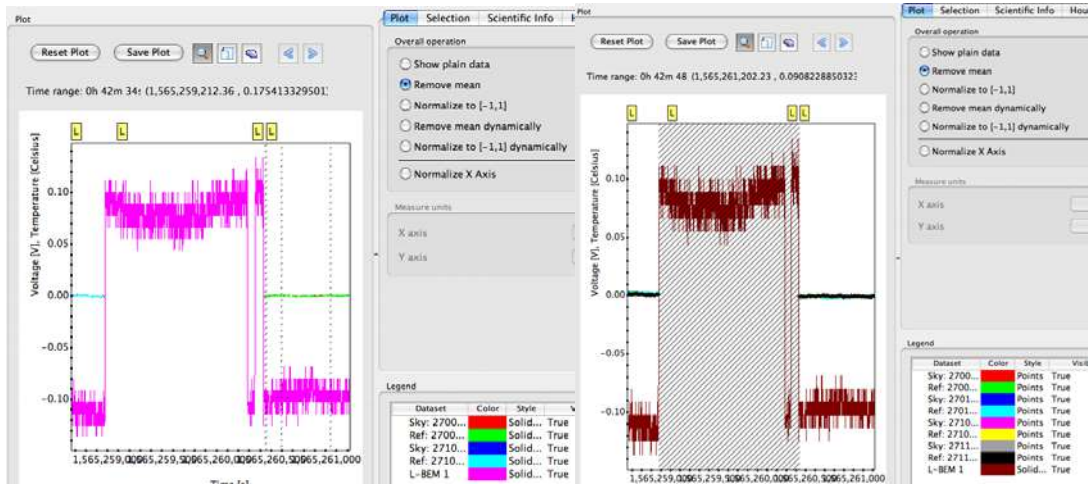


Figure 20

Test AMB 0095 08/08/2007

Temperature jumps following a behaviour similar to AMB0094. Data taken in COM5 mode on all channels, except RCA 27 (COM5, AVR1, RAW0). Data acquired in RAW0 mode are not visible.

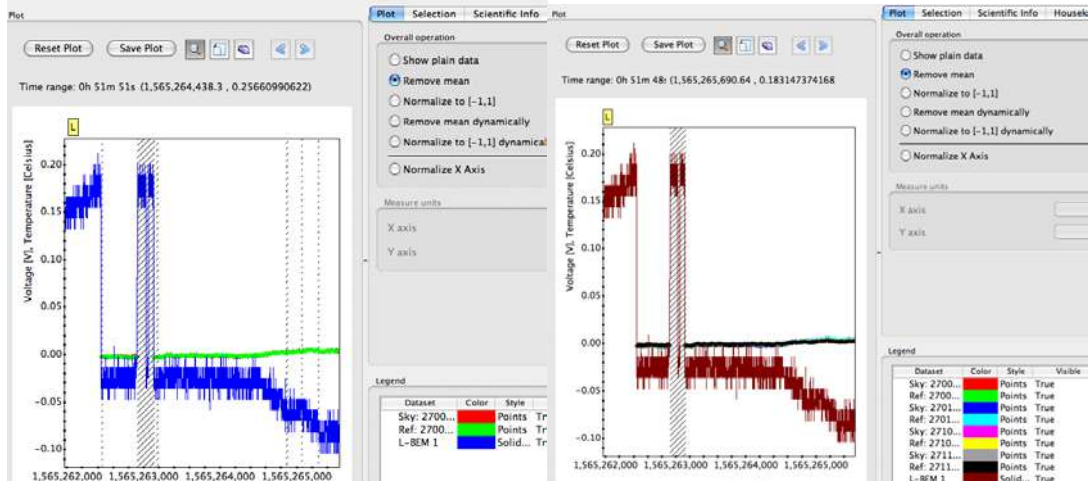


Figure 21

**5.2.3 FROM SFT**

Test AMB 0098 13/09/2007

LFI on. When turning science off on RCA25 11, no jumps visible. All data acquired in AVR1 mode. The temperature jumps when operator log says “science activation” is clearly correlated with the change in DAE offset. There is another jump in temperature when data start arriving.

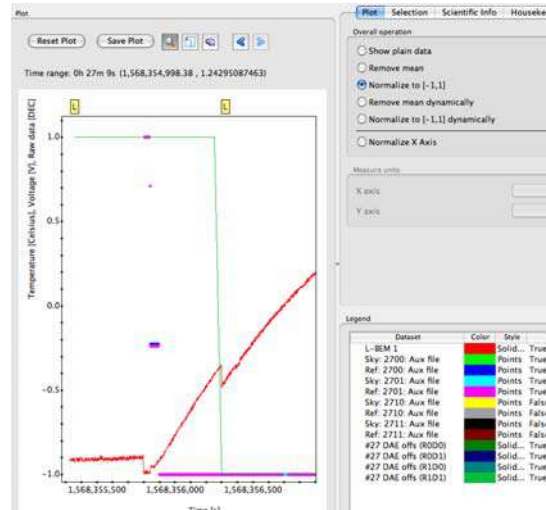


Figure 22

### 5.2.4 FROM SIT

Test AMB 0110 24/10/2007

LFI on. All data acquired in AVR1 mode. T jumps when data start arriving.

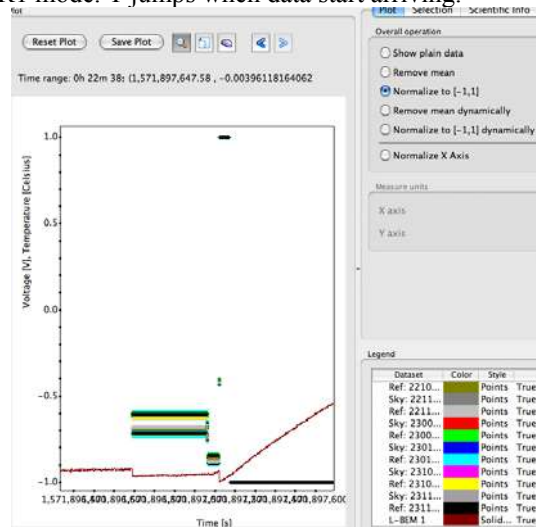


Figure 23

### 5.2.5 Explanation

Although this feature is very strange and an exact explanation was not found it can be reasonably guessed that is due to some interaction between the acquisition system of HK and the science sequencer.

In any cases, although measured, variations are well within the required accuracy and sensibility range for the DAE sensors. Actually, they have  $\pm 1^{\circ}\text{C}$  minimum accuracy and  $\pm 0.5^{\circ}\text{C}$  sensibility. So it is possible that a sensor gives back a number of significant digits larger than its effective capabilities: if this is true, it means that temperature jumps are not showing a non nominal behaviour.



### 5.3 Signal inversion in RCA25 R0D1

During EMC performed in October 2007, a strange inversion between sky and reference signal, from RCA25 Channel R1D0, was observed. A deeper analysis on previous tests allowed to find a similar behaviour shown already during SFT test. This feature is traced by Action#4 H-P-TASF-MN-9737.

This effect exhibit as shown in the figure below. During SFT it appeared twice. It seems to be triggered by the power incoming the DAE (which modulation is driven by the FEM temperature), since it occurs in correspondence of well defined values of the scientific voltage.

This feature seems to be the effect of a signals mixing. Up to now, a satisfactory explanation is not still available. This effect will be investigated deeper in the dedicated TN (RD 3)

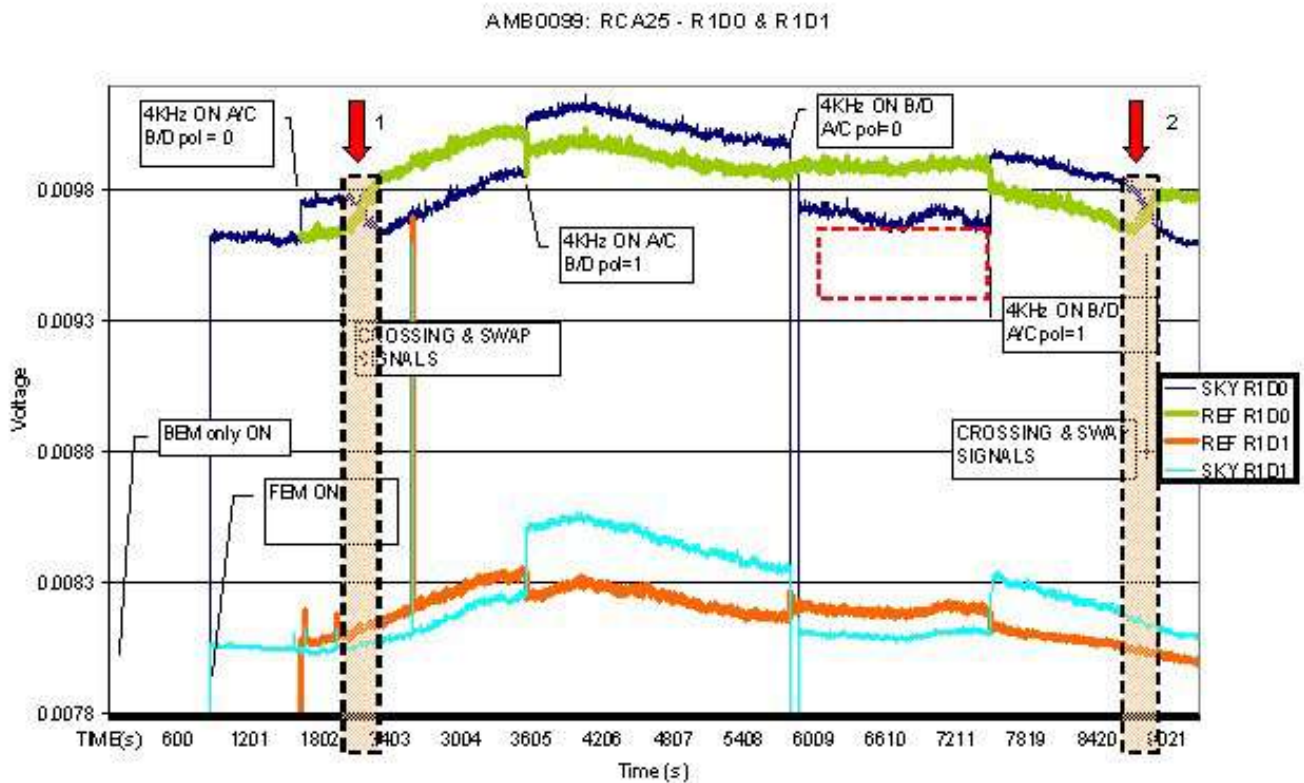


Figure 24 signal swap in R1D0 between sky and ref. No evidence of the same feature is shown in R1D1.



## 5.4 Spike Analysis

This analysis is devoted to compare AMB\_0099 with the data set acquired during the WFT (Warm Functional Test) both in Cannes (AMB\_0089 and AMB\_0091) and in Milan with, AMB\_0101. In particular this comparison has been performed in terms of spikes in the amplitude power spectra. These are the data set analysed, with the corresponding selected ranges for each phase switch state:

### **WFT (Warm Functional Test) in Milan during FM test campaign (2006)**

AMB\_0101 in which 4KHz is ON on B/D and A/C=0 [3861, 4469] (608 s)  
AMB\_0101 in which 4KHz is ON on B/D and A/C=1 [4699, 5363] (664 s)  
AMB\_0101 in which 4KHz is ON on A/C and B/D=0 [5685, 6286] (601 s)  
AMB\_0101 in which 4KHz is ON on A/C and B/D=1 [6410, 6922] (512 s)

### **WFT (Warm Functional Test) in Cannes (August 2007)**

AMB\_0089 in which 4KHz is ON on A/C and B/D=0 [1565248068, 1565248403] (335 s)  
AMB\_0089 in which 4KHz is ON on A/C and B/D=1 [1565248558, 1565249897] (1339 s)  
AMB\_0091 in which 4KHz is ON on B/D and A/B=0 [1565252034, 1565253209] (1175 s)  
AMB\_0091 in which 4KHz is ON on B/D and A/B=1 [1565253539, 1565254674] (1135 s)

### **SFT (Short Functional Test) in Cannes (September 2007)**

AMB\_0099 in which 4KHz is ON on A/C and B/D=0 [1568360986, 1568362482] (1496 s)  
AMB\_0099 in which 4KHz is ON on A/C and B/D=1 [1568362843, 1568364795] (1952 s)  
AMB\_0099 in which 4KHz is ON on B/D and A/C=0 [1568365087, 1568366452] (1365 s)  
AMB\_0099 in which 4KHz is ON on B/D and A/C=1 [1568366807, 1568368213] (1406 s)

Since the time intervals are quite different, due to some problems occurred during the test, comparison was performed also considering just 5 minutes of acquisition for each test. The results are reported in Sections 5.4.3 and 5.4.4. In the following plots the blue line is for the sky signal, green for the ref signal and red for the differenced data.

The power spectra computed from 300 seconds of acquisition are very similar. The best frequency resolution highlight a much larger number of spikes at lower frequency in the Cannes data set: this feature will be investigated in detail in a further analysis. The full analysis is reported in Appendix. Here follows a description summarizing main results from each comparison.

### 5.4.1 WFT vs SFT in Cannes

Except for the case where A/C is switching and B/D = 0 (where the WFT are clearer than SFT), the power spectra are quite similar in the two tests. However, this is due to the lower frequency resolution of the WFT in the selected range, as it can be inferred from Sect. 5.4.1 where only 5 minutes are considered for each sample.

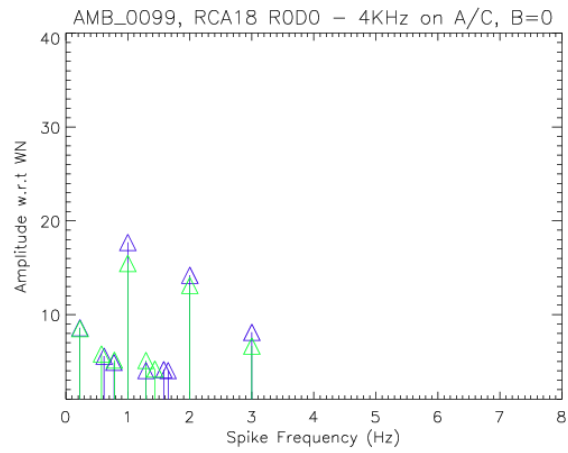
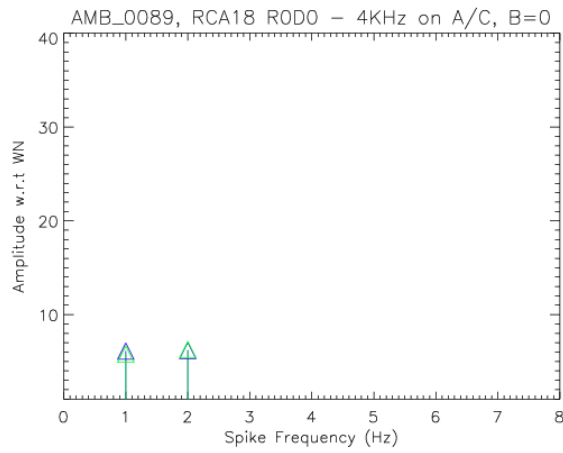


Figure 25 WFT in Cannes (left) vs SFT (right), RCA18 in which 4KHz is on A/C and B/D=0.

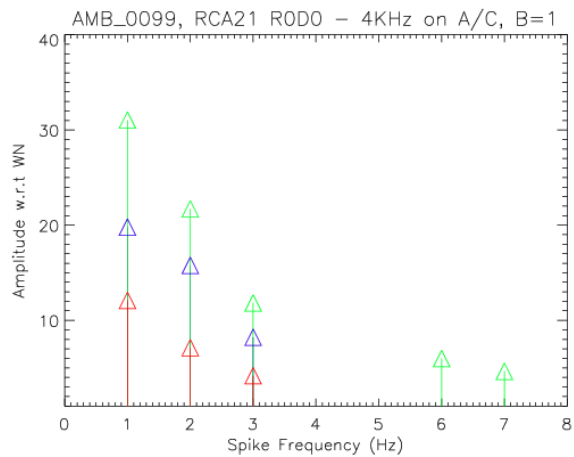
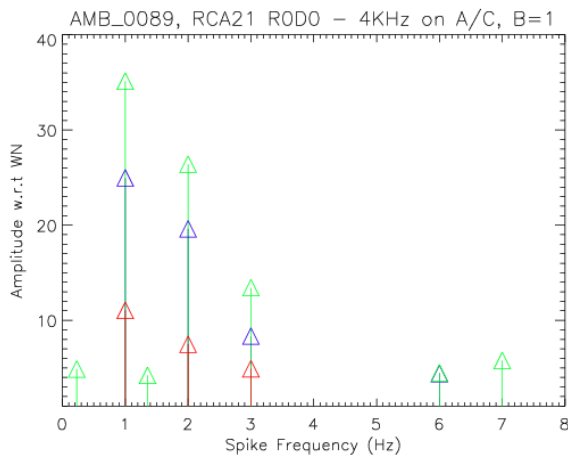


Figure 26 WFT in Cannes (left) vs SFT (right), RCA21 in which 4KHz is on A/C and B/D=1.

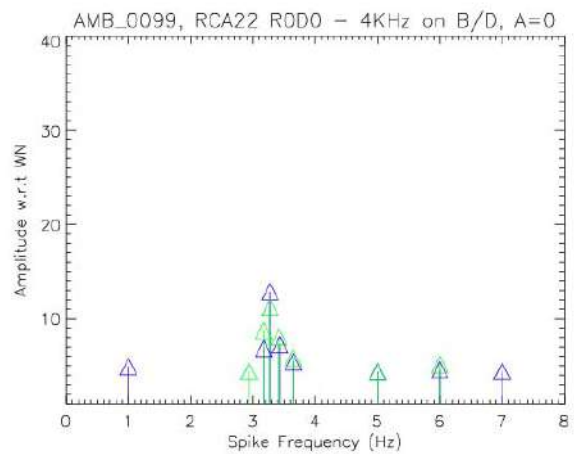
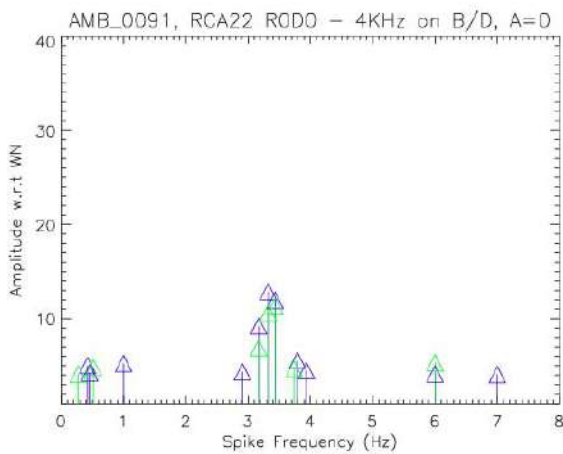


Figure 27 WFT in Cannes (left) vs SFT (right), RCA22 in which 4KHz is on B/D and A/C=0.



### 5.4.2 WFT in Milan vs SFT

Also in this case the same considerations written in the previous section can be done, with the exception that also when A/C is switching and B/D=0 the spectra in Milan showed similar spikes.

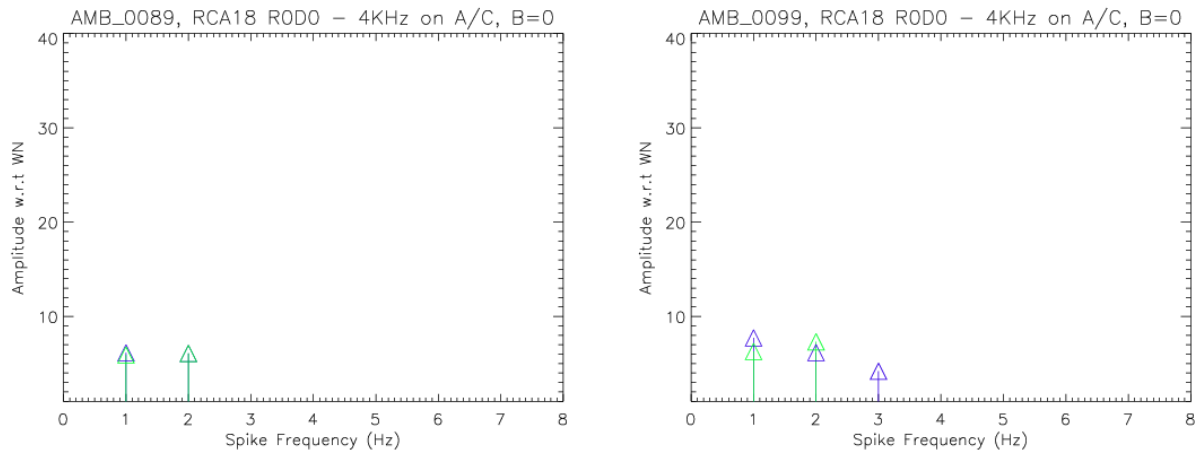


Figure 28 SFT in Cannes (left) vs WFT in Milan (right), RCA18 in which 4KHz is on A/C and B/D=0.

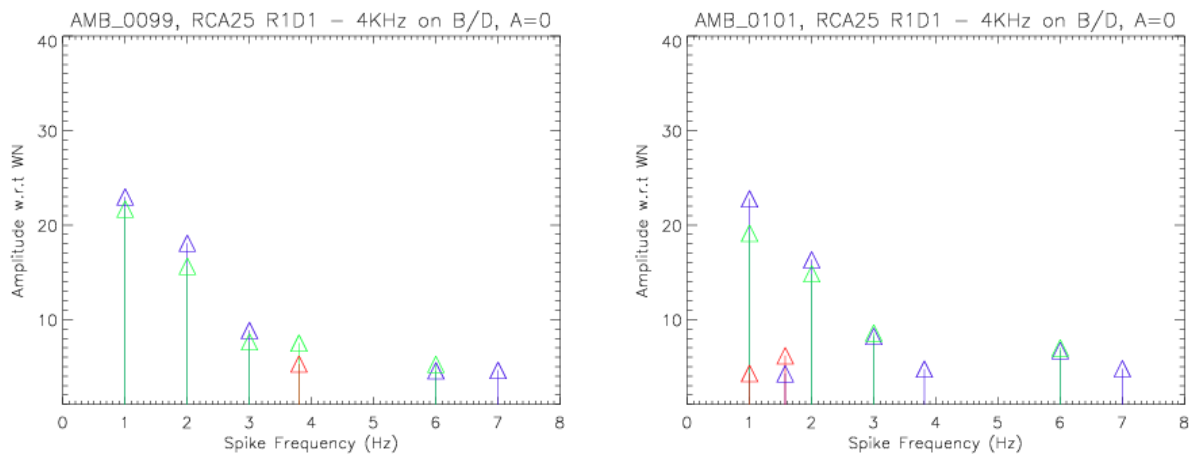


Figure 29 SFT in Cannes (left) vs WFT in Milan (right), RCA25 in which 4KHz is on B/D and A/C=0.





### 5.4.3 SFT in Cannes vs WFT in Milan (300 sec)

Spikes are very similar, in frequency and amplitude. In some cases they are slightly worse. The RCA 22 shows a spike at about 3 Hz in two arms that in the WFT in Milan was not present. In Milan there was a spike at about 6 Hz. Also in this case in the 30 GHz there are more spikes at lower frequency but the 4 Hz is disappeared.

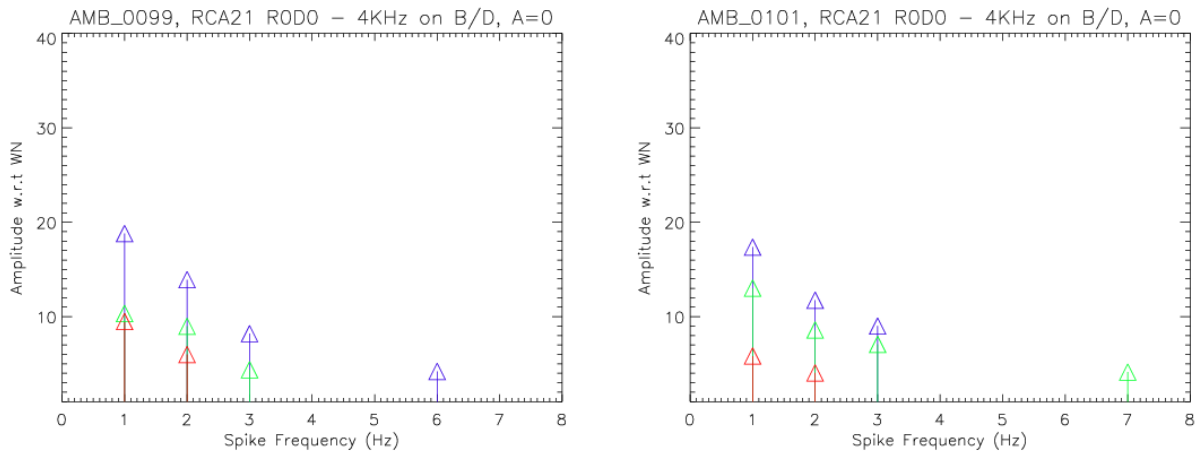


Figure 30 SFT in Cannes (left) vs WFT in Milan (right), RCA21 in which 4KHz is on B/D and A/C = 0.

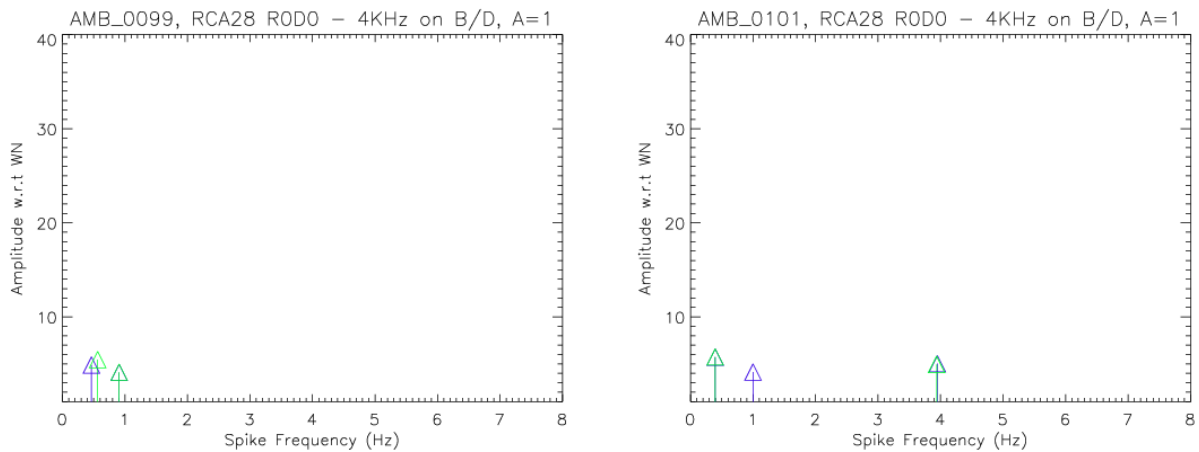


Figure 31 SFT in Cannes (left) vs WFT in Milan (right), RCA28 in which 4KHz is on B/D and A/C = 1.



### 5.4.4 WFT in Cannes vs SFT in Cannes (300 sec)

Spikes are very similar, in frequency and amplitude.

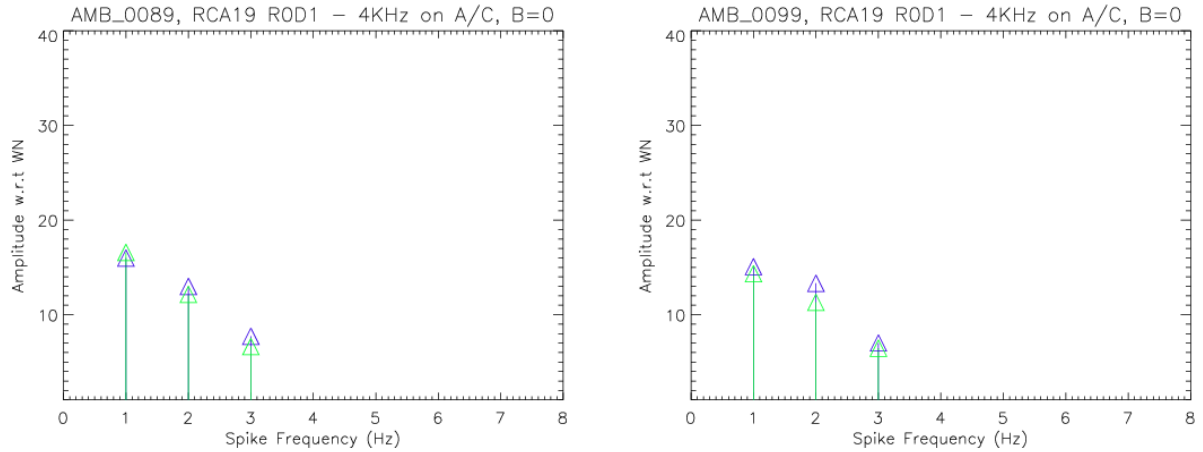


Figure 32 WFT in Cannes (left) vs WFT in Milan (right), RCA19 in which 4KHz is on A/C and B/D = 0.

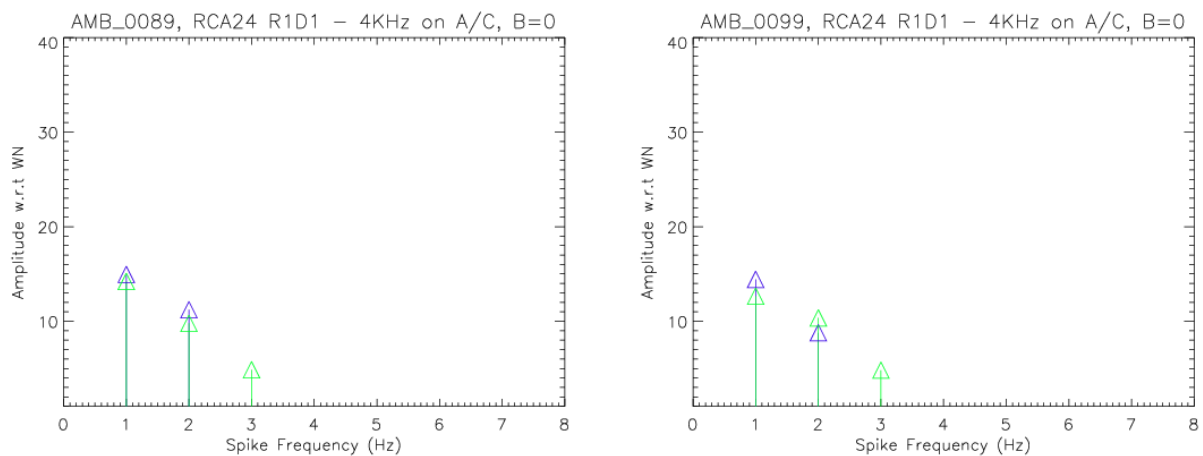


Figure 33 WFT in Cannes (left) vs SFT in Milan (right), RCA24 in which 4KHz is on A/C and B/D = 0.

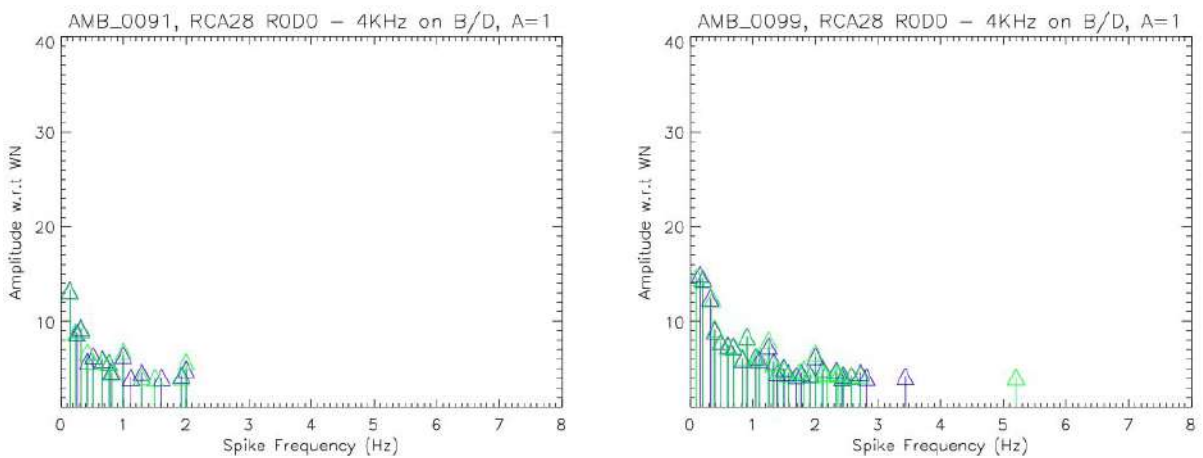


Figure 34 WFT in Cannes (left) vs SFT in Milan (right), RCA24 in which 4KHz is on B/D and A/C = 1.



## 6 SFT Conclusion

All the pass/fail criteria requested from the procedure have been checked and passed so the Short functional test is successfully completed.

There are some differences between SFT and previous tests (WFT and FM Warm Tests) and these differences (Idrain and Voltages output) have a systematic trend all over the RCA output. However, values are within the acceptable range .

There is a low frequency ripple in the radiometric output that seems to come from a thermal issue: fluctuations seem to be strongly driven by thermal changes but a precise correlation is non straight, due to absence of available sensors on the LFI FPU. However a possible explanation , using available data , have been given.

An unexpected inversion was observed in RCA 2501: the problem repeated in the following tests and was possibly present already at FM instrument level test campaign (2006) . It is deeper analyzed in a dedicated work.

Another unexpected feature was observed (and found again in further tests) in some Lateral trays sensors: it looks like a digital change in temperature, probably related with the acquisition system of HK and the science sequencer: however, it does not seem ascribable to a real change in temperature ( no drift observed but abrupt change). In any cases, changes are within the accuracy and sensibility of DAE sensors.

Frequency spikes have been investigated in detail, comparing with results from WFT and FM tests. The overall behaviour looks unchanged, although in some cases spikes seem to have changed frequency or amplitude. Since they depend strongly on integration time and on N-average , a dedicated test was required to better investigate and understand possible changes of the instrument response with time.

### 6.1 NCR and TBC list

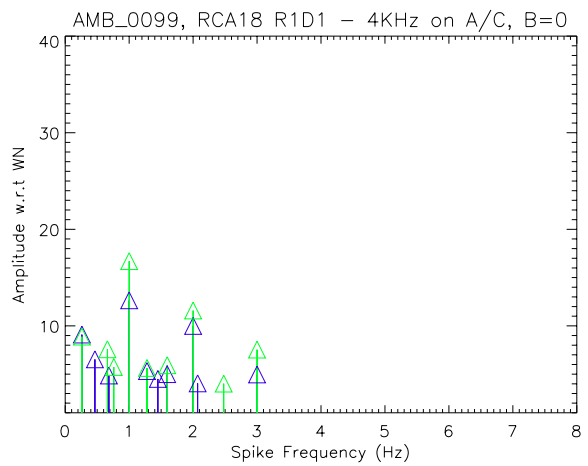
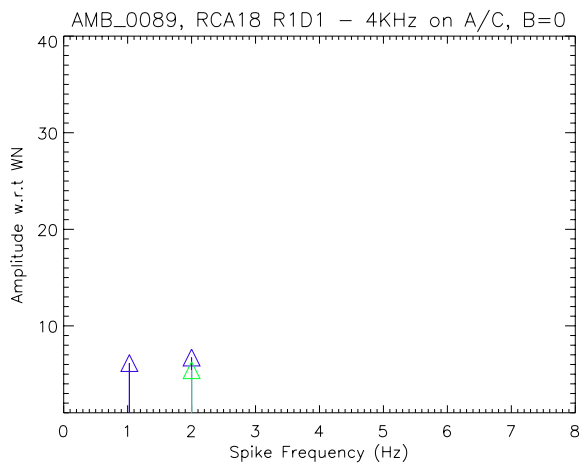
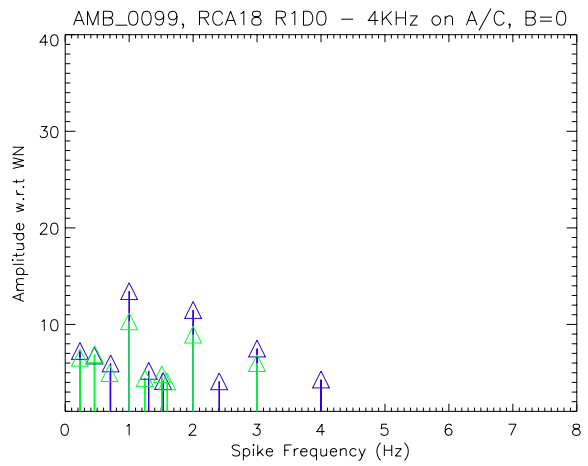
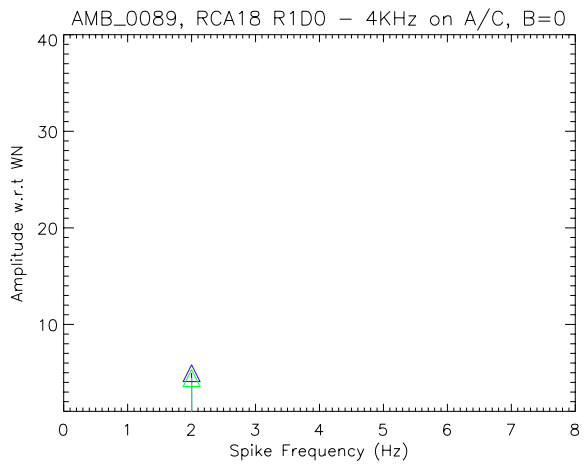
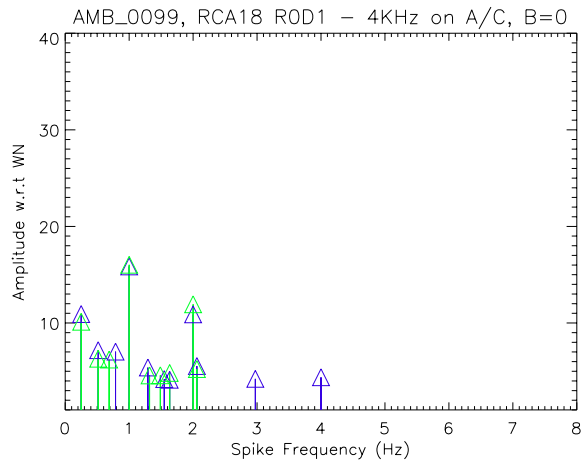
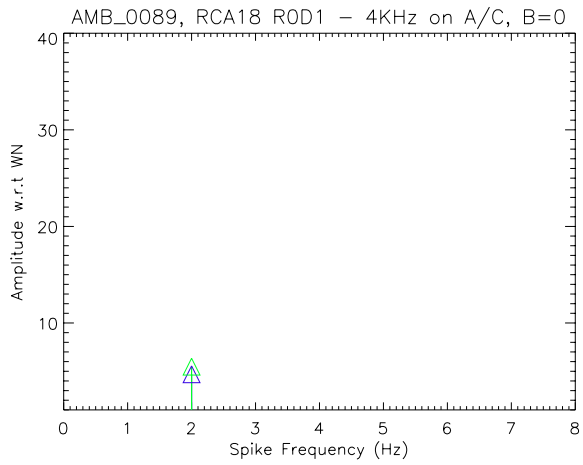
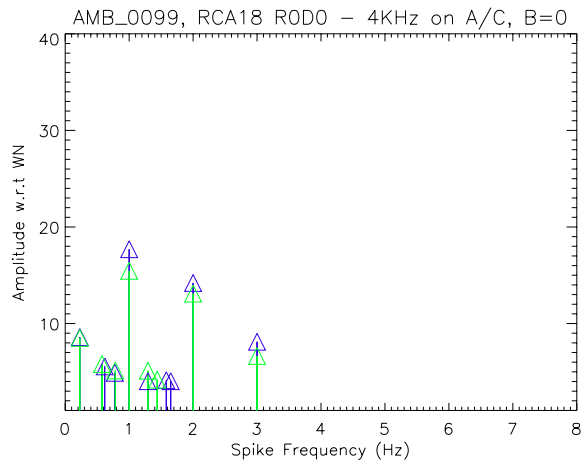
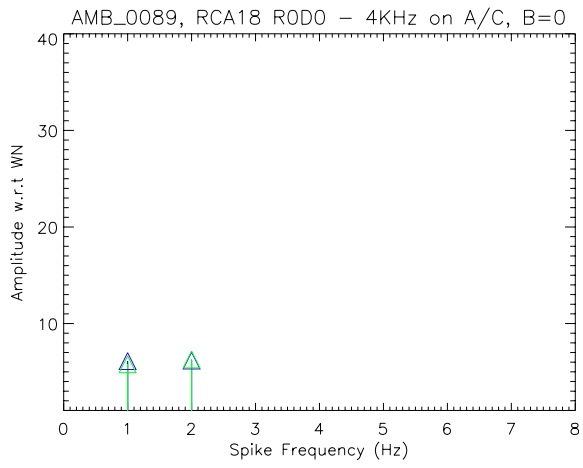
Type	Number	Description	Notes
NC	TBD	Complete Un-Expected features (FFT) Data analysis	A few differences to be deeper investigated in further dedicated tests (RD 4)
NC	14372	Complete Thermal data analysis respect to WFT	Completed: possible explanation; variations within sensor's specifications.
NC	Action#4 H-P-TASF-MN-9737	Signal swap in RCA 25 R0D1	Analysed and traced problem during FM, WFT, SFT, EMC tests. Not still explained. Dedicated tests required (RD 3)
		Signal modulation possibly due to thermal fluctuations	Strong correlation with drain currents in the FEM. Not correlated with limited thermal data available. Maybe due to combination of different thermal behaviours.

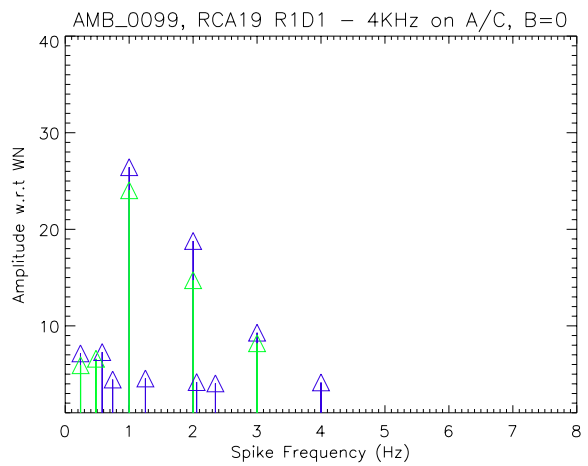
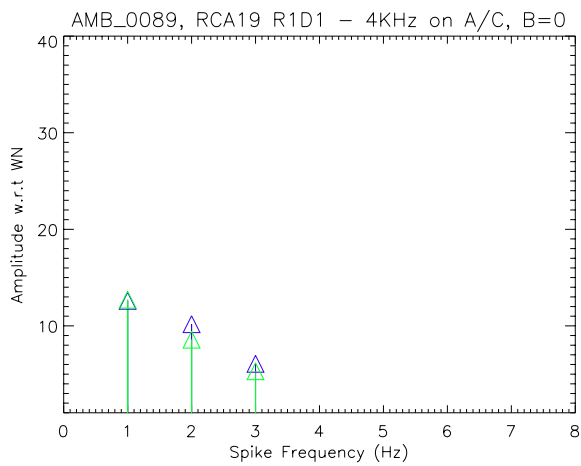
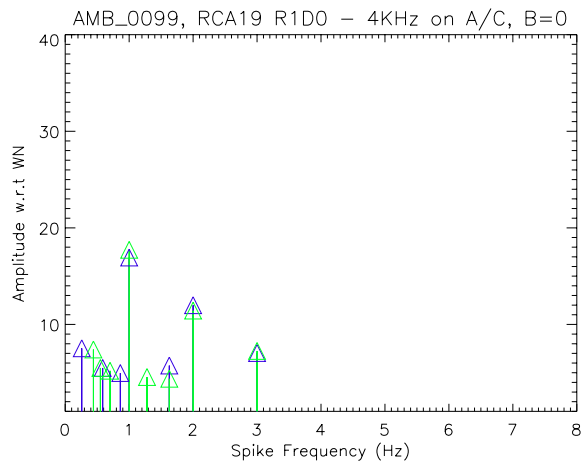
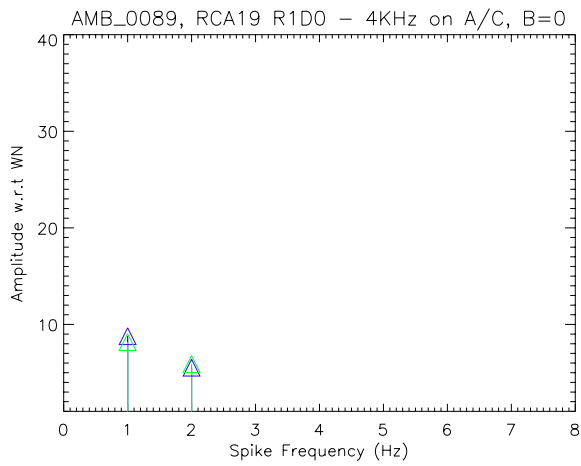
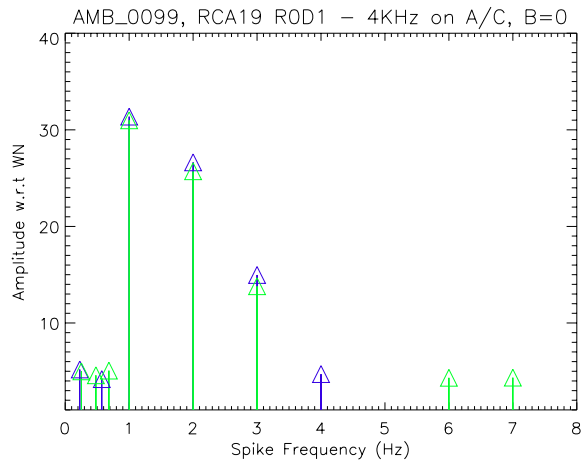
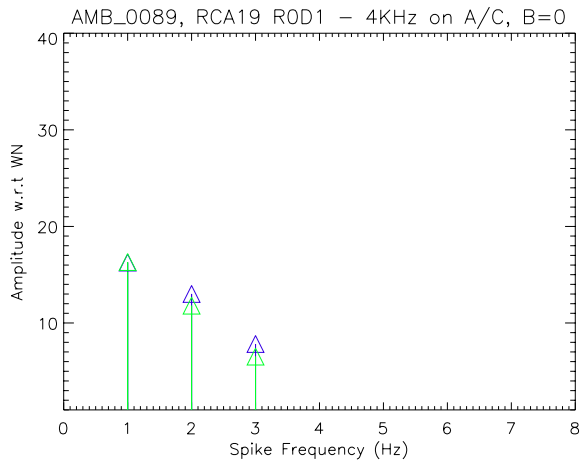
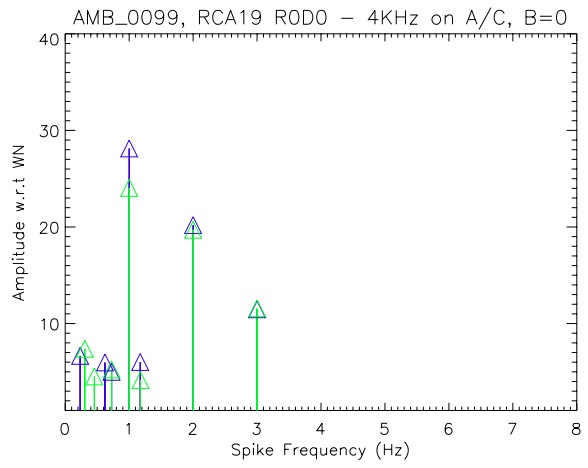
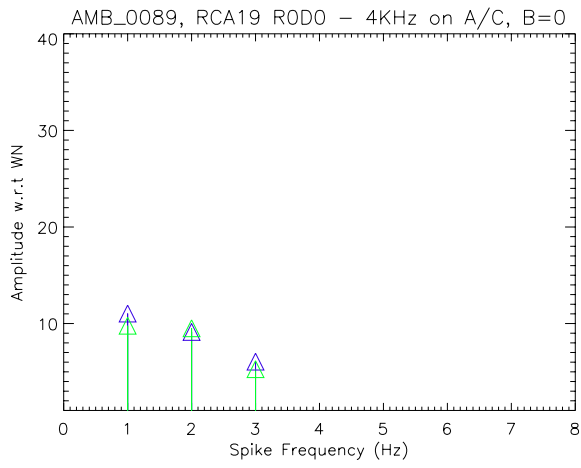


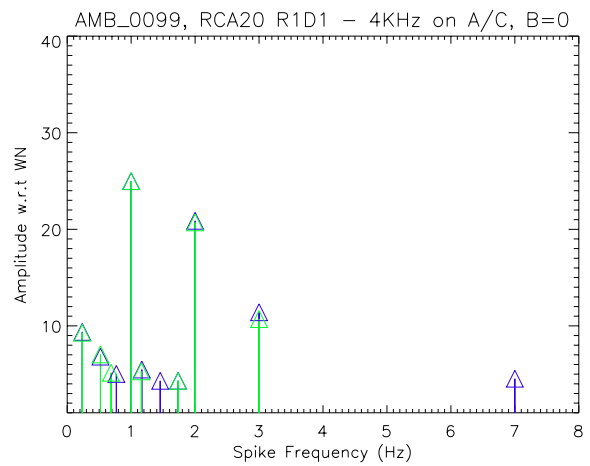
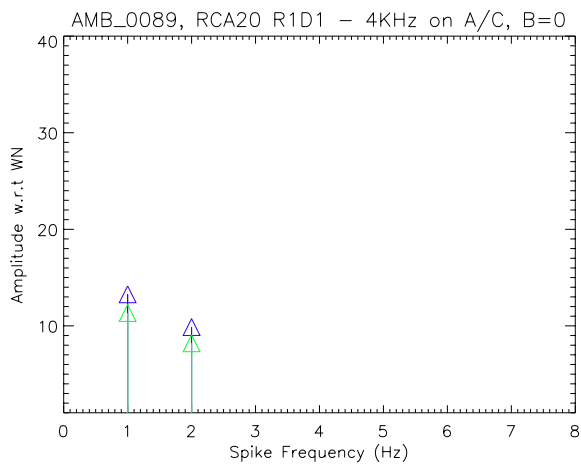
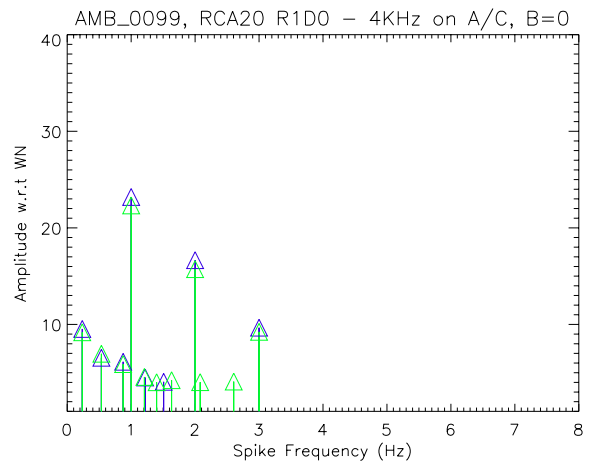
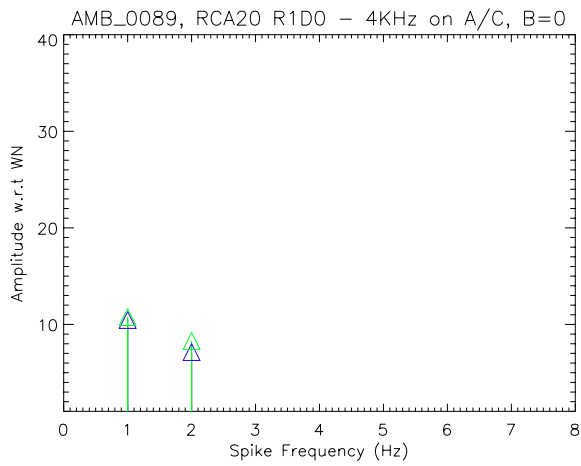
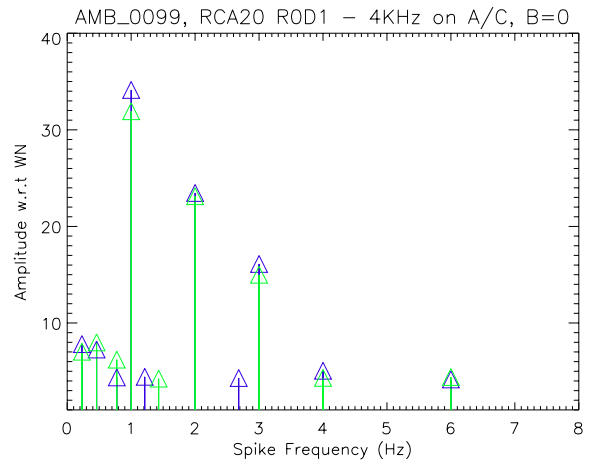
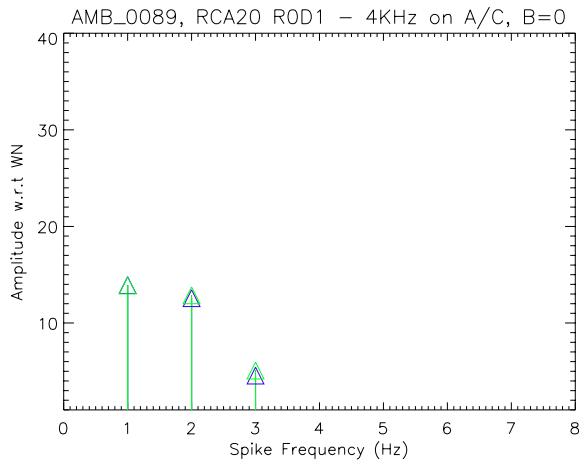
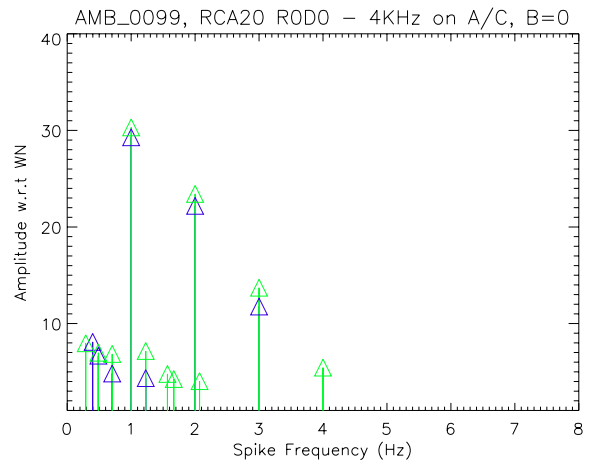
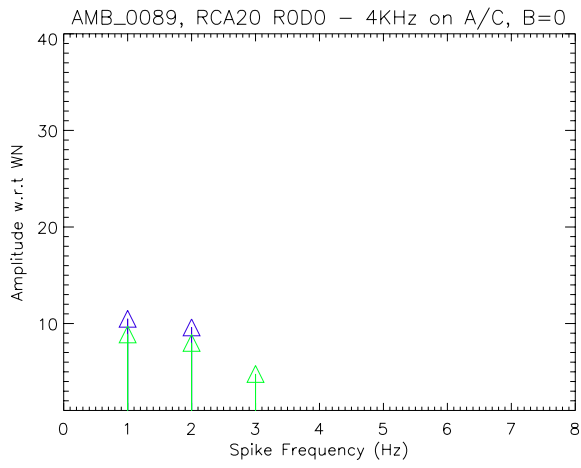
## **7 Annex : SPIKES FULL ANALYSIS**

COMPARISON: SFT vs WFT .....	2
COMPARISON: SFT vs WFT (300 secs).....	48
COMPARISON: SFT vs FM (WFT Milano).....	91
COMPARISON: SFT vs FM (WFT Milano)...(300 secs).....	136

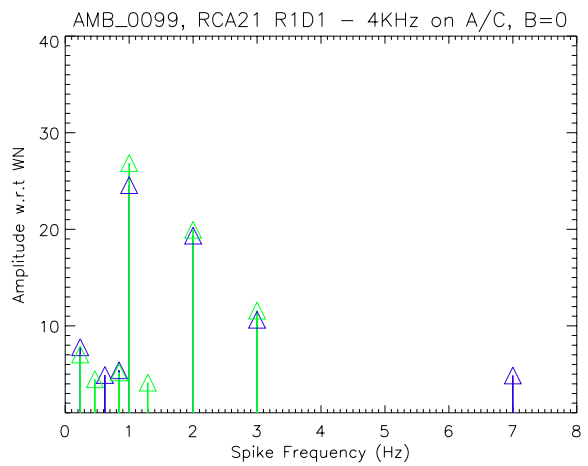
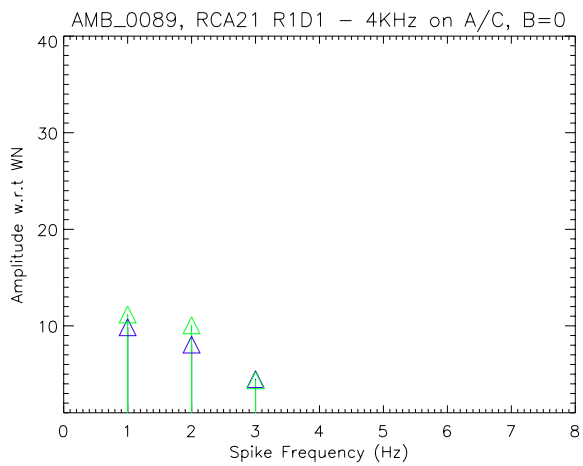
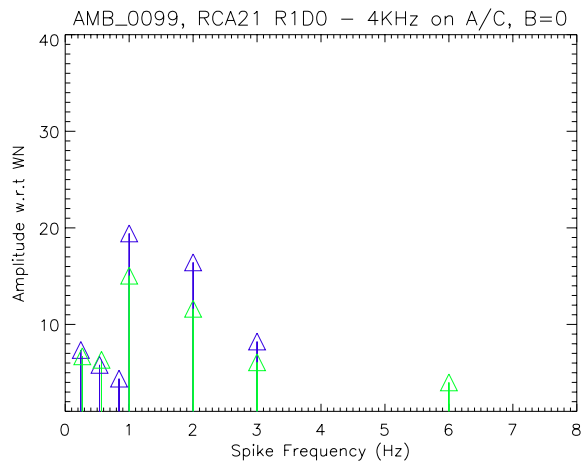
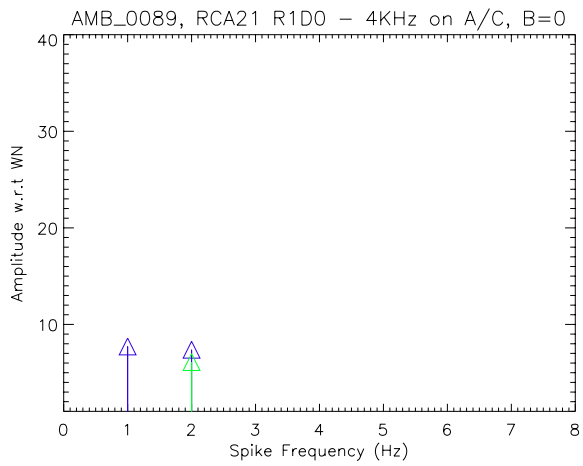
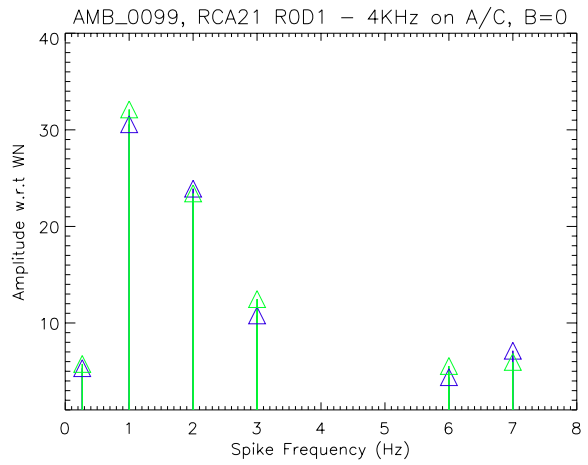
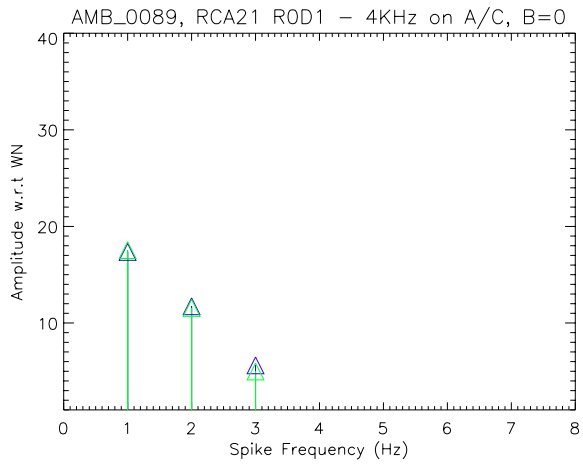
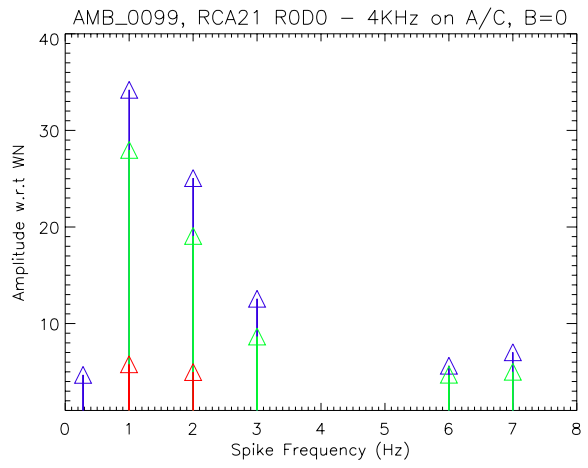
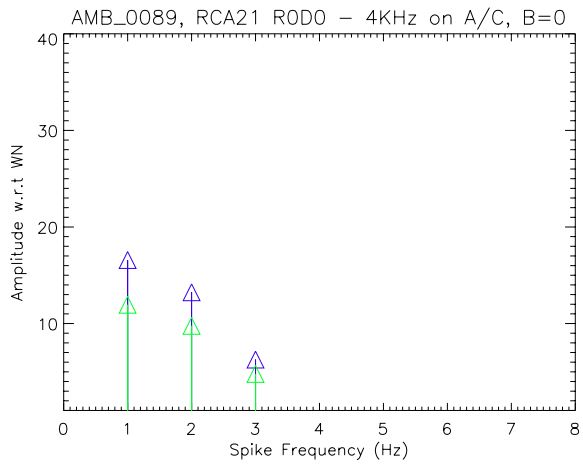
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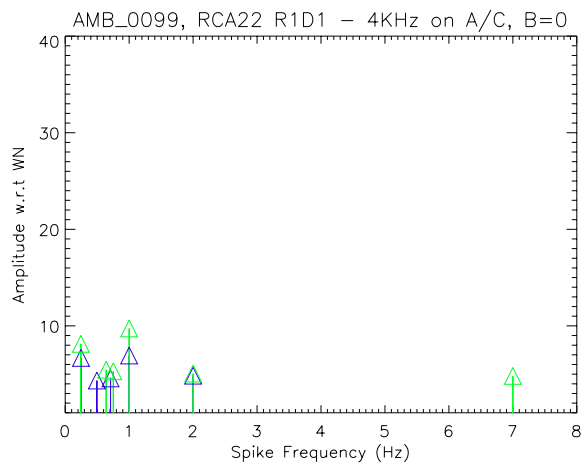
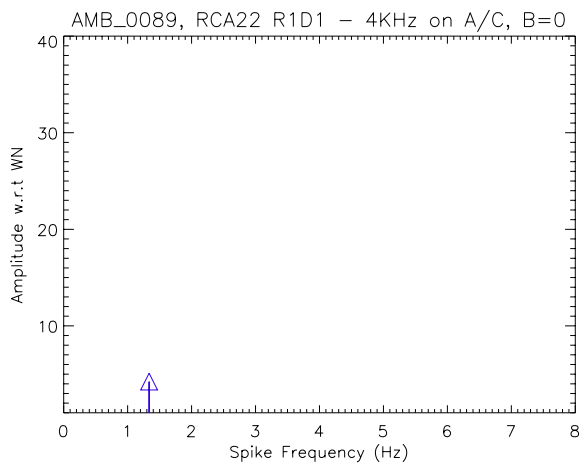
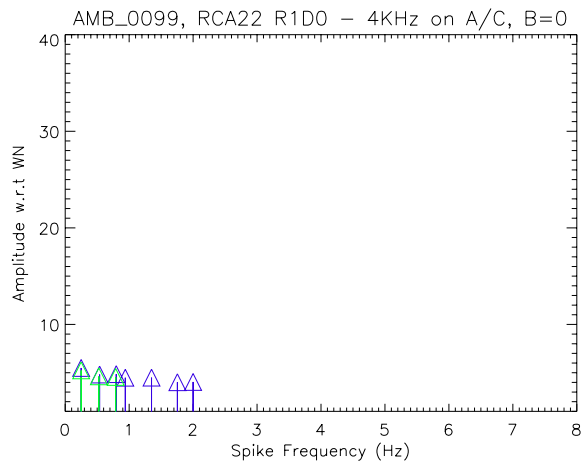
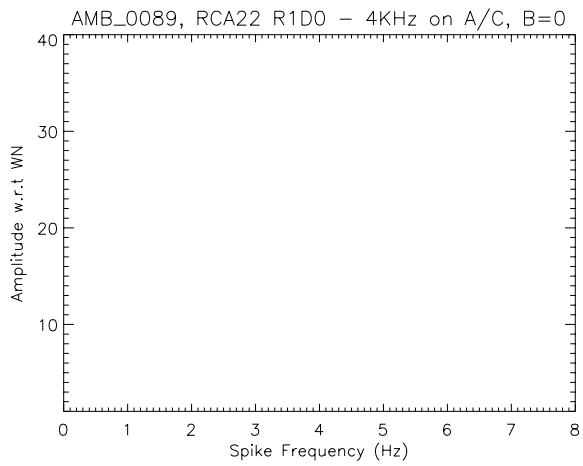
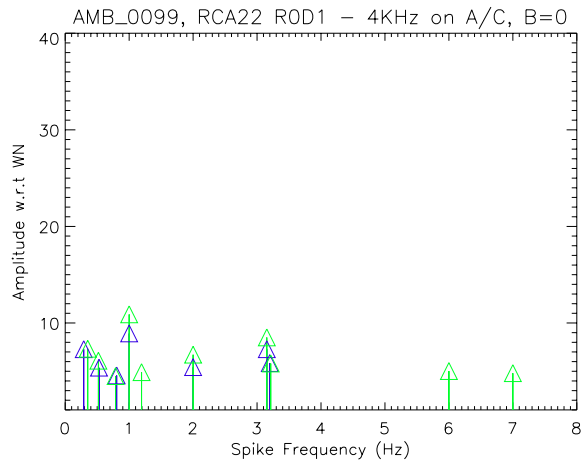
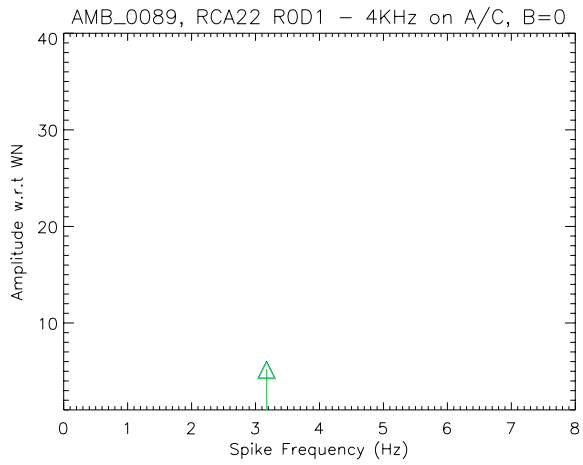
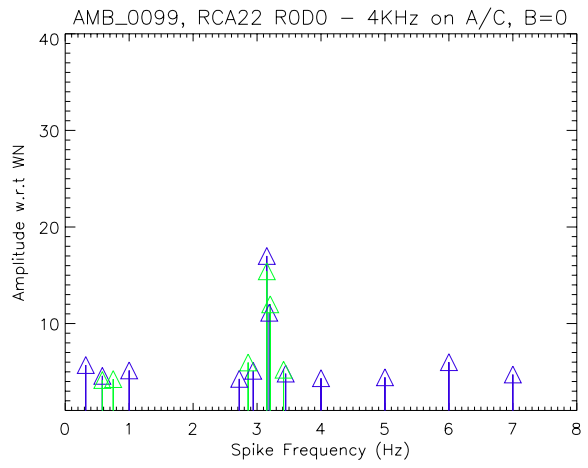
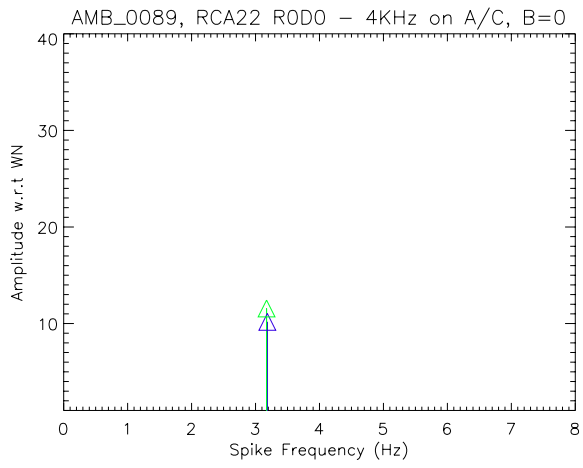


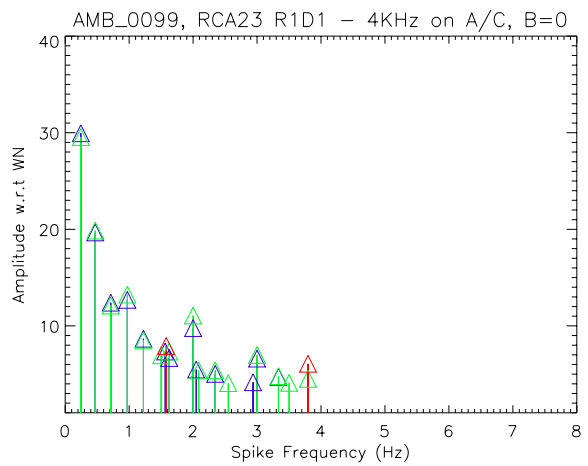
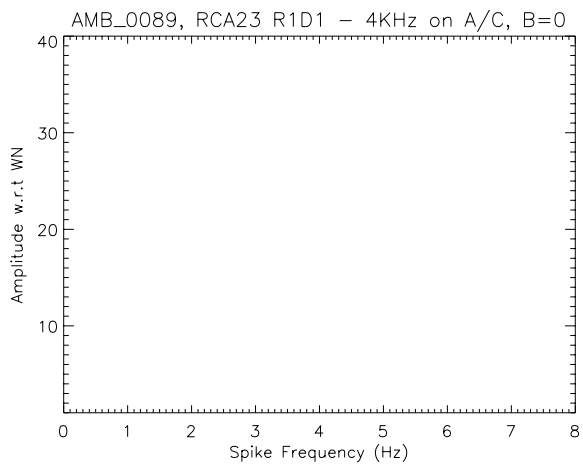
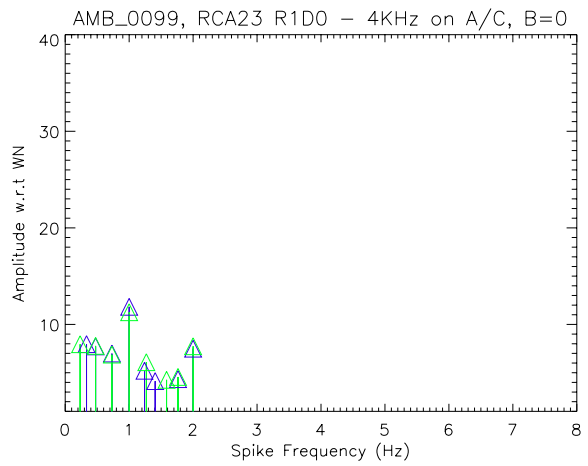
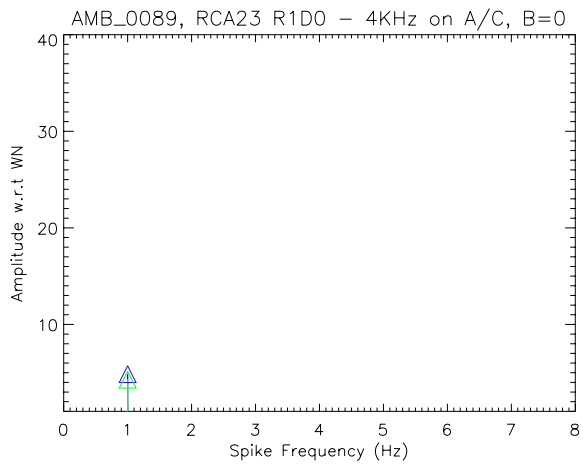
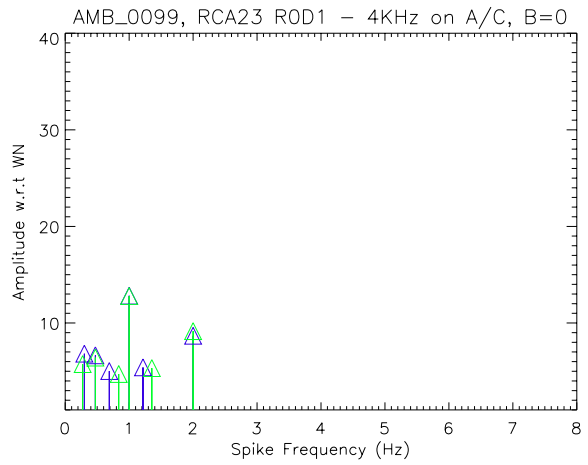
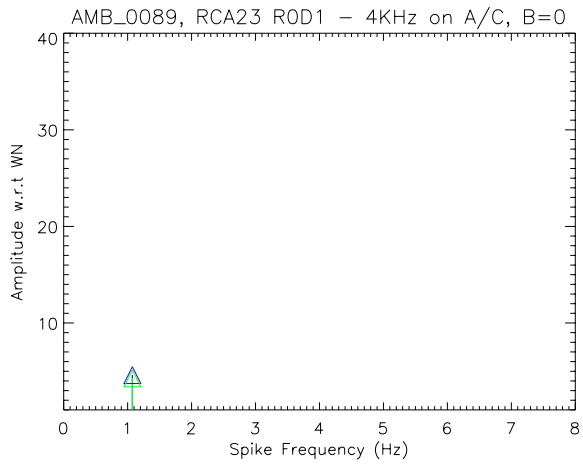
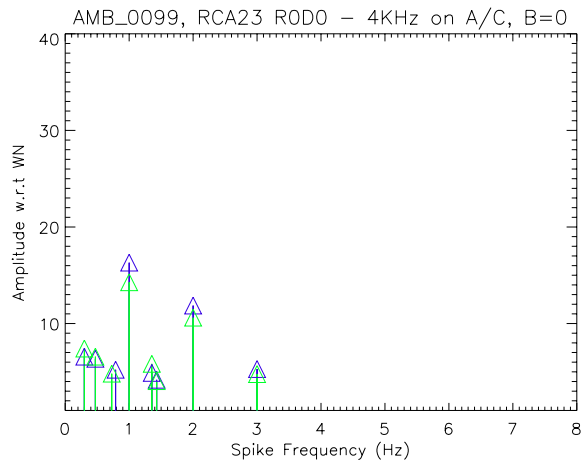
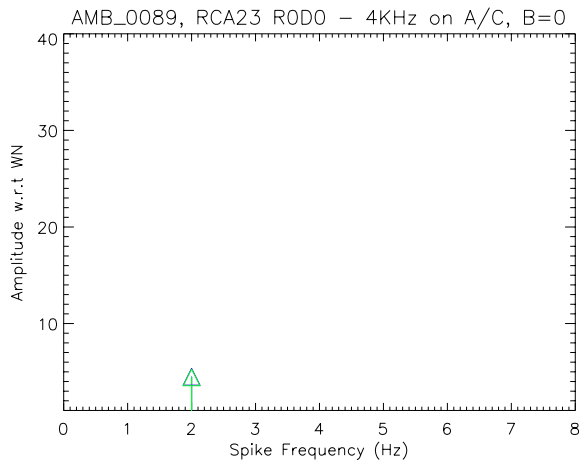


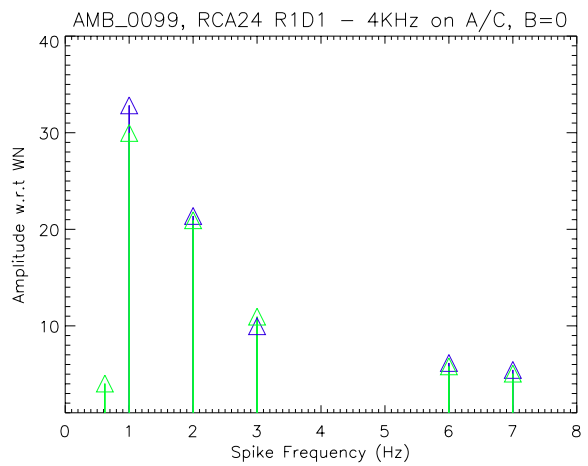
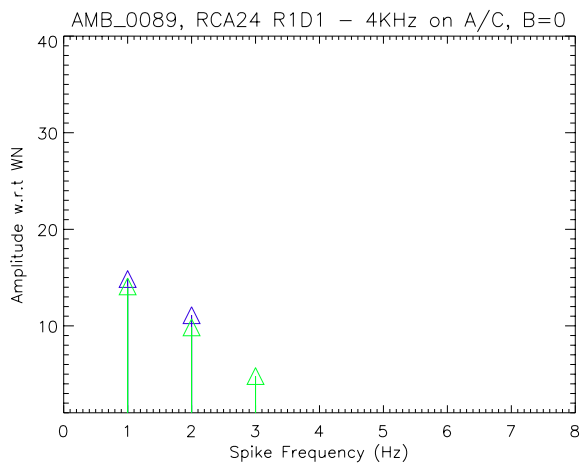
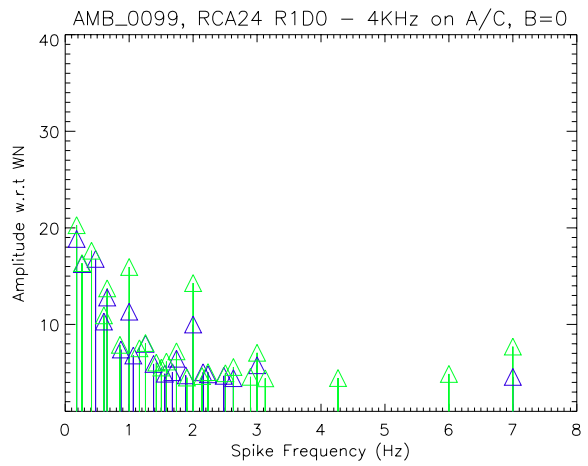
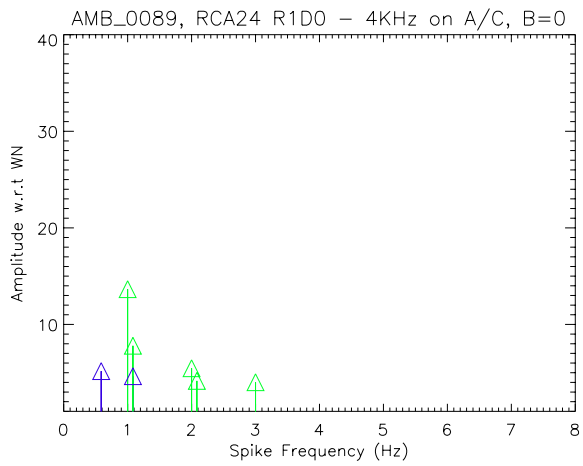
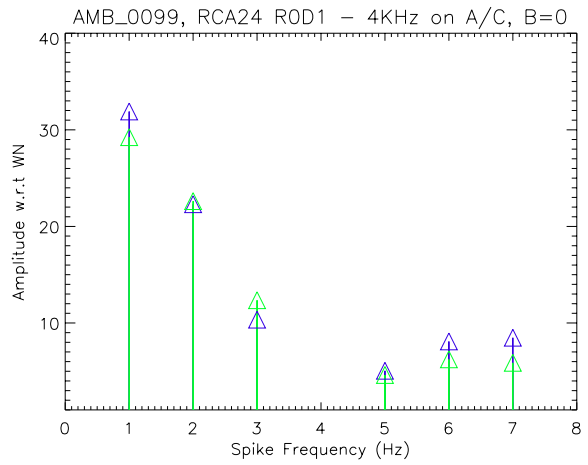
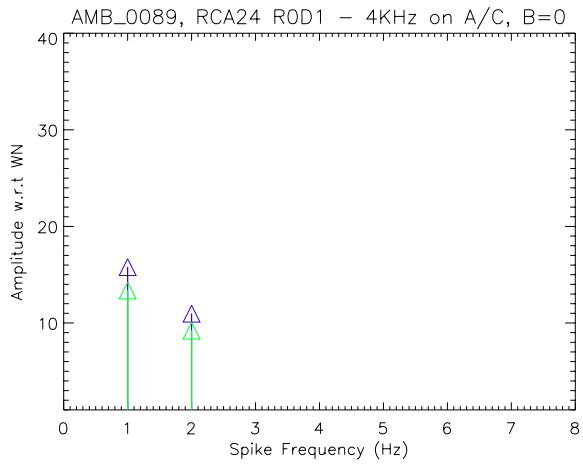
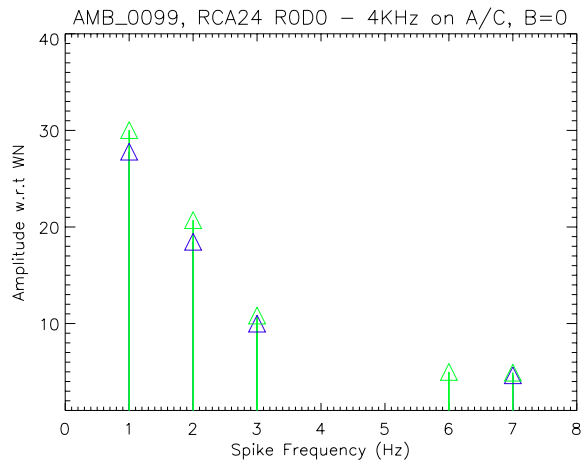
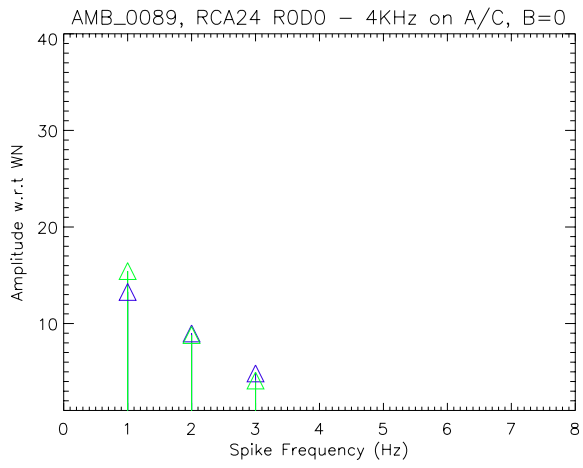


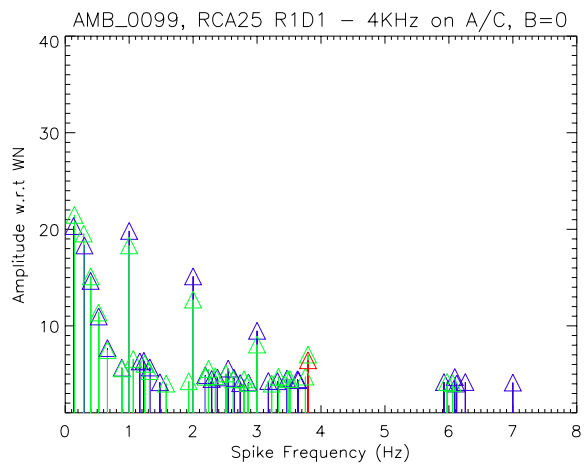
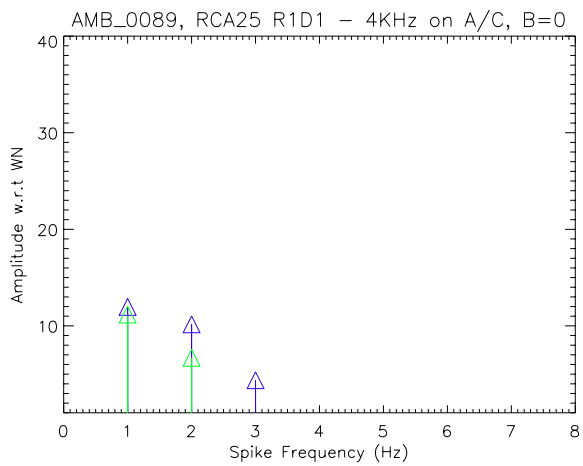
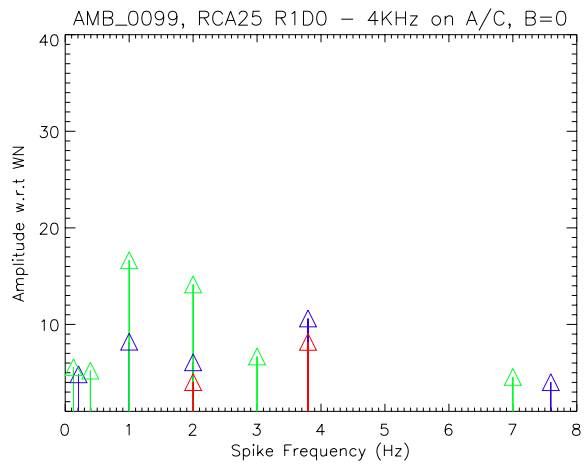
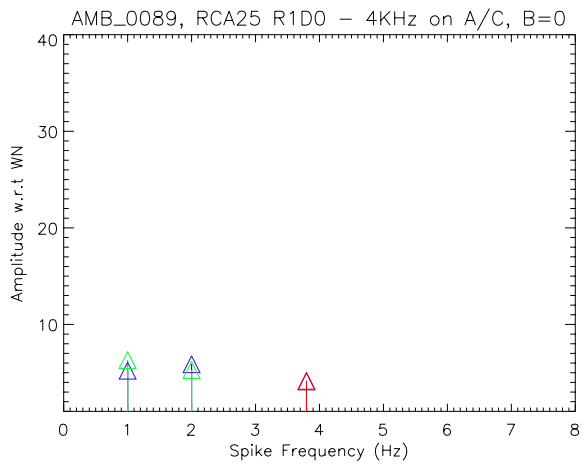
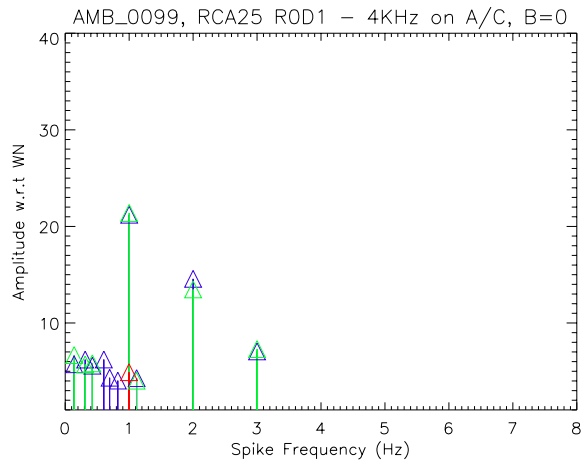
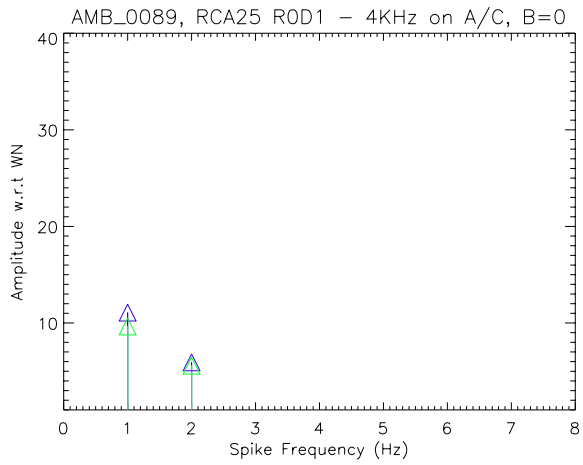
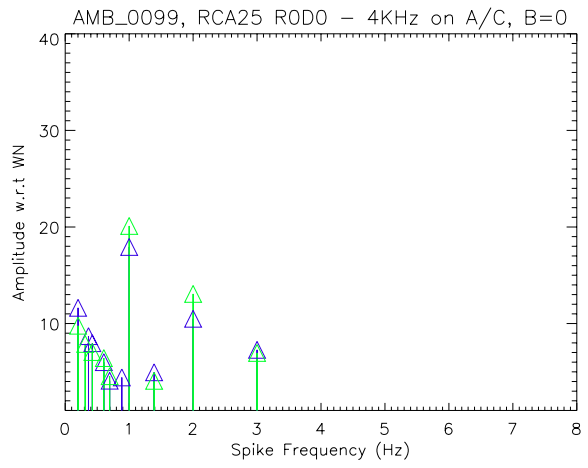
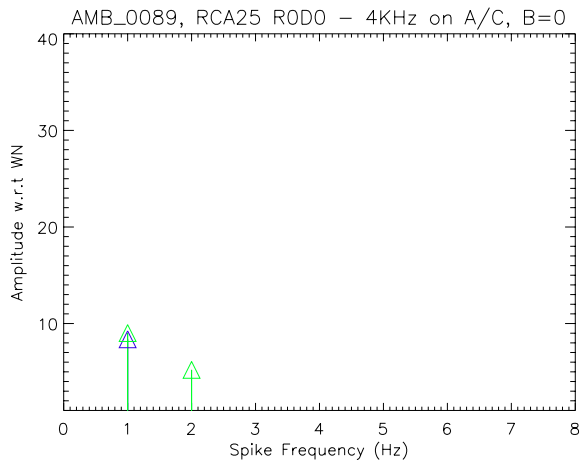


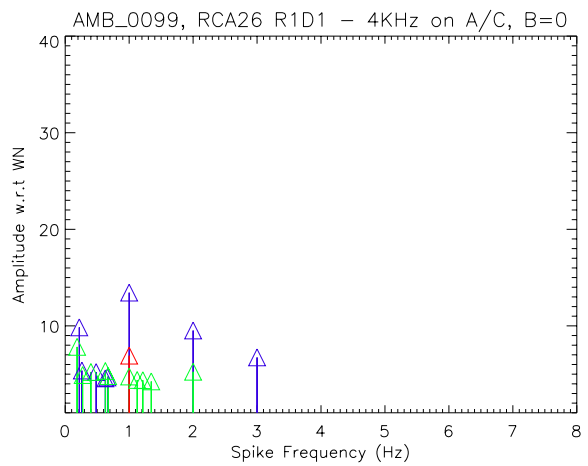
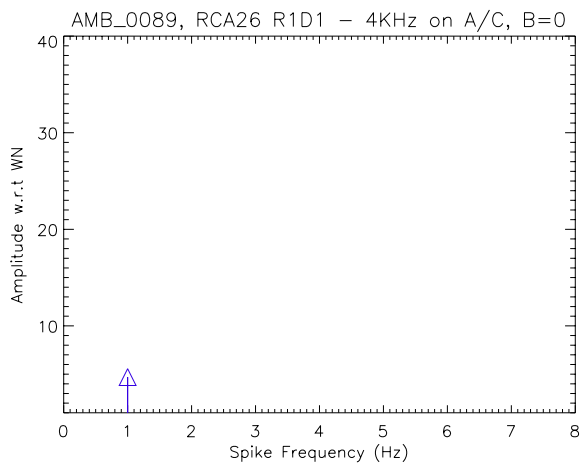
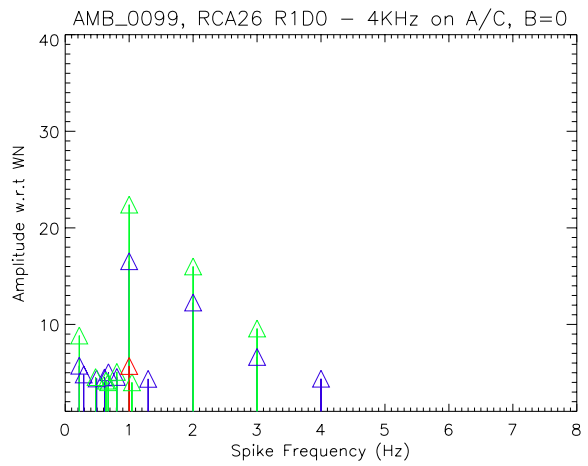
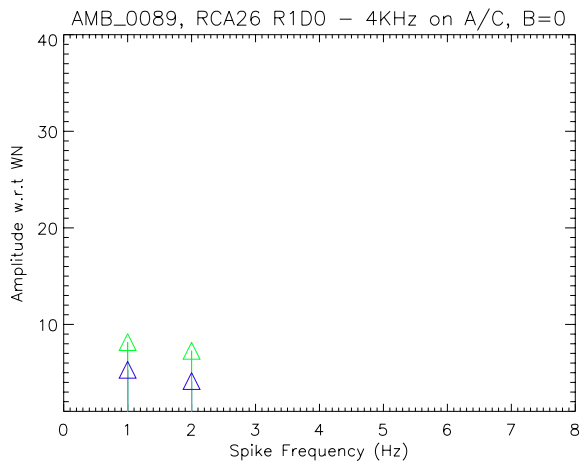
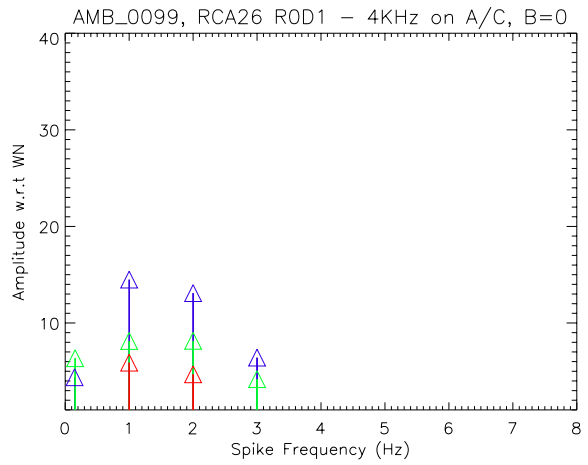
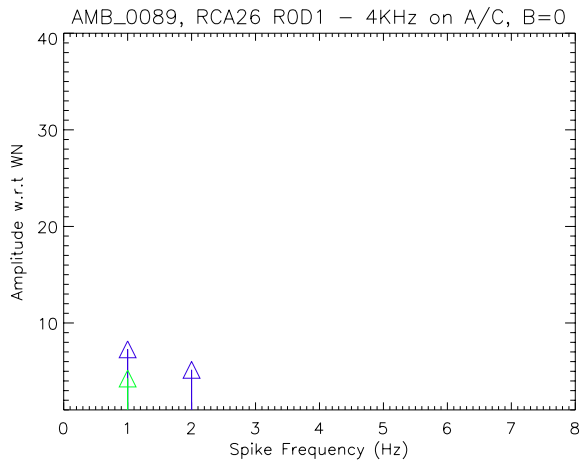
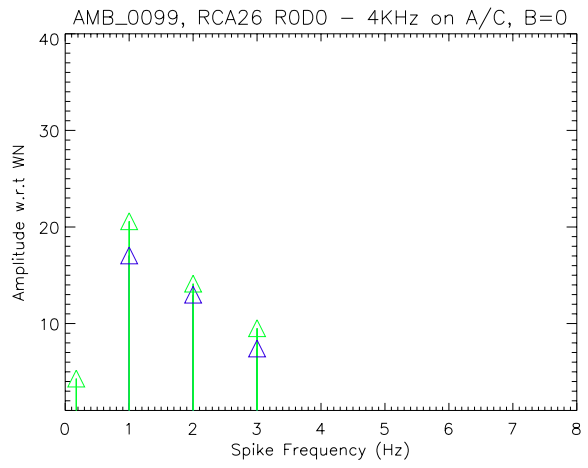
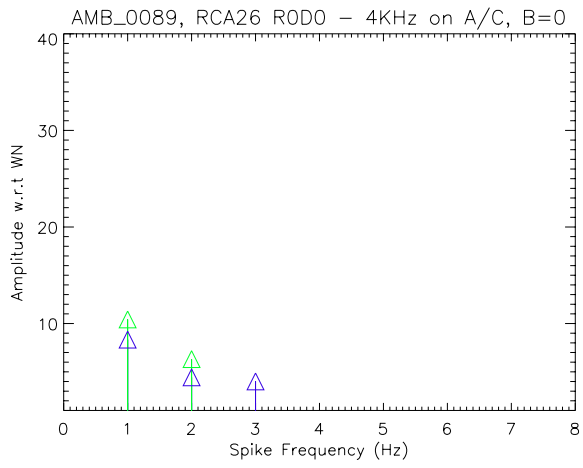


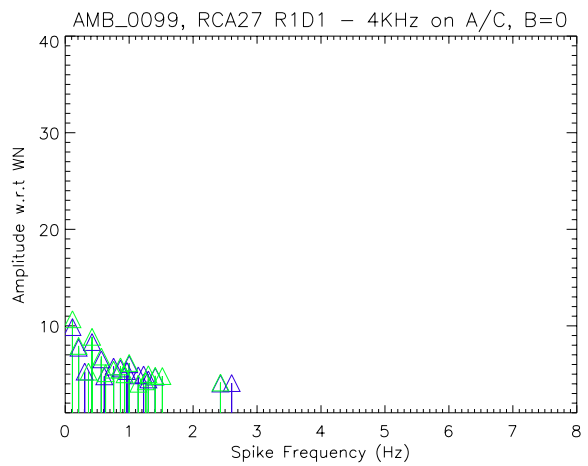
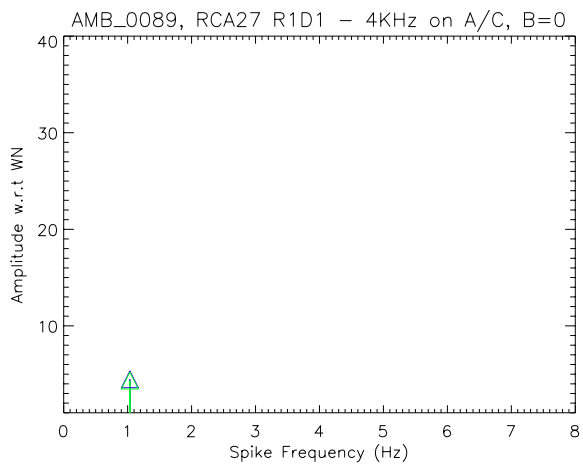
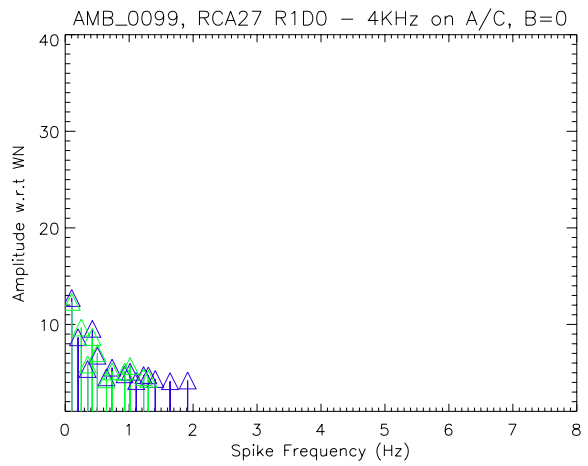
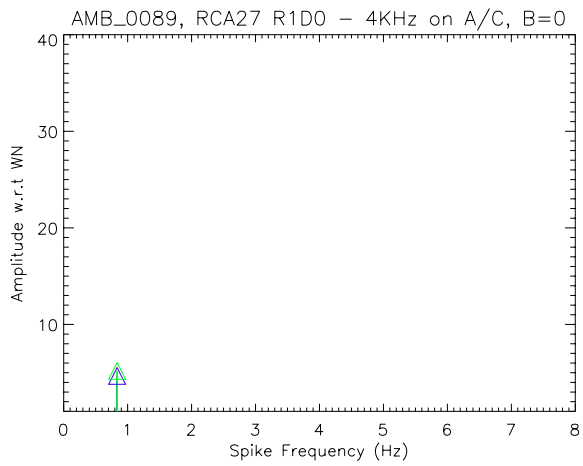
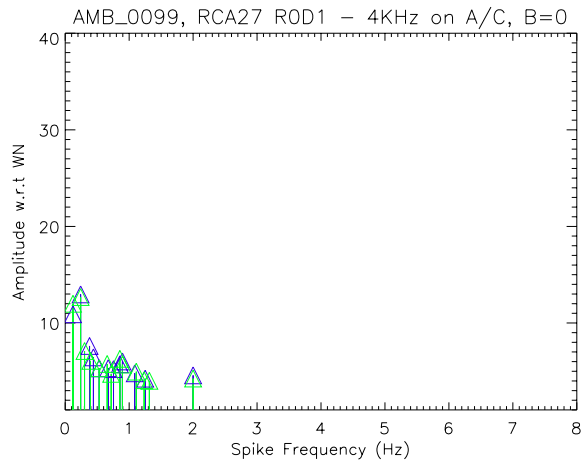
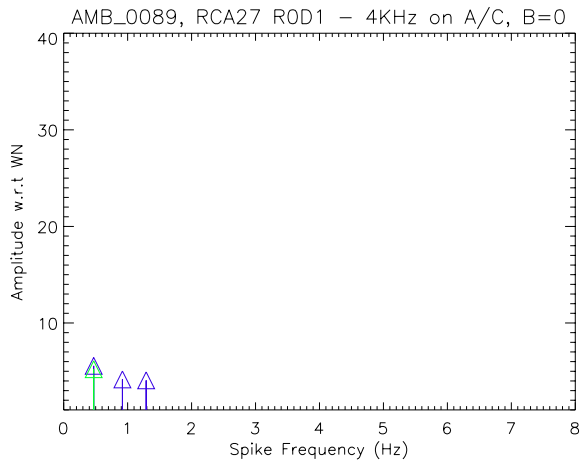
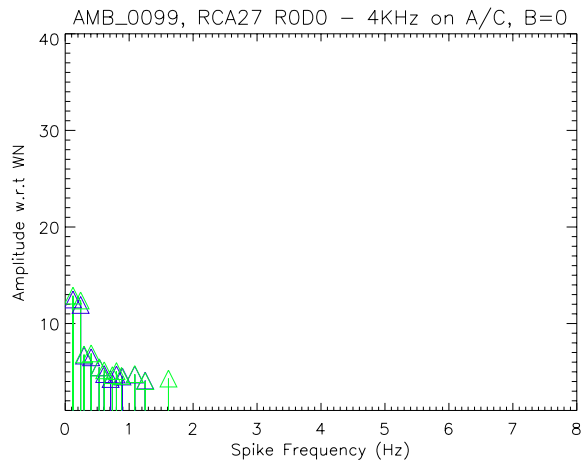
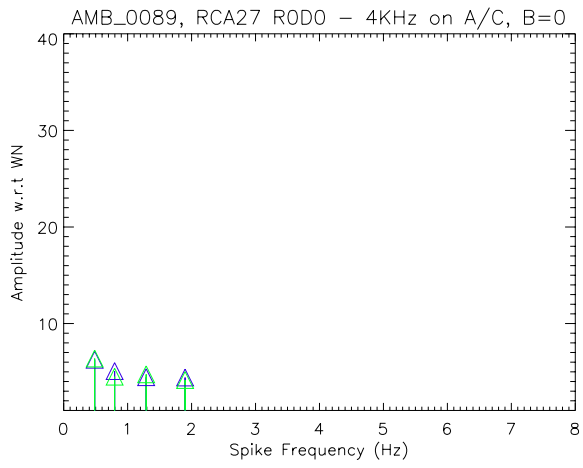


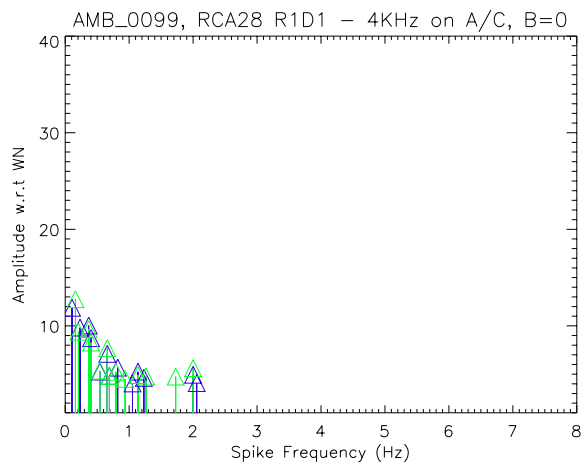
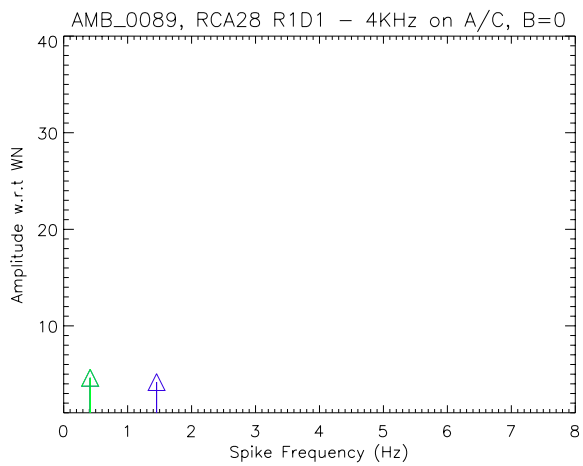
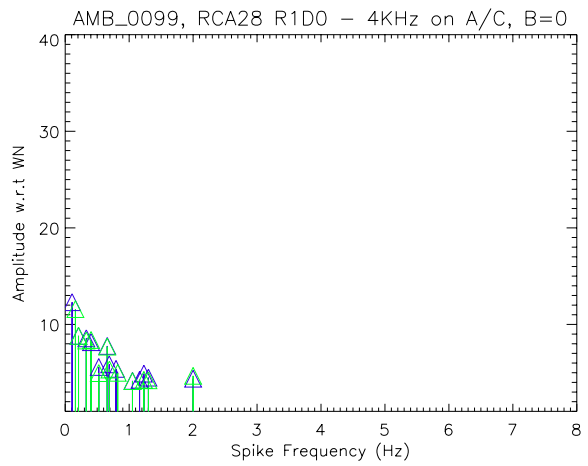
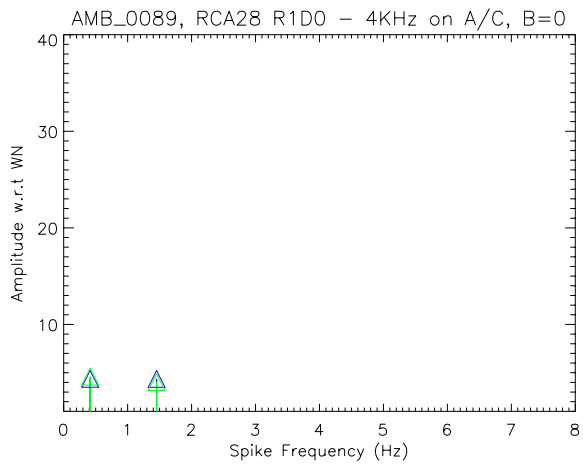
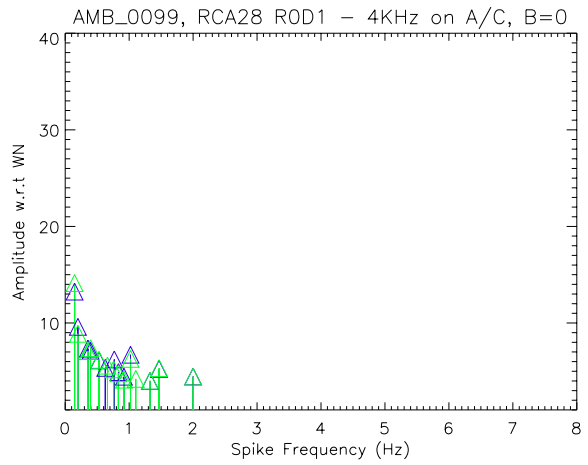
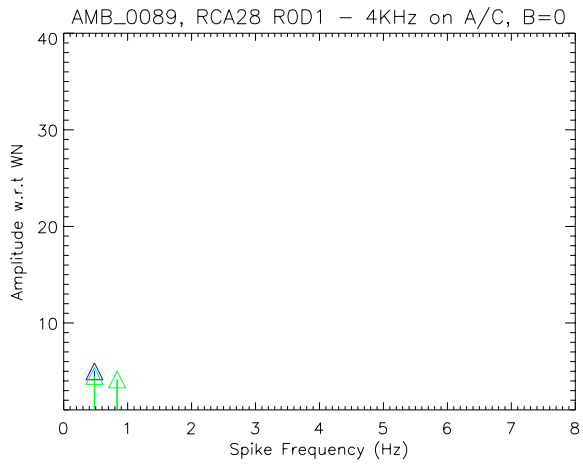
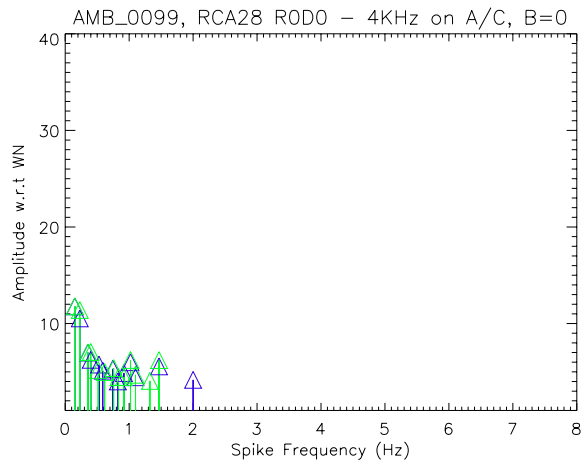
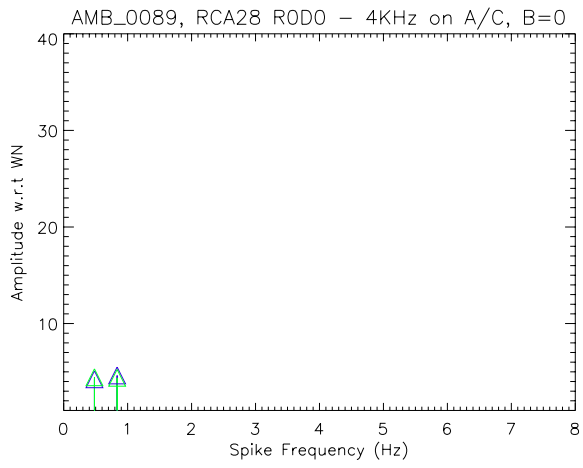




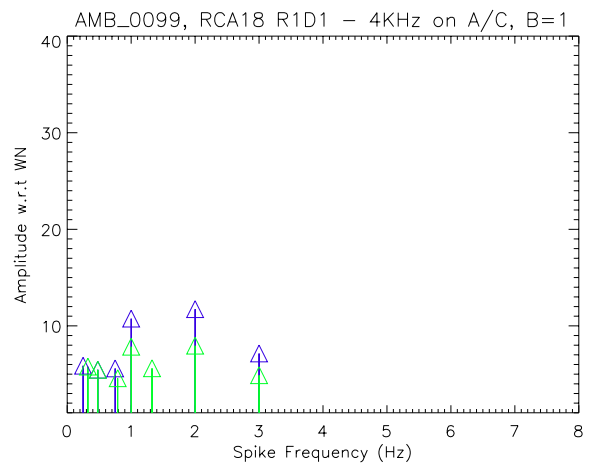
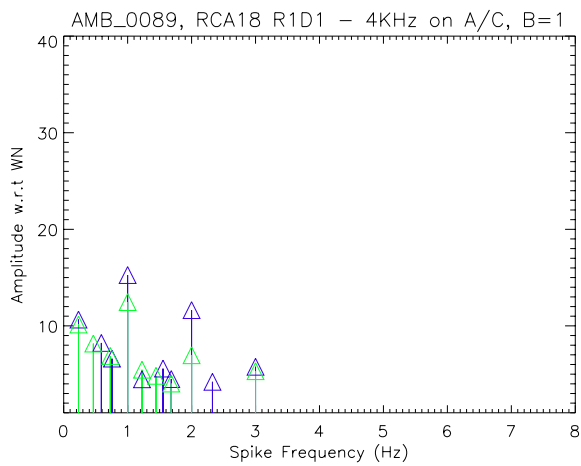
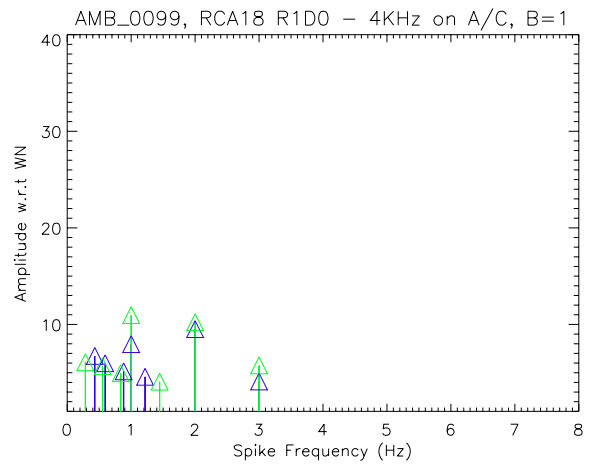
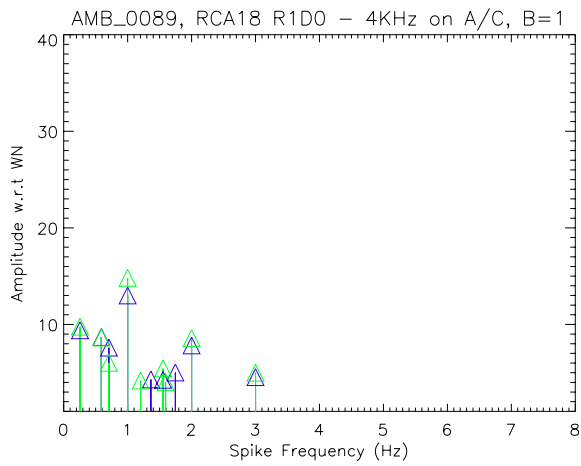
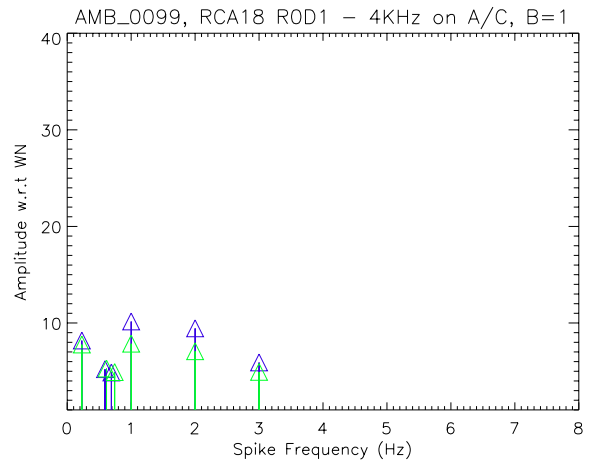
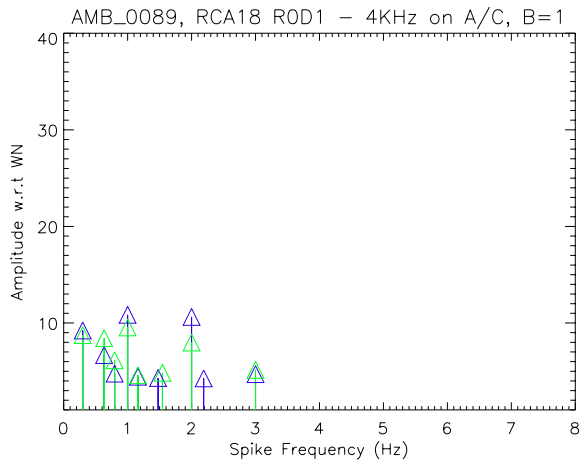
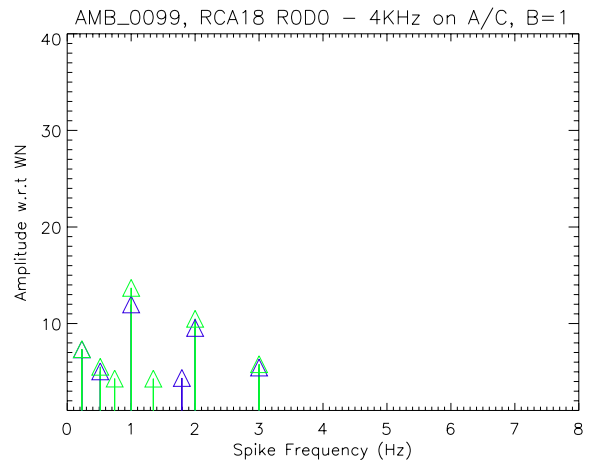
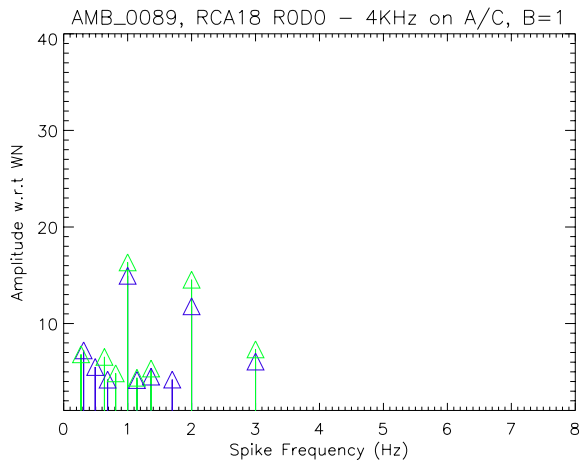


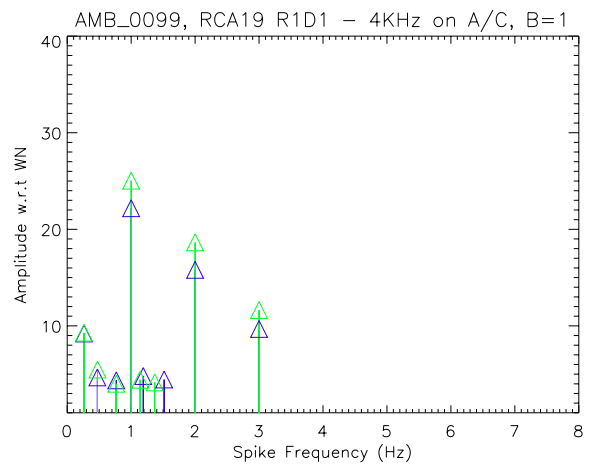
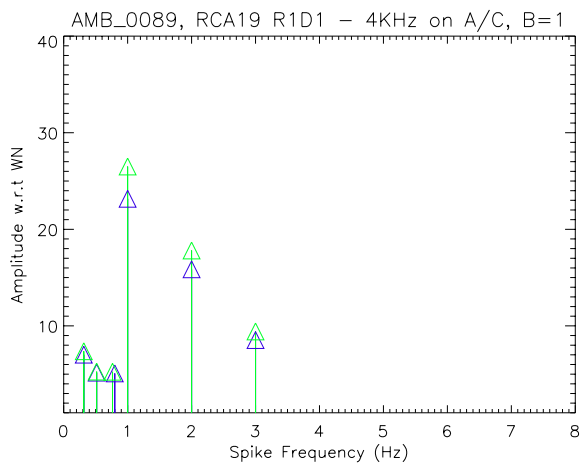
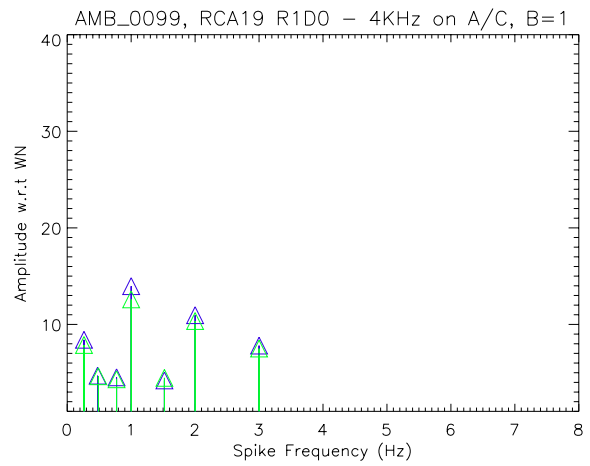
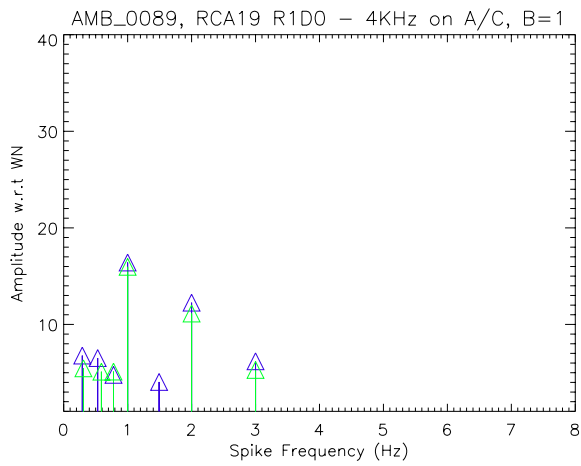
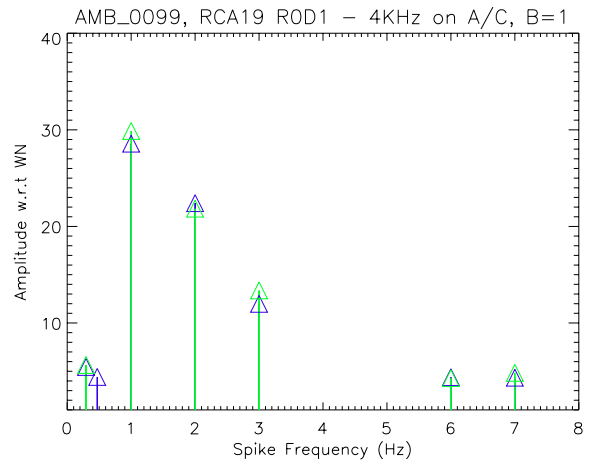
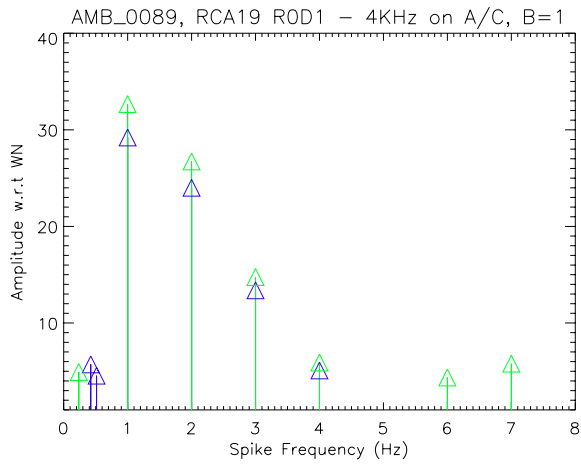
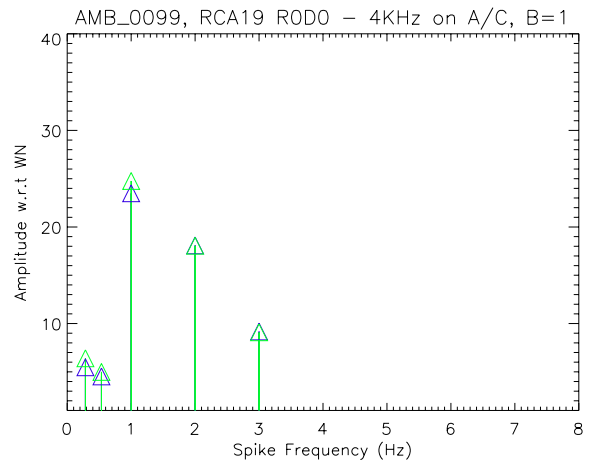
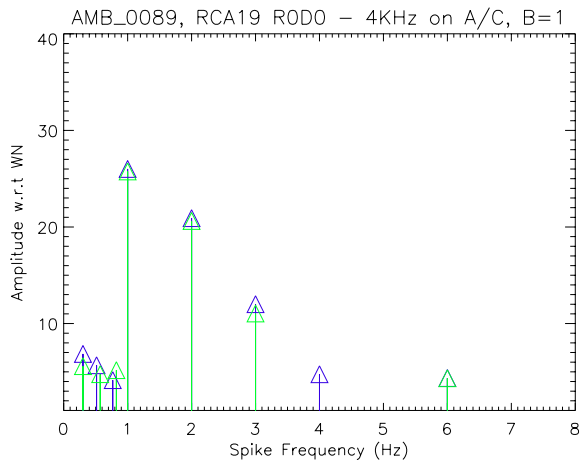


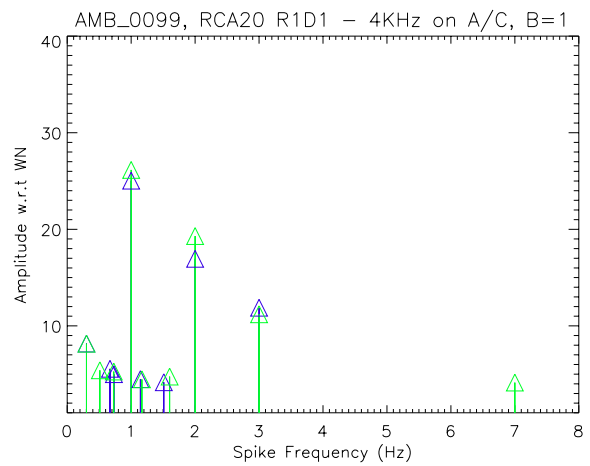
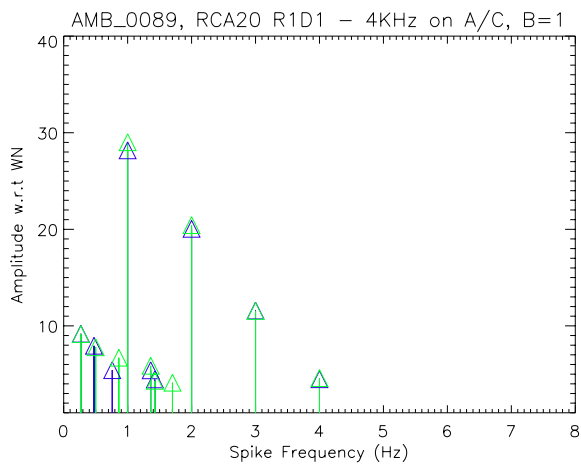
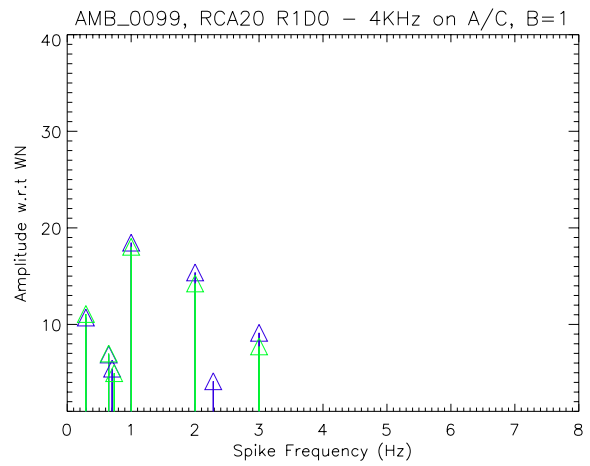
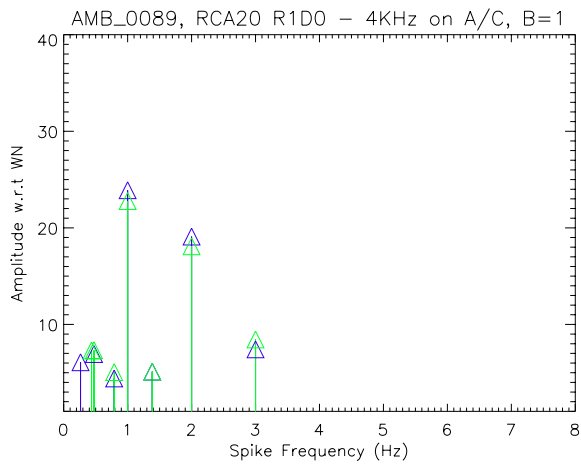
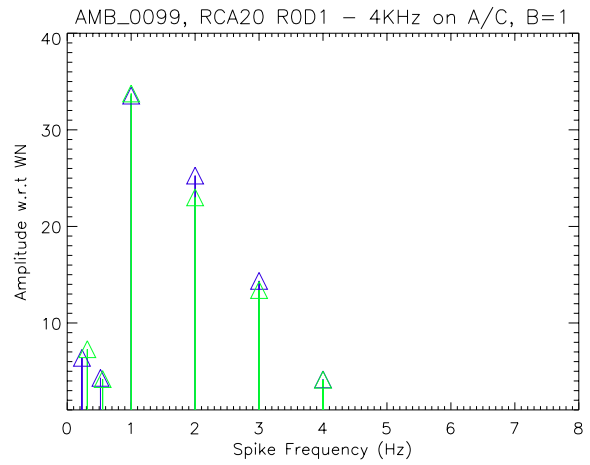
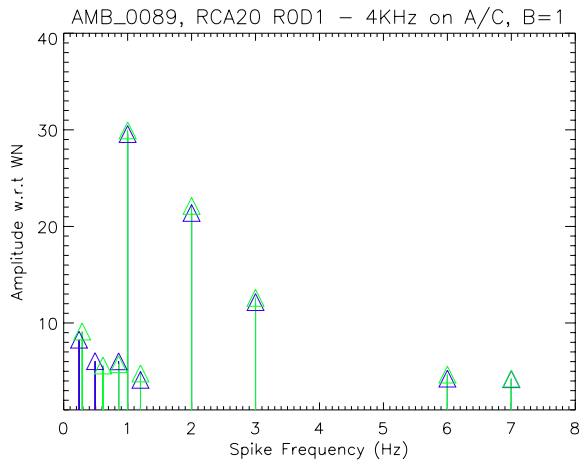
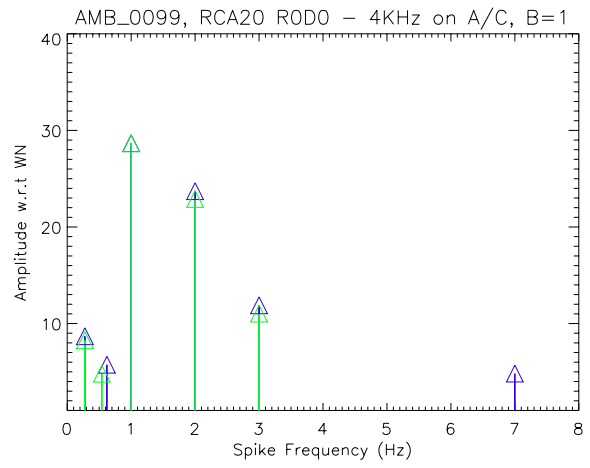
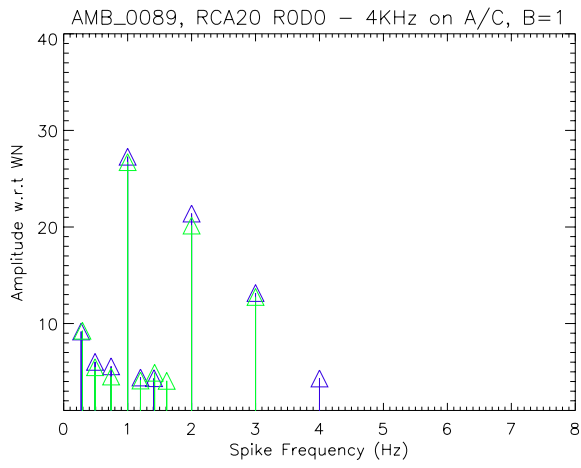


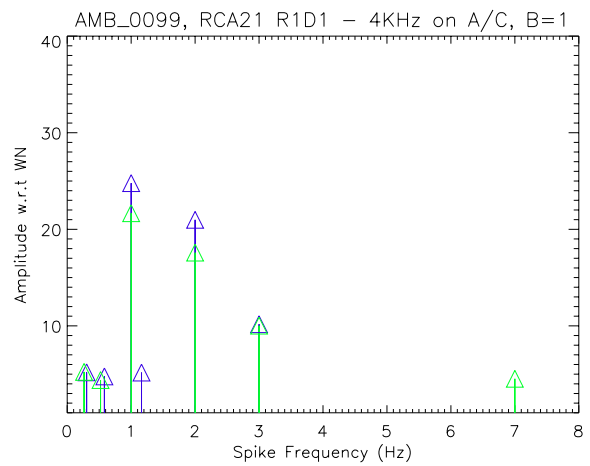
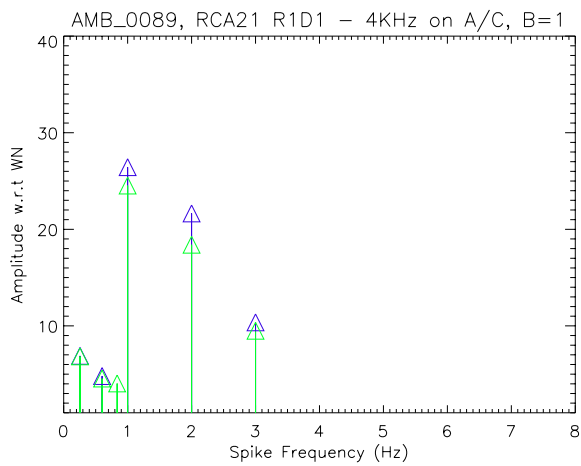
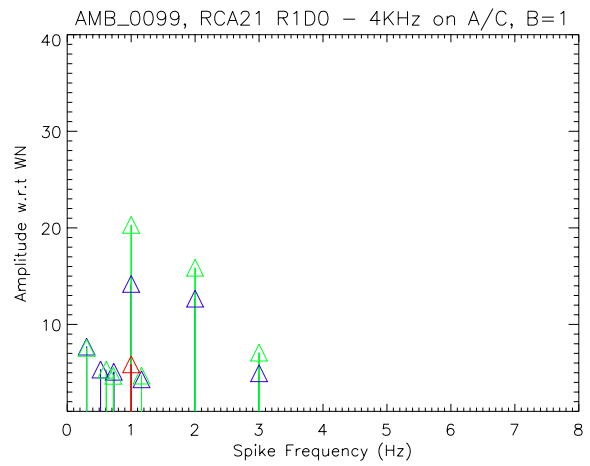
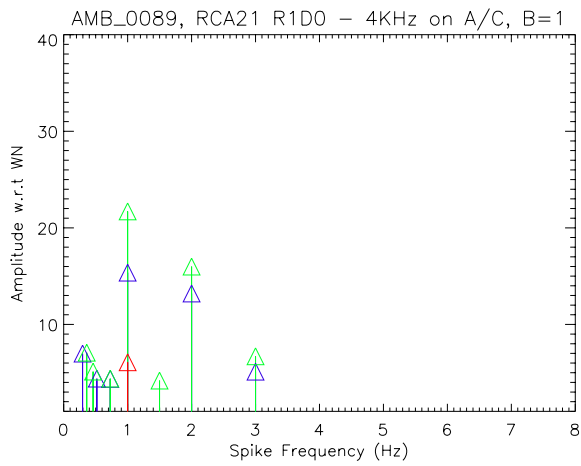
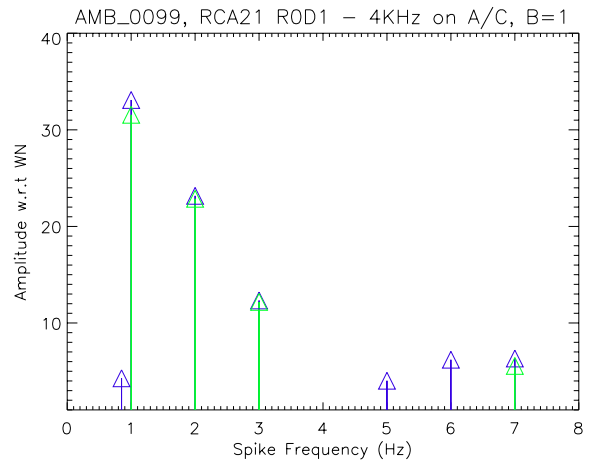
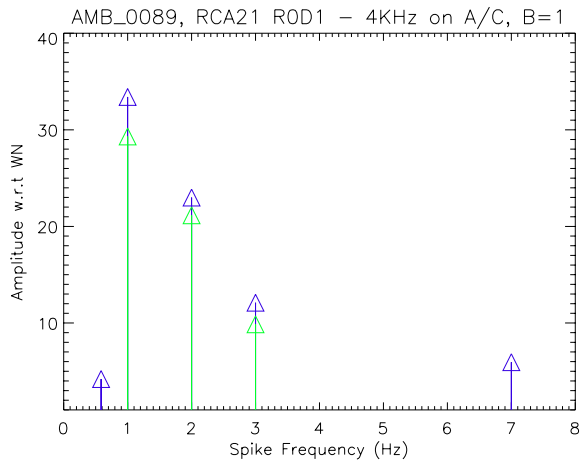
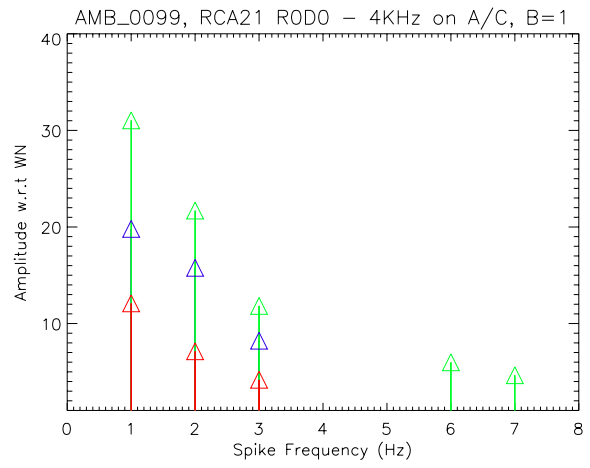
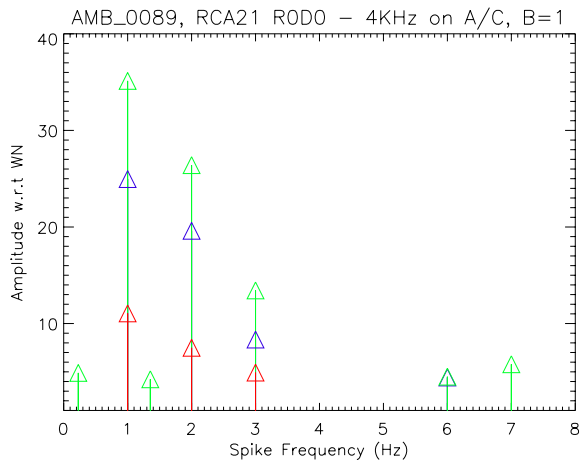


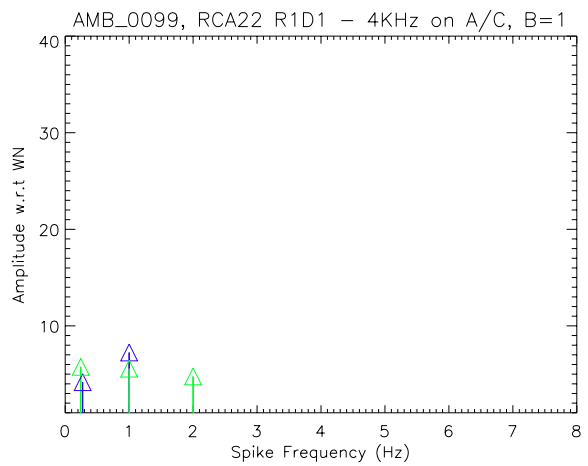
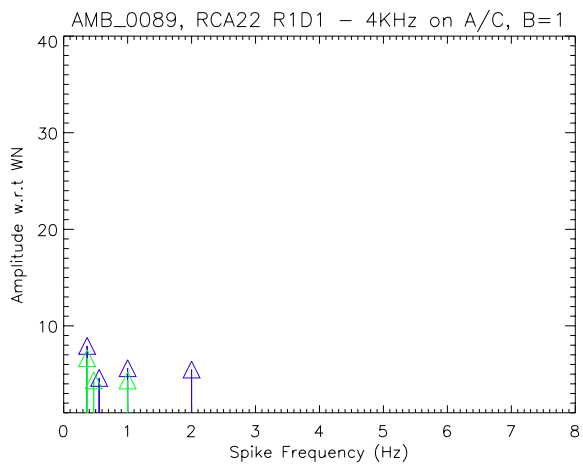
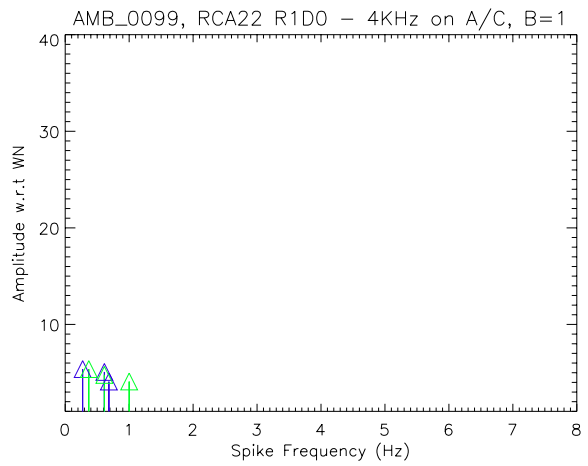
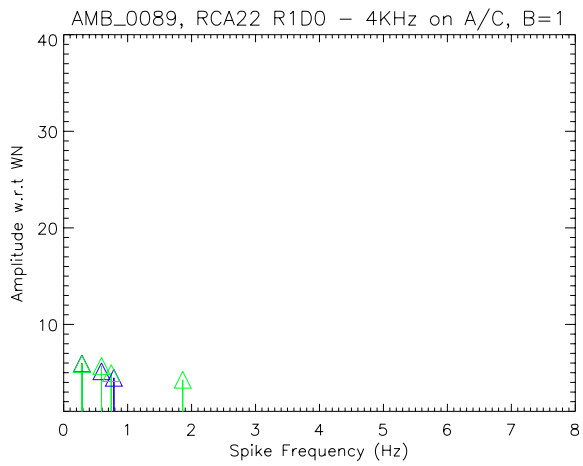
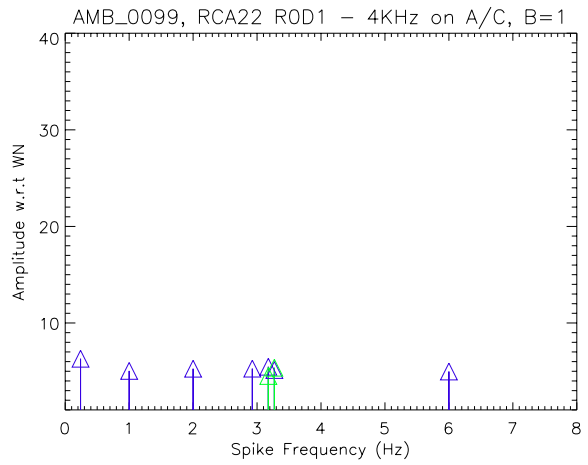
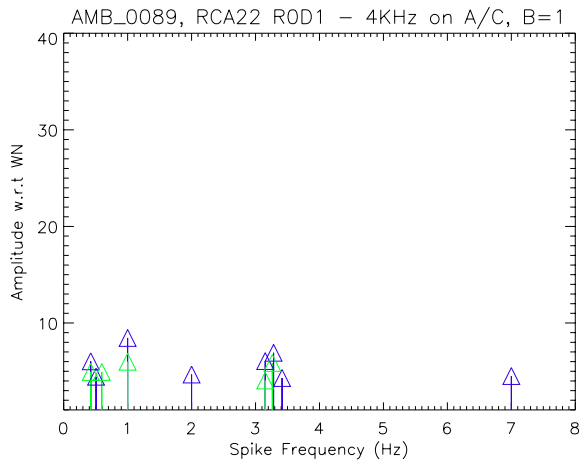
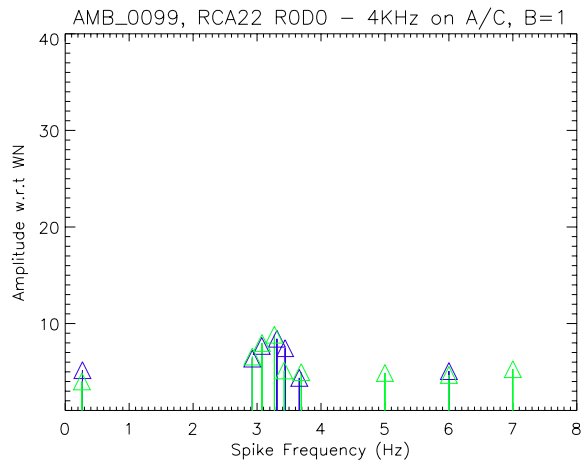
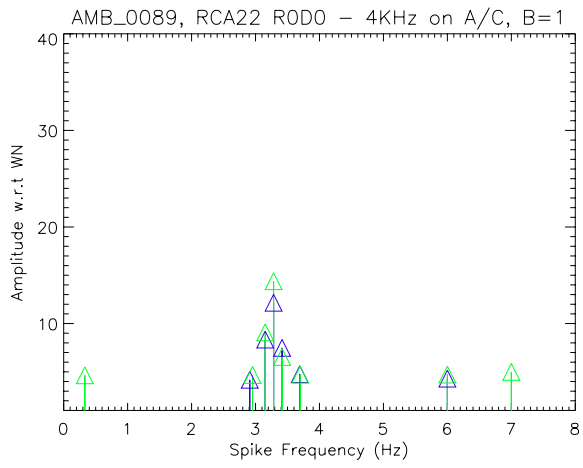


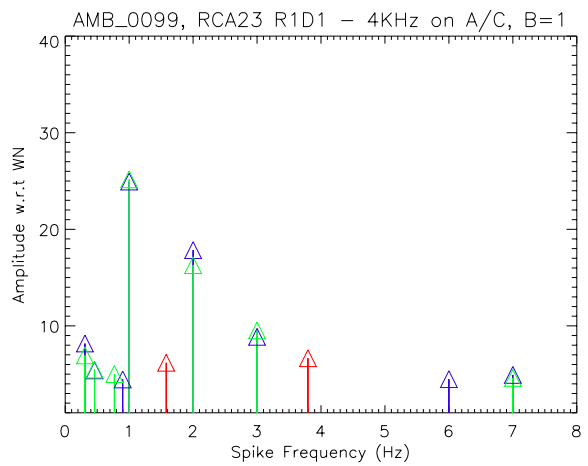
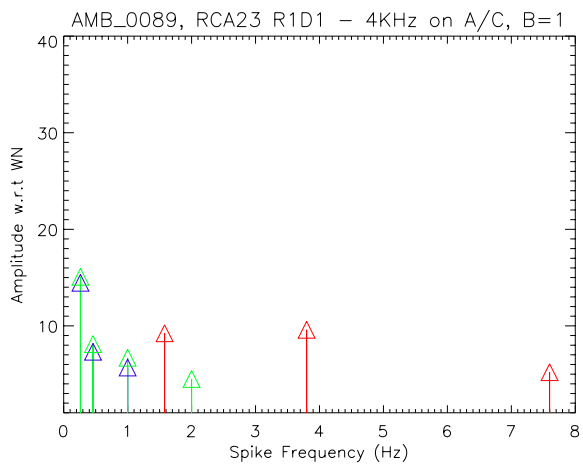
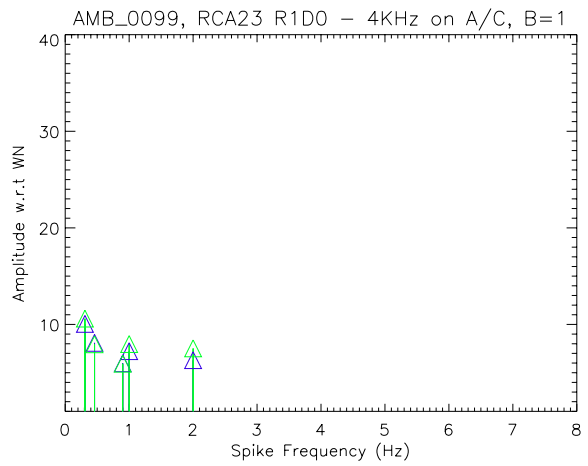
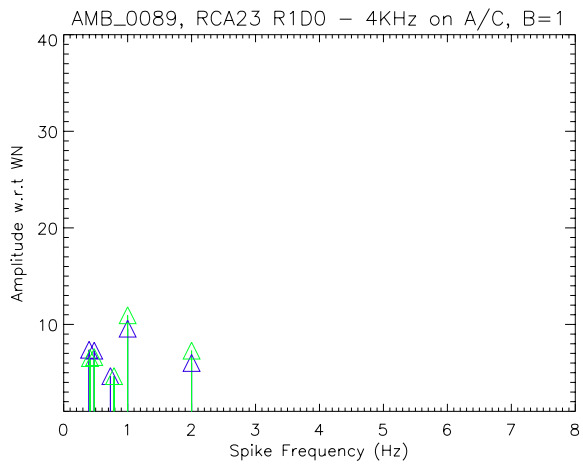
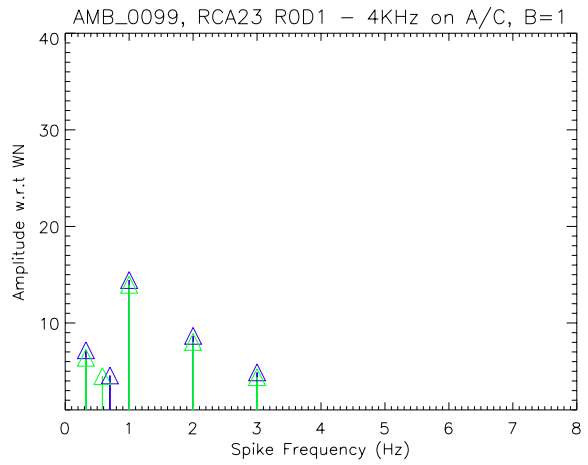
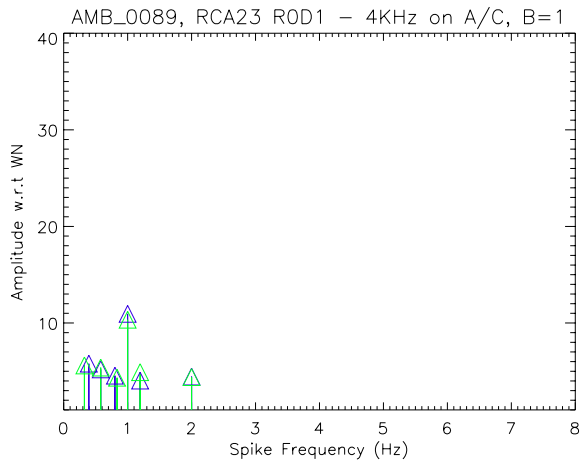
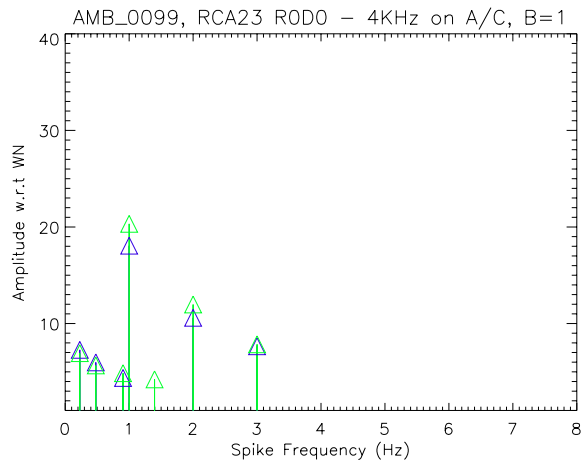
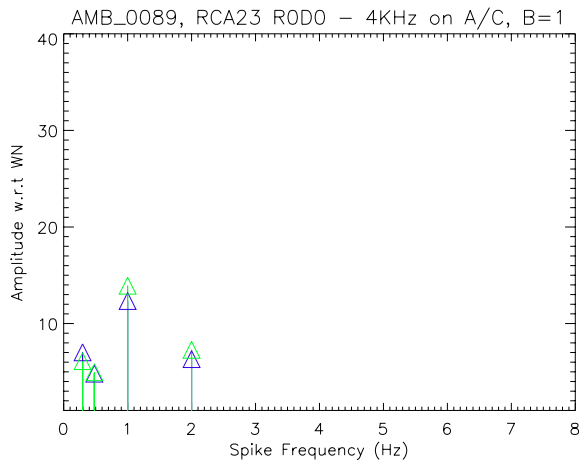


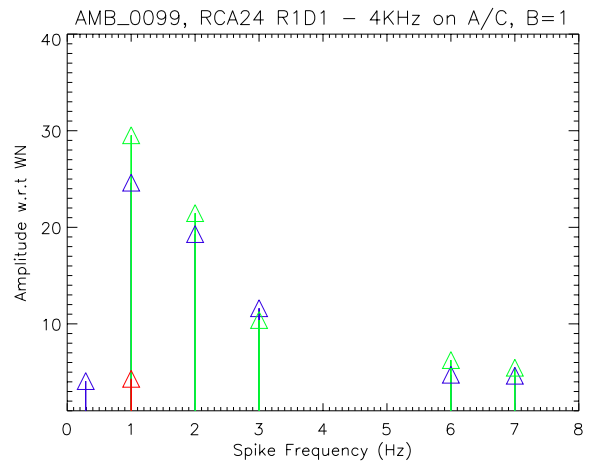
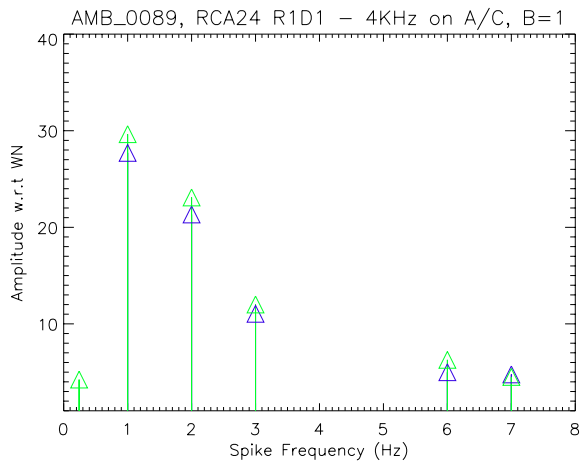
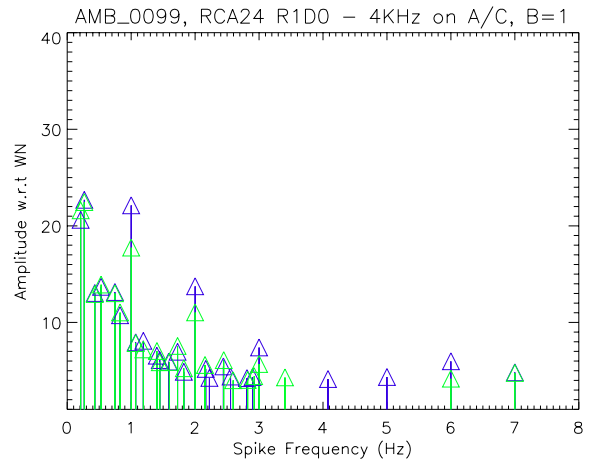
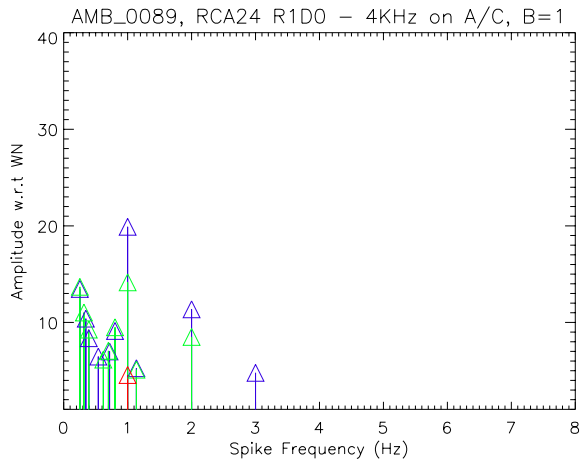
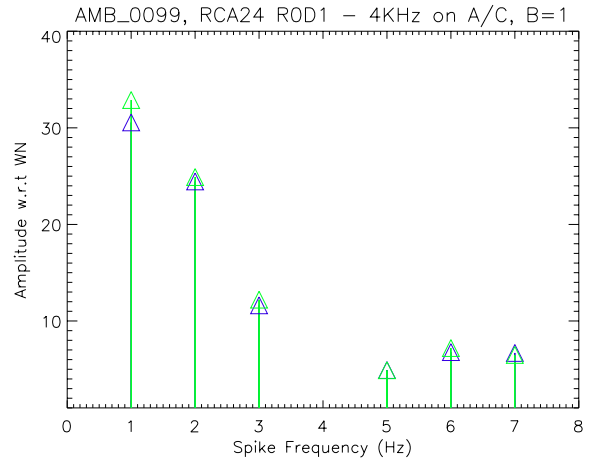
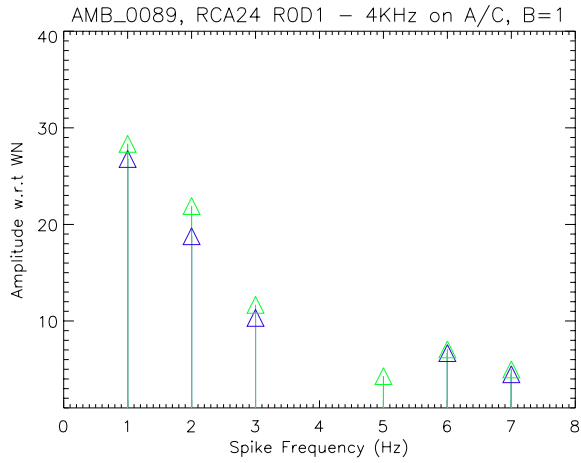
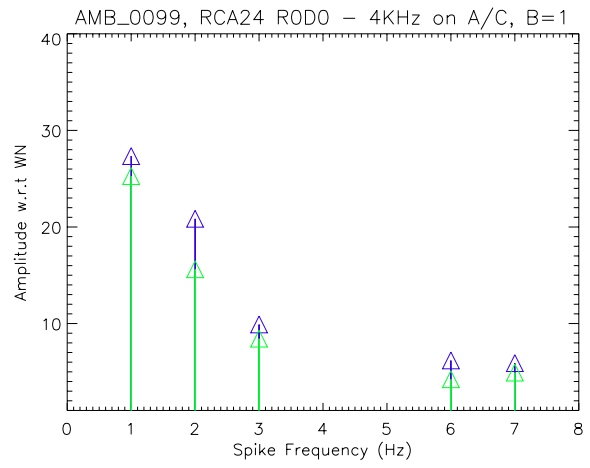
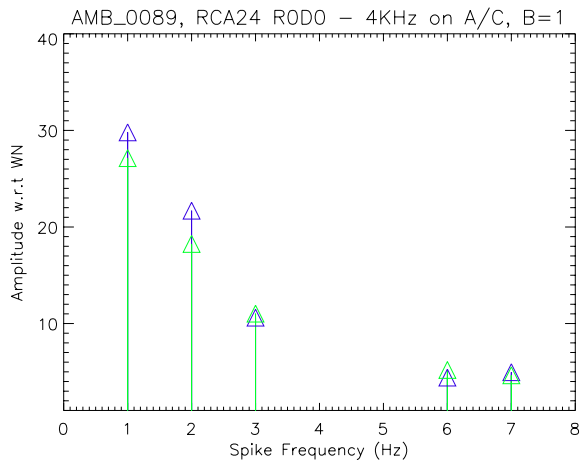


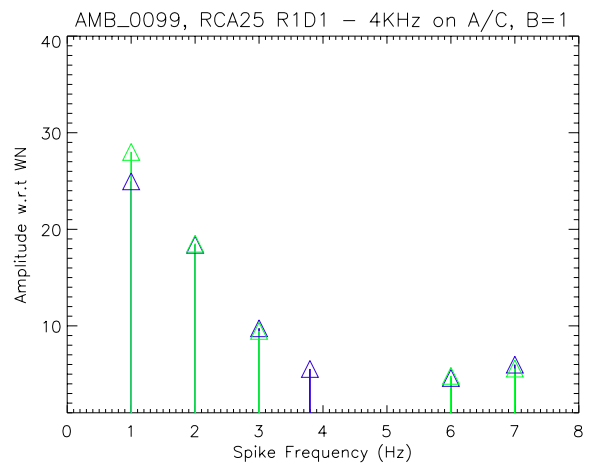
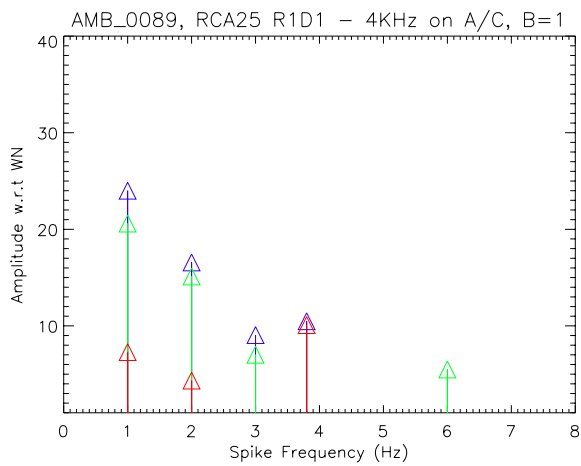
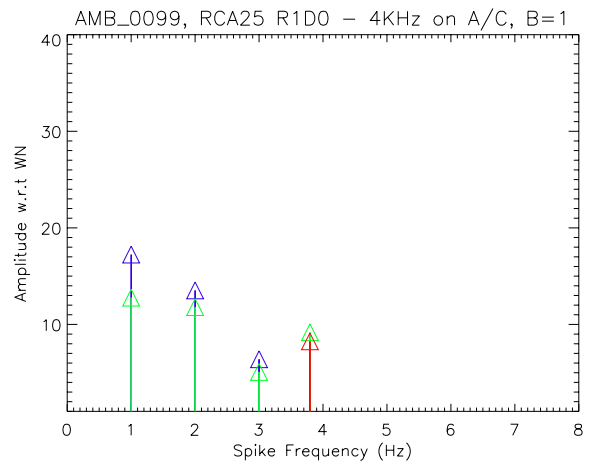
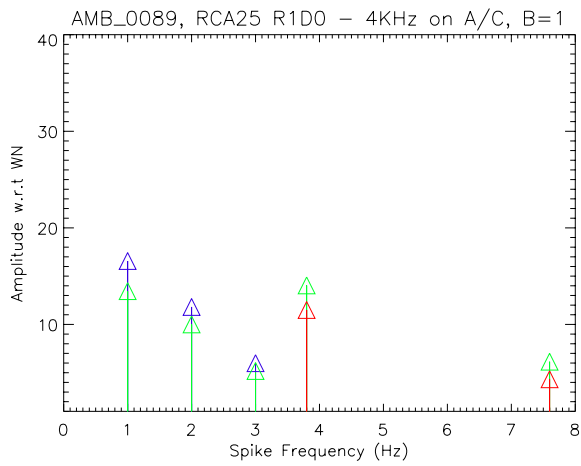
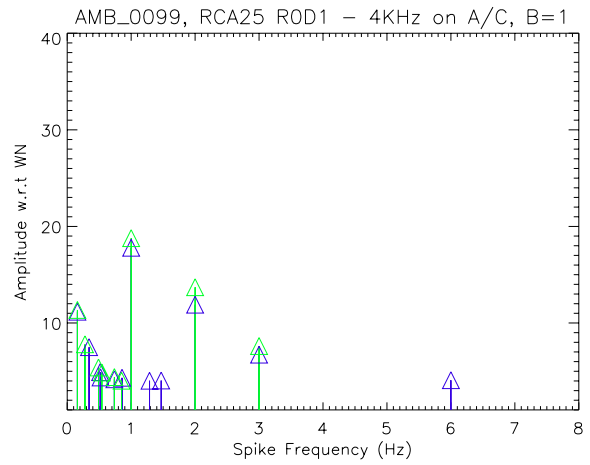
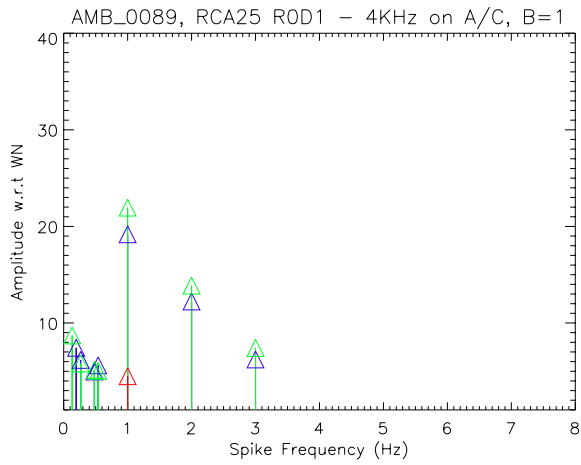
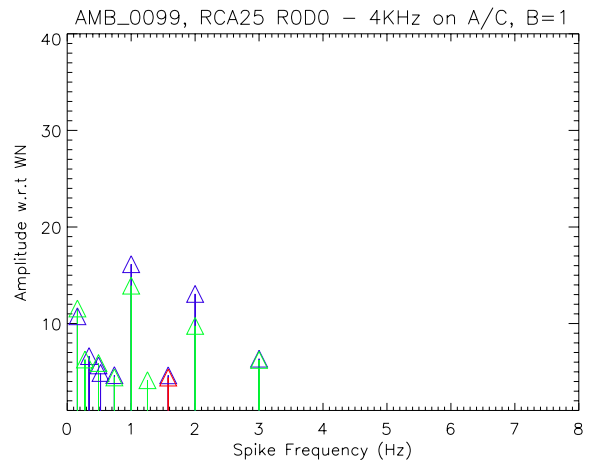
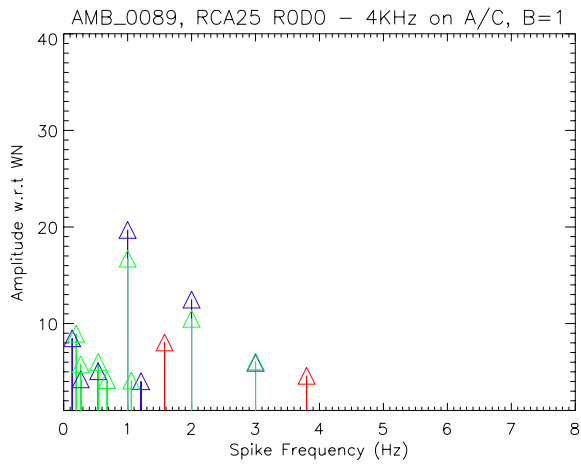




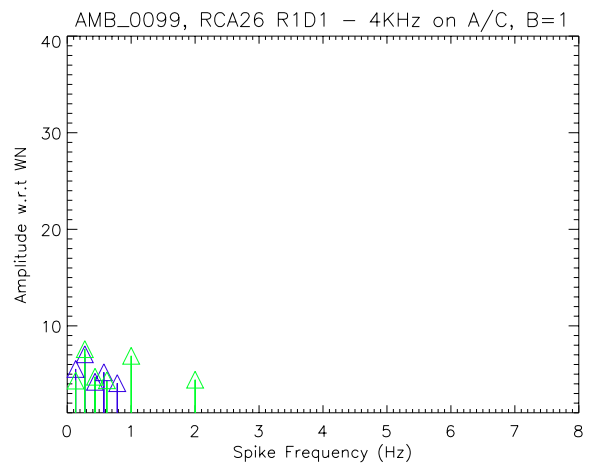
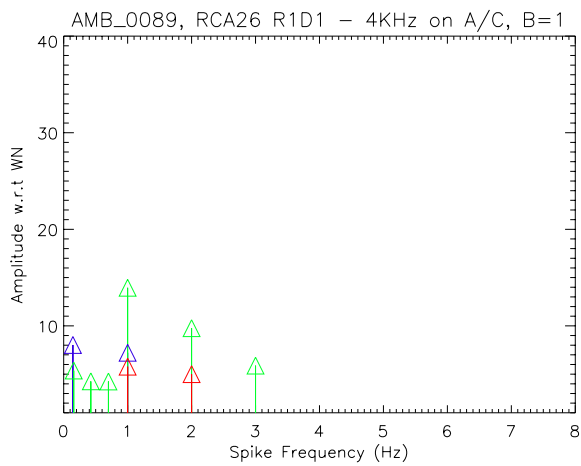
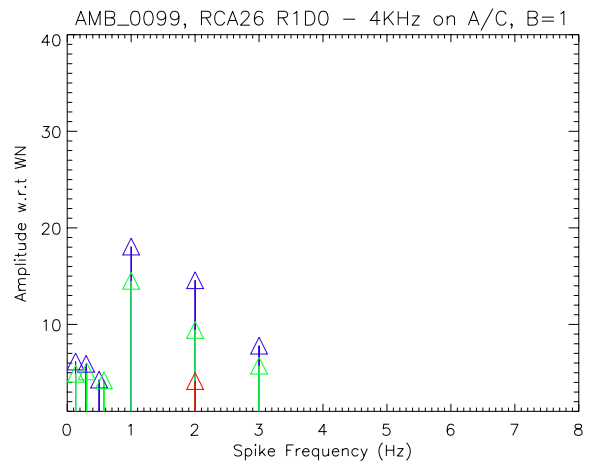
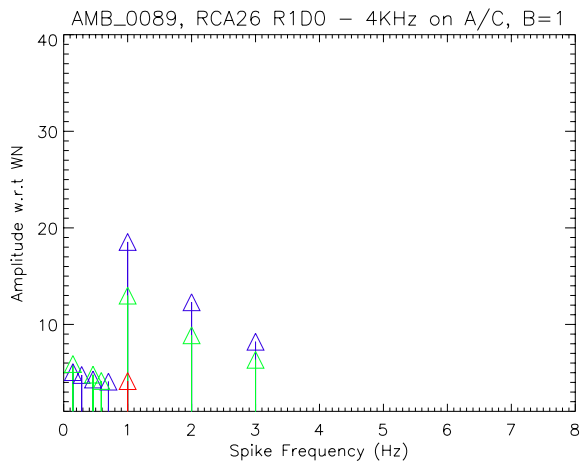
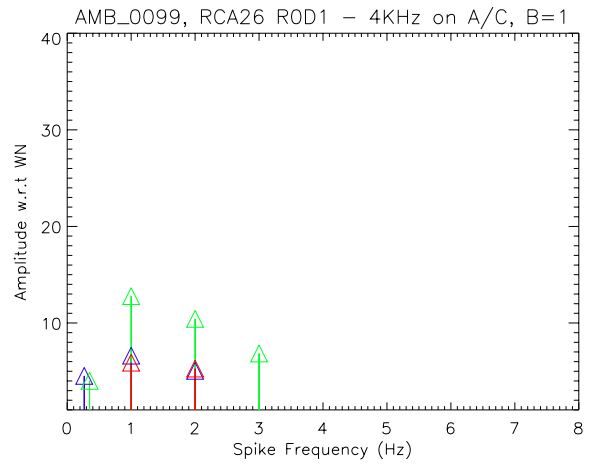
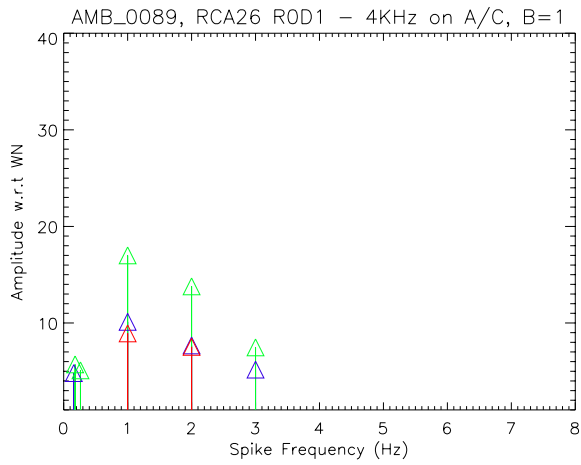
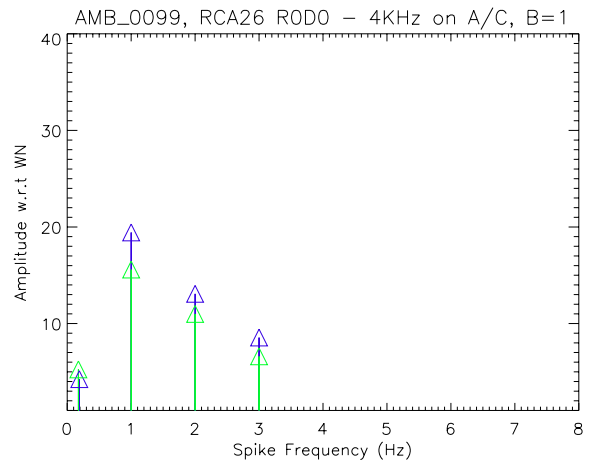
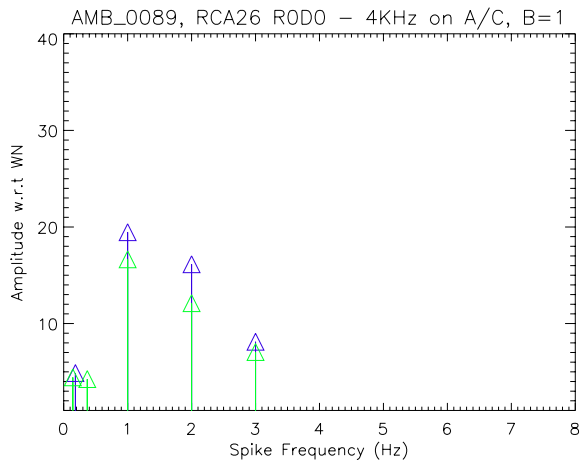


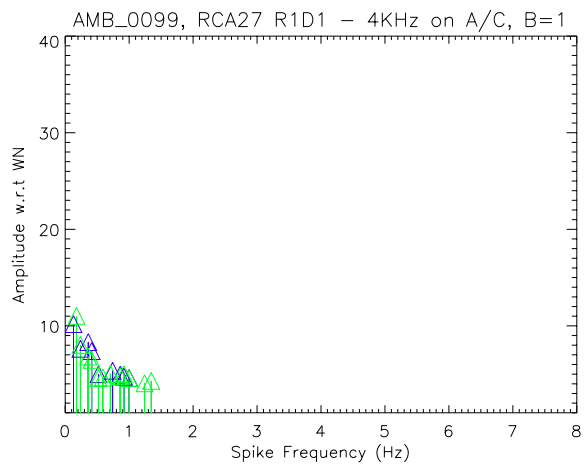
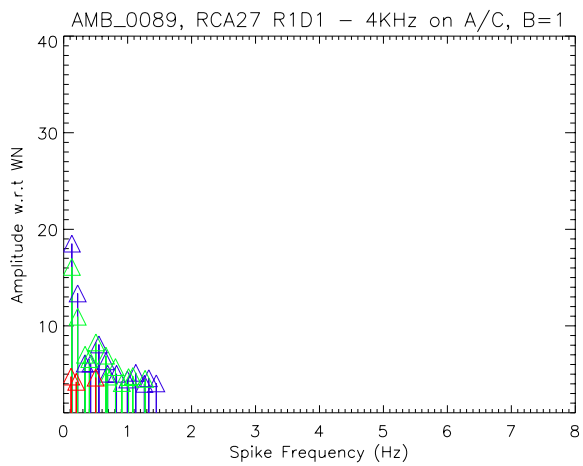
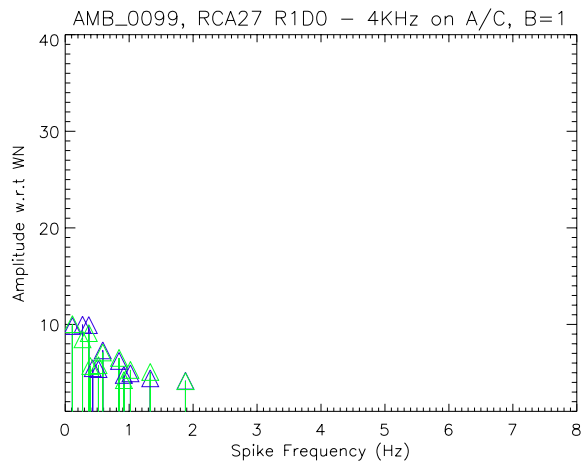
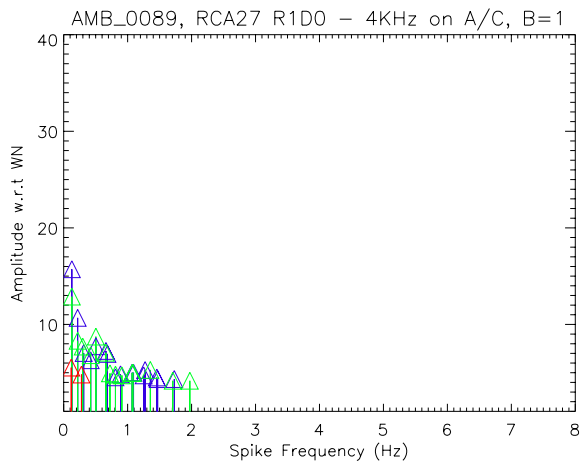
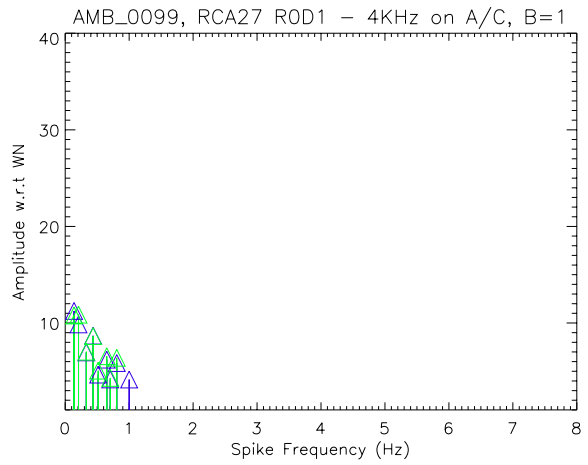
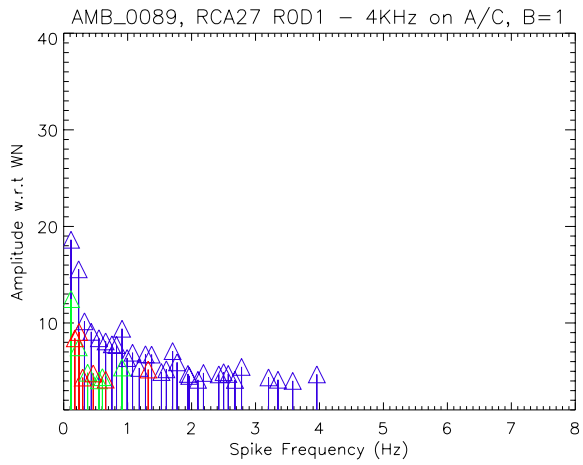
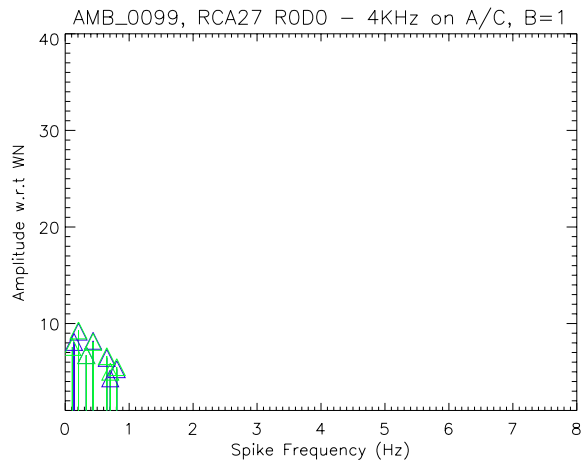
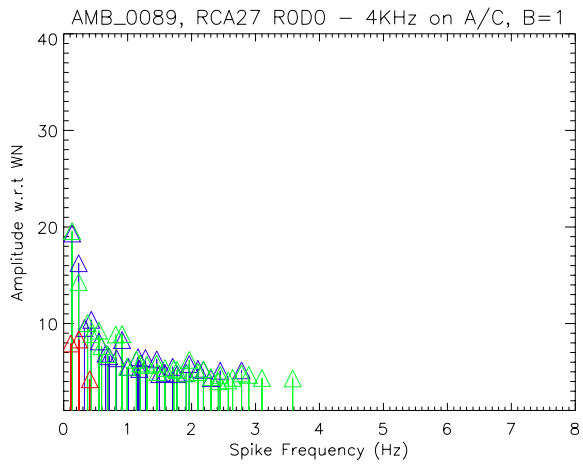


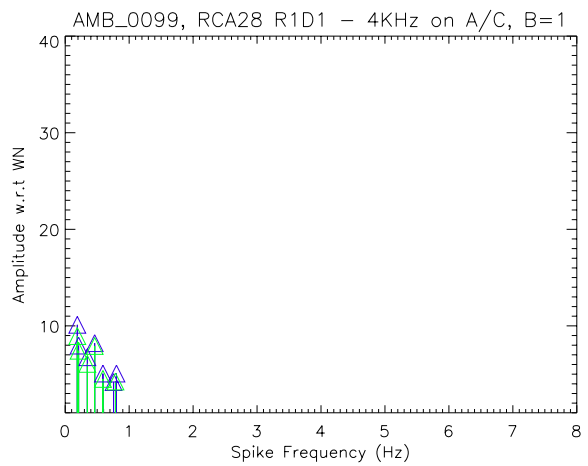
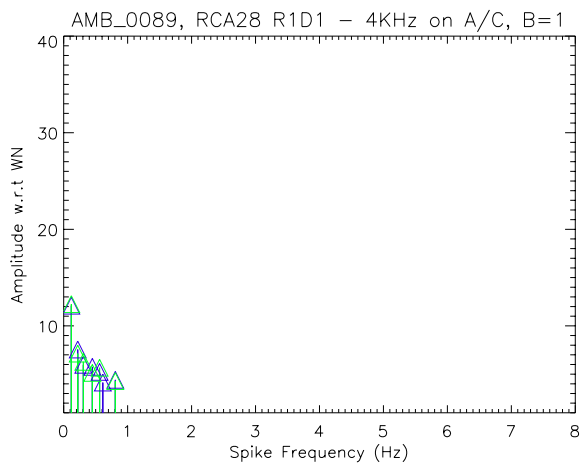
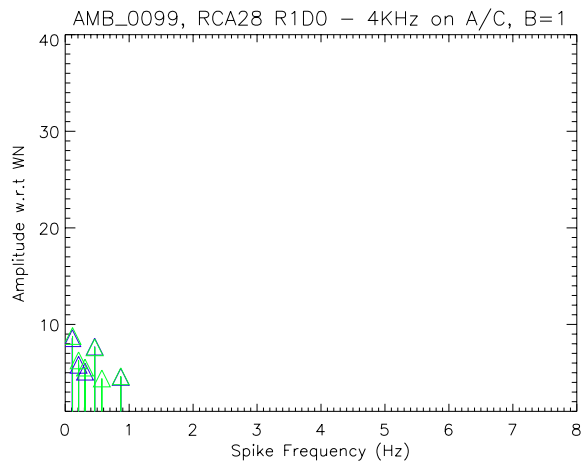
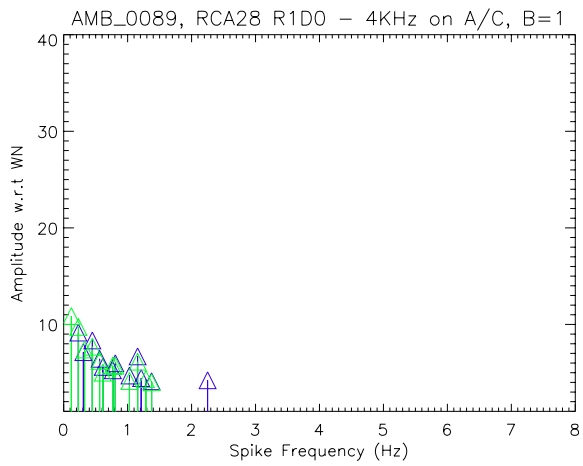
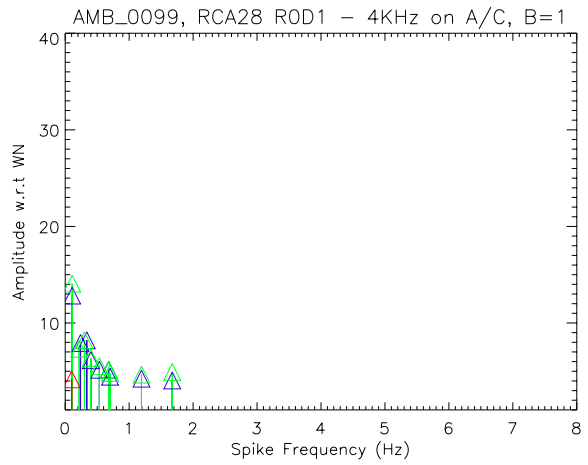
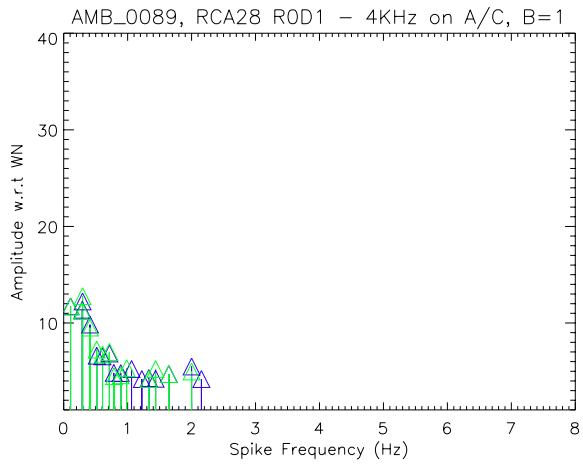
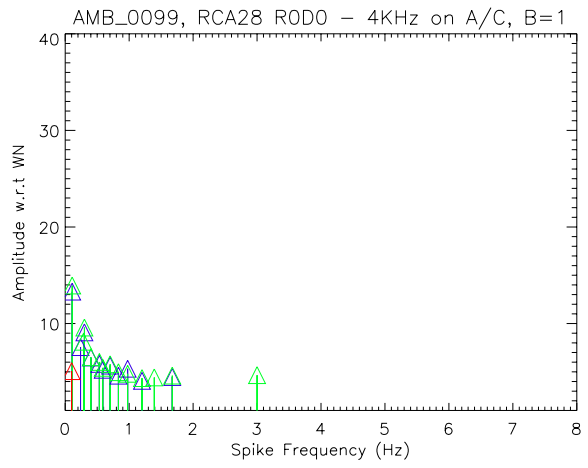
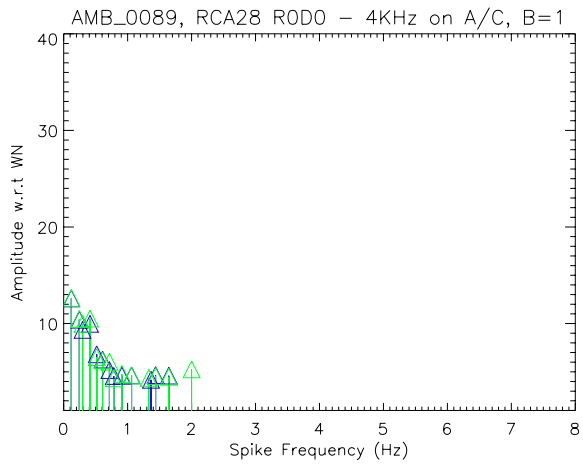


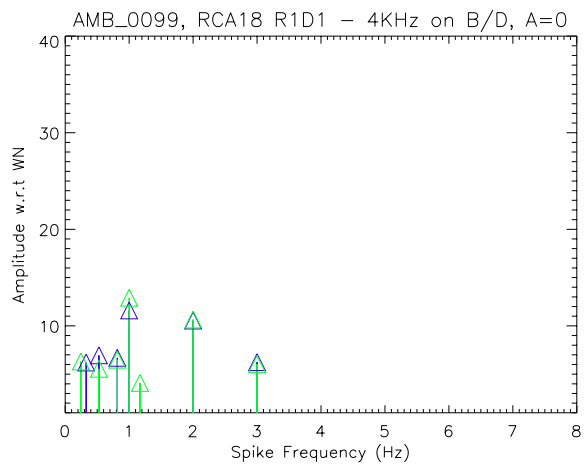
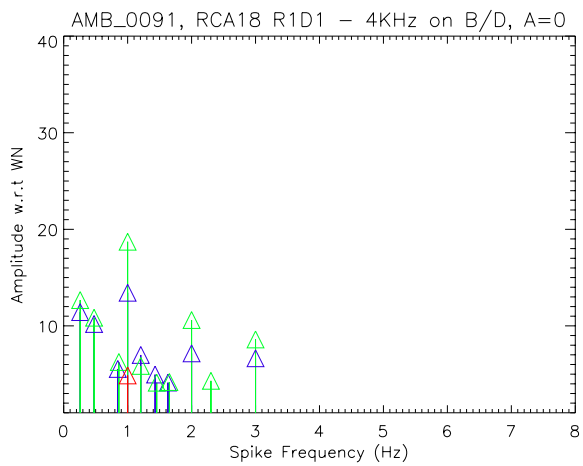
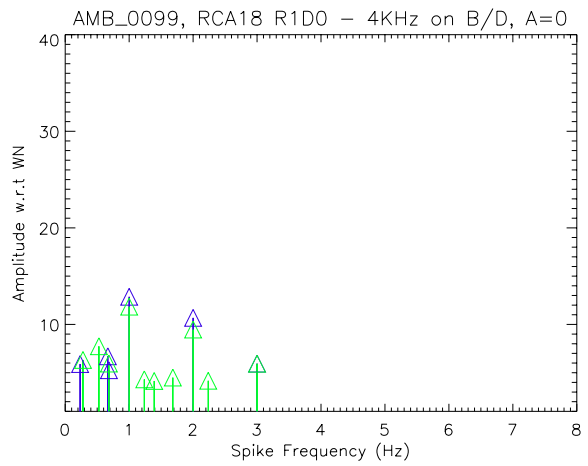
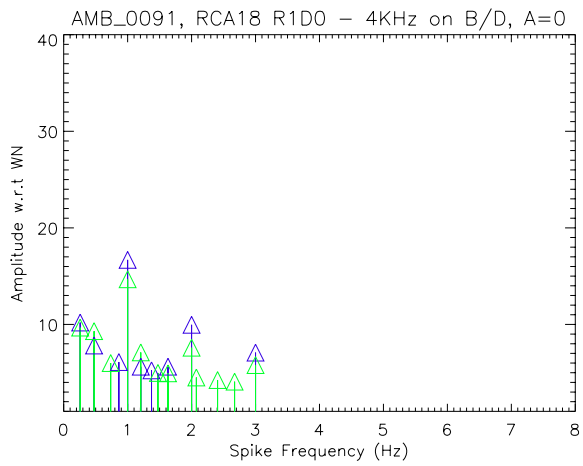
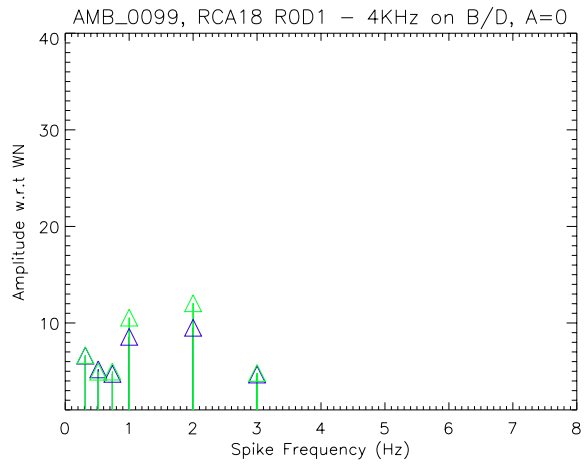
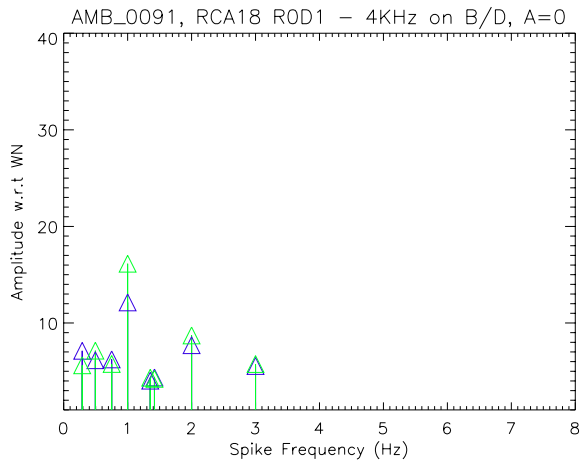
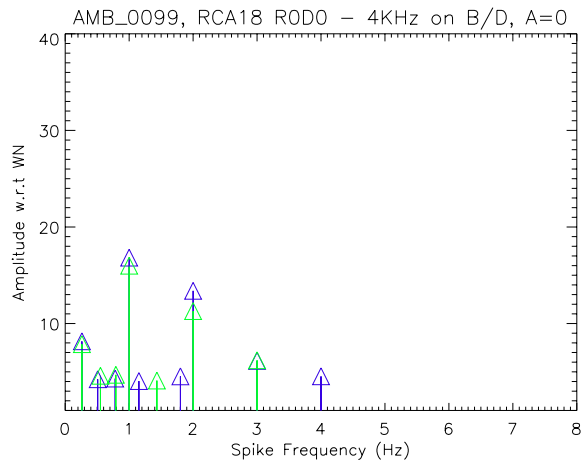
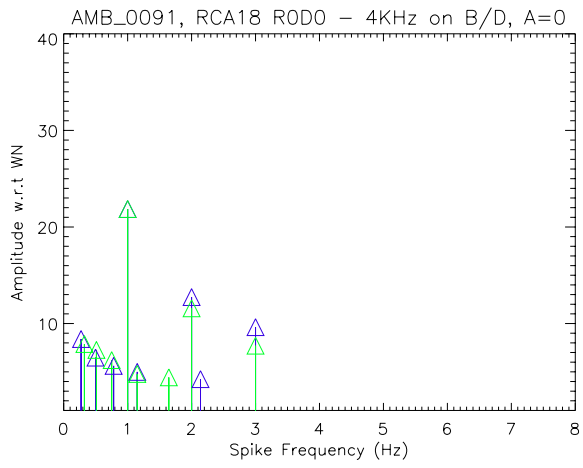


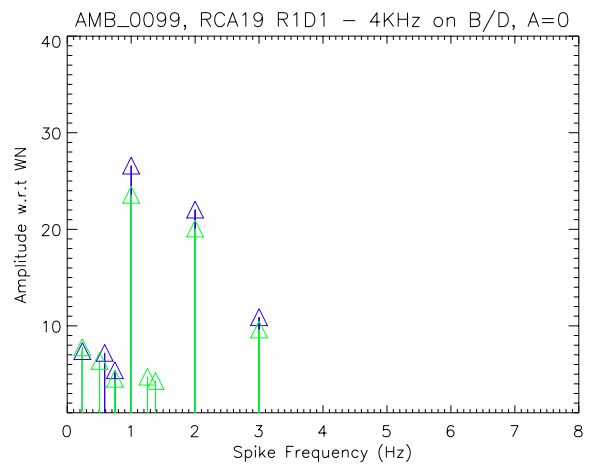
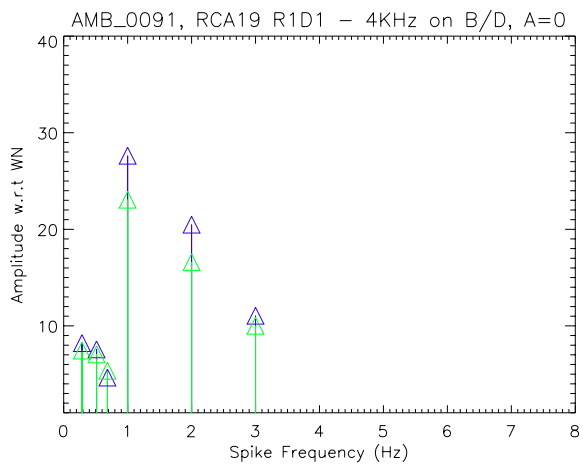
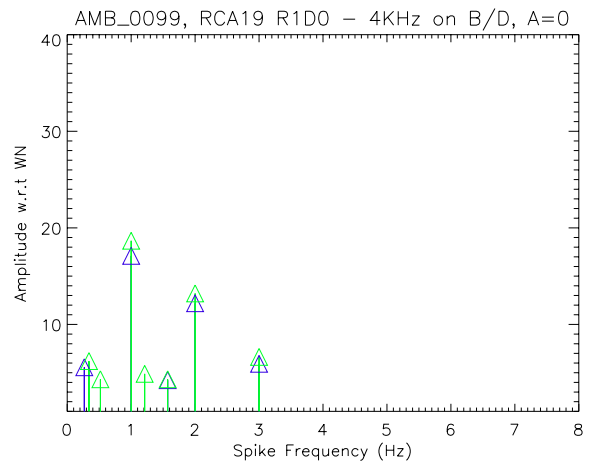
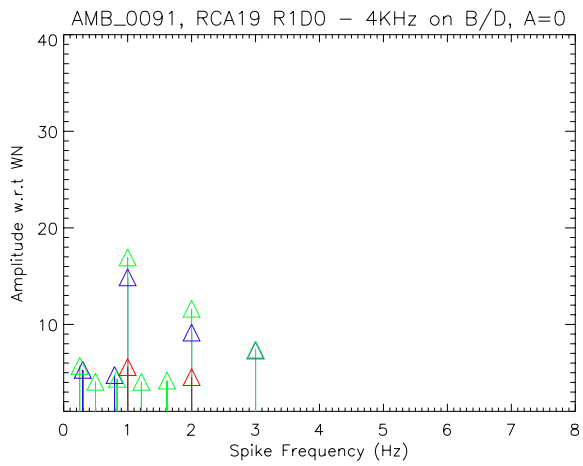
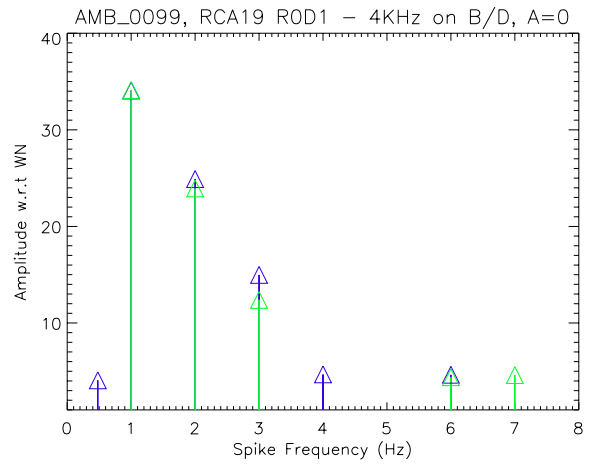
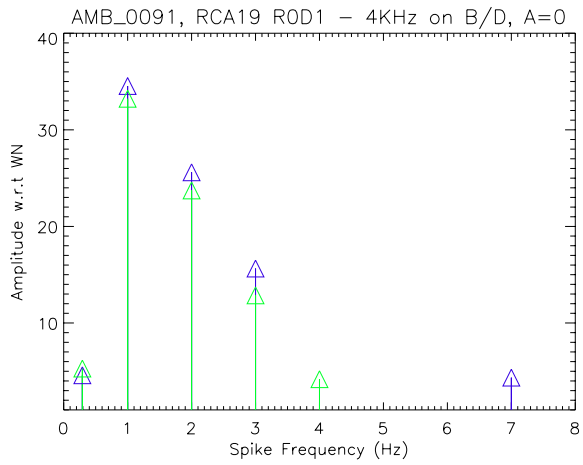
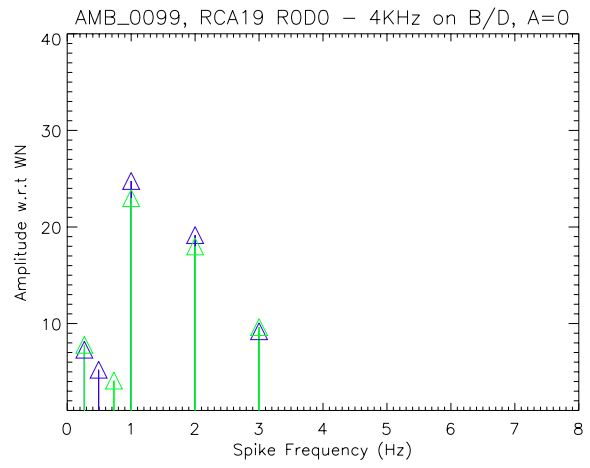
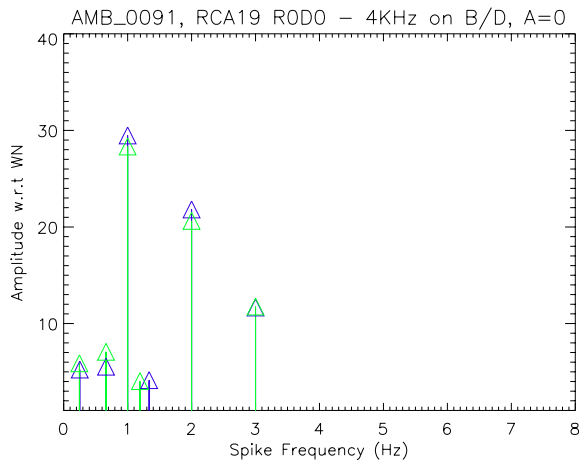


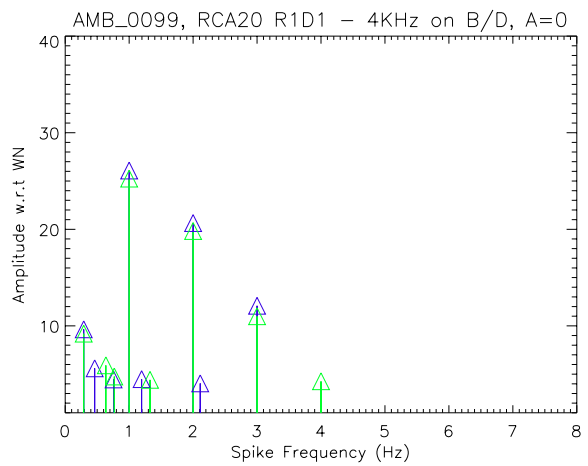
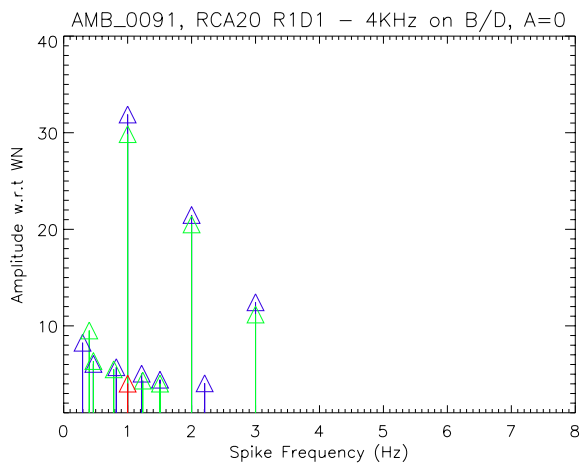
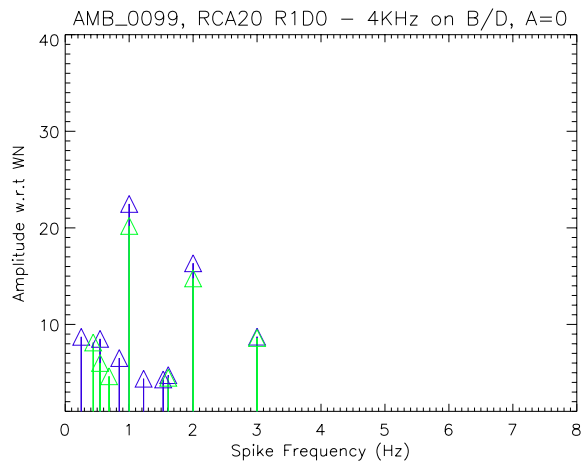
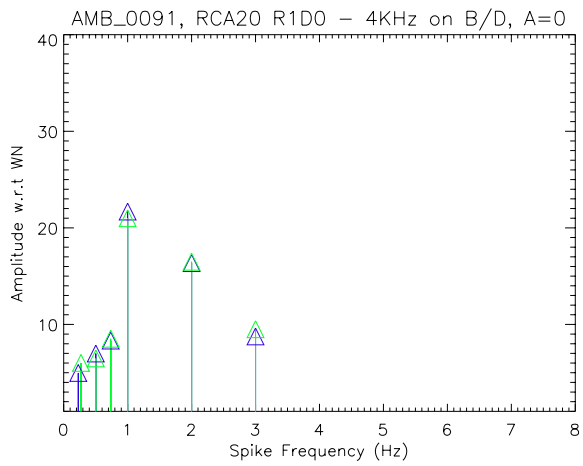
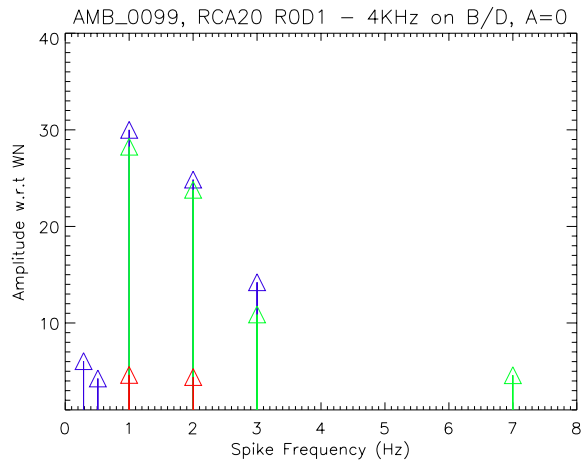
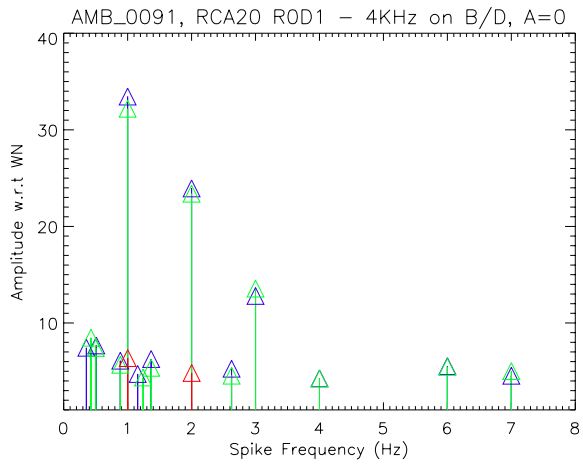
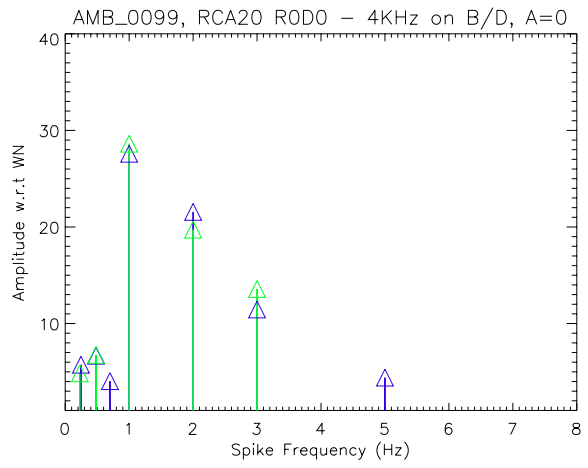
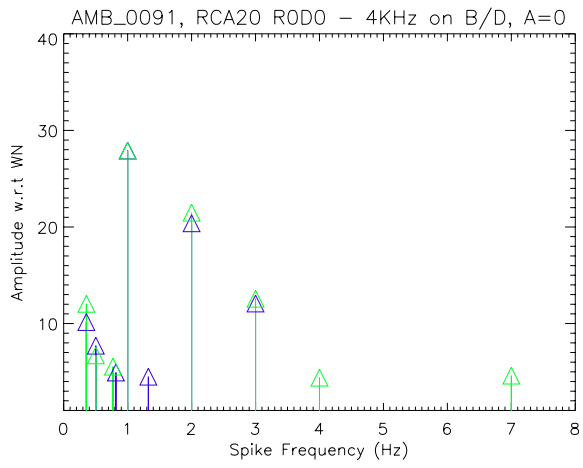


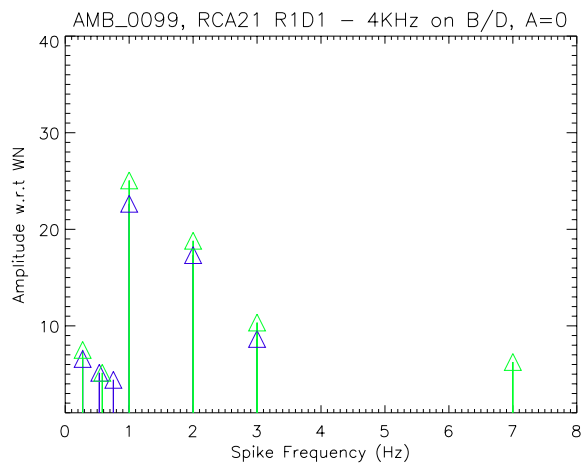
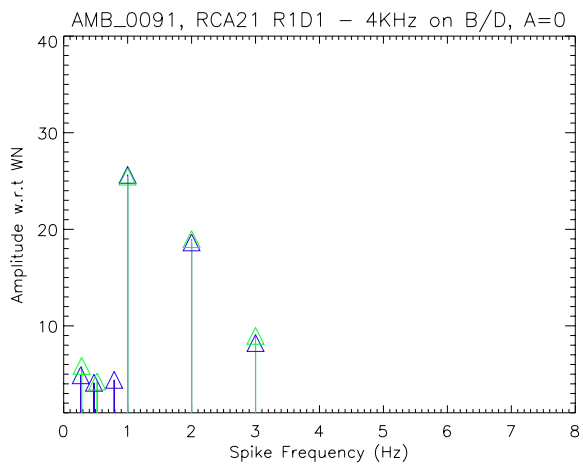
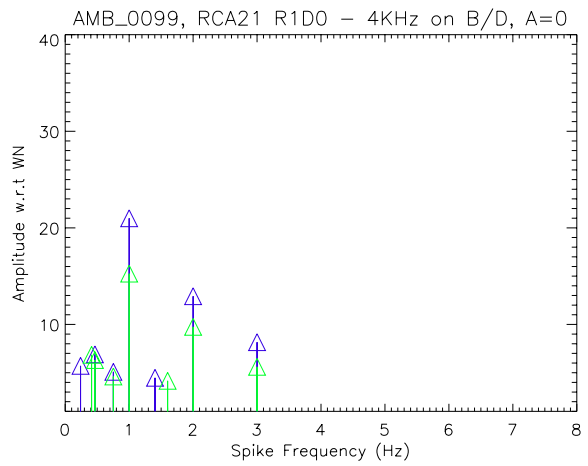
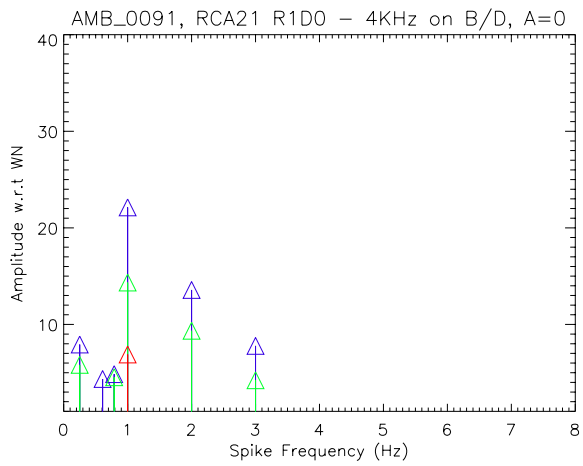
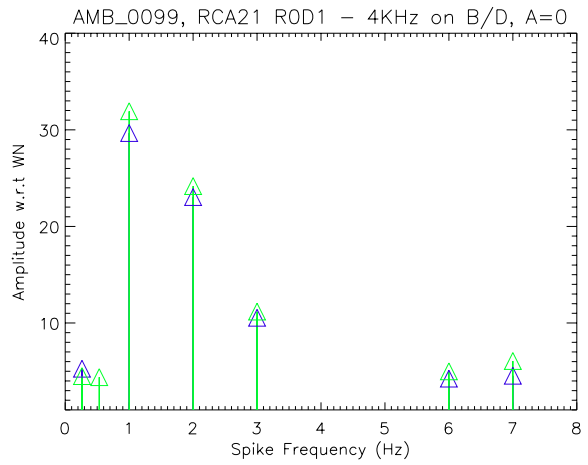
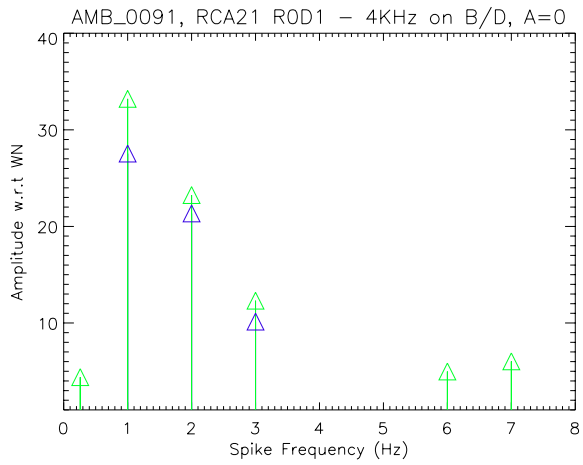
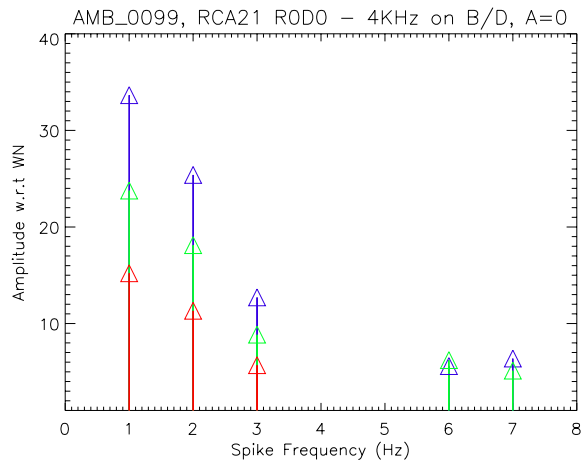
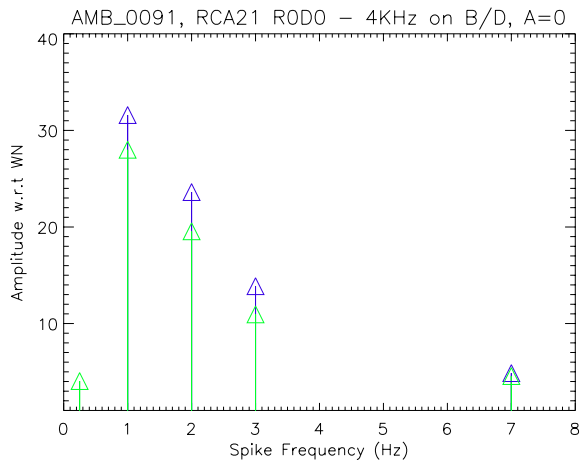


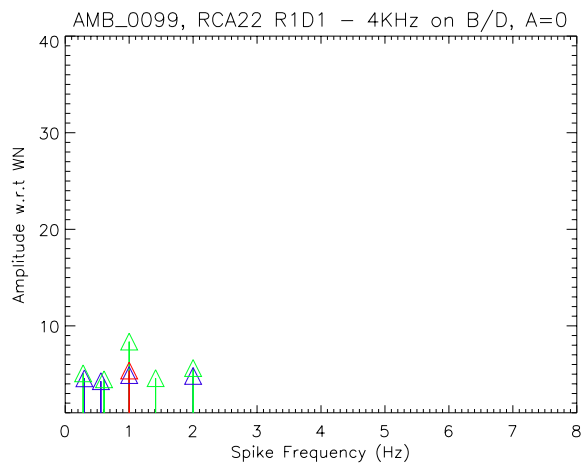
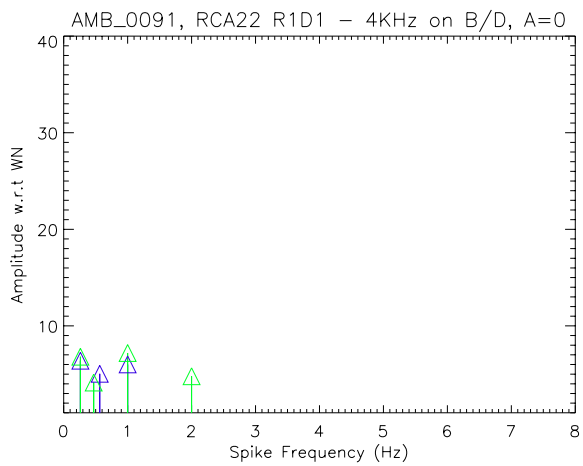
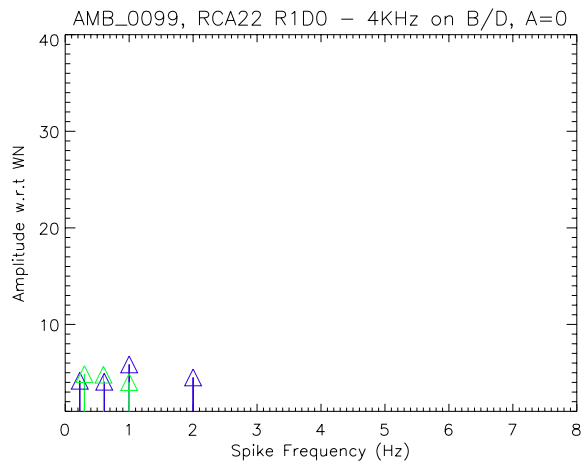
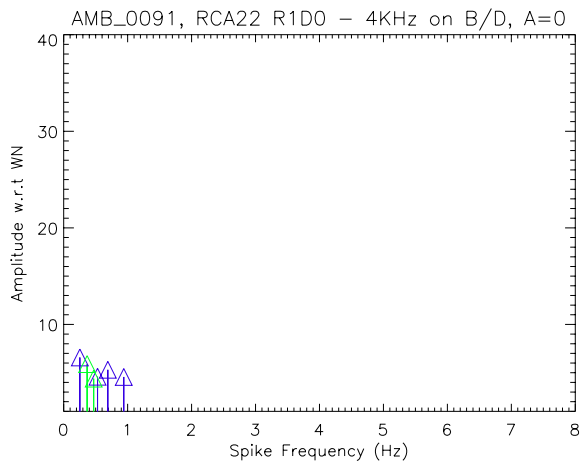
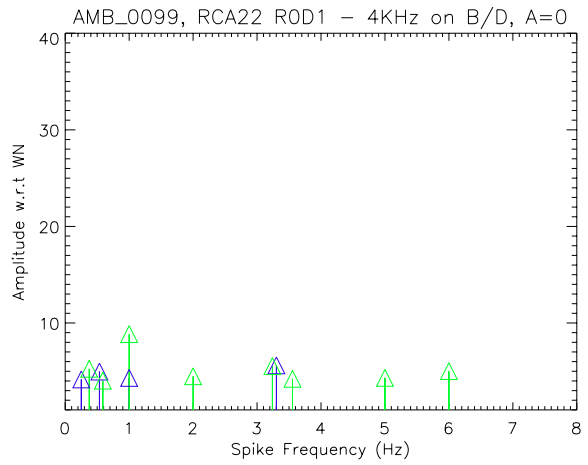
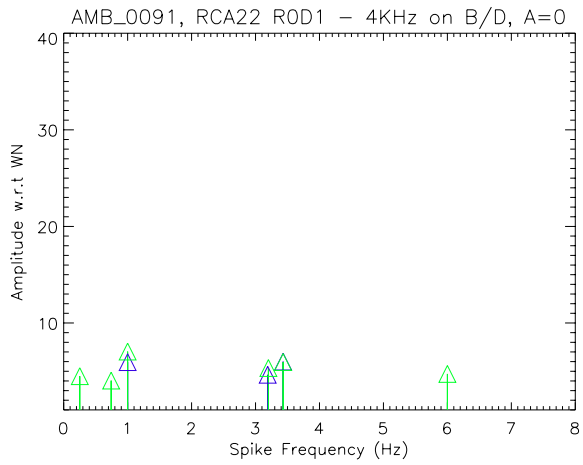
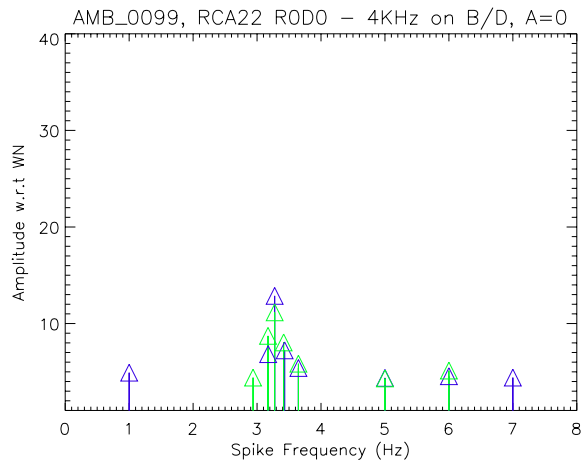
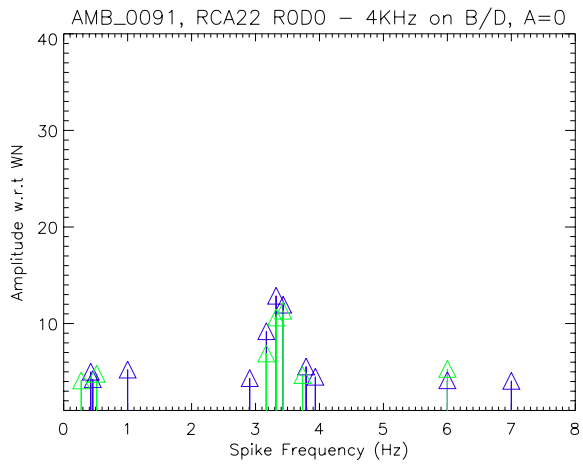




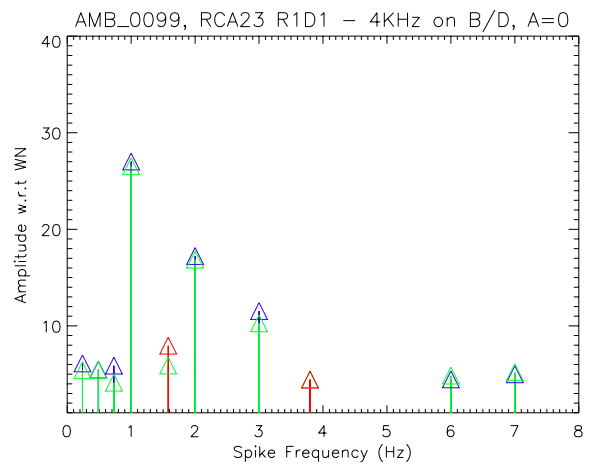
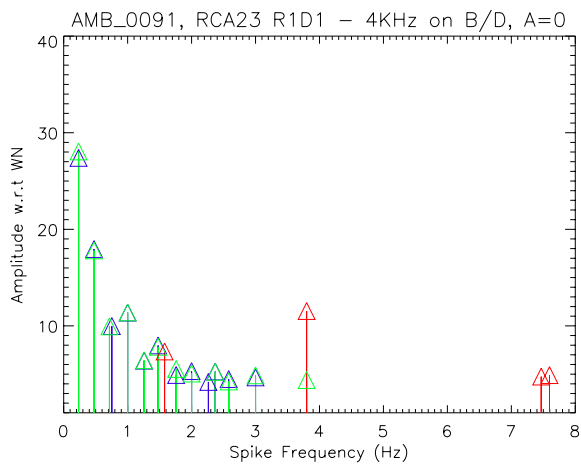
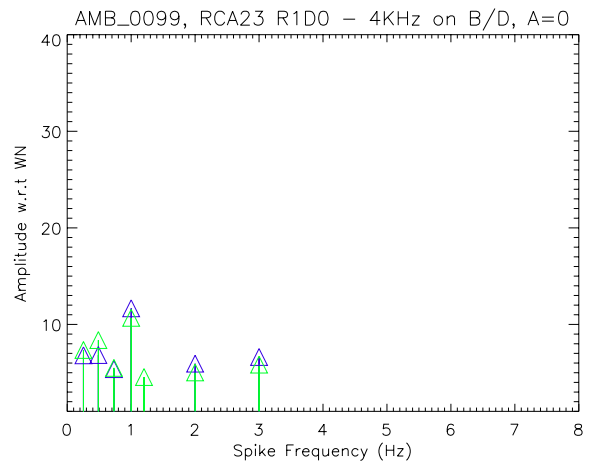
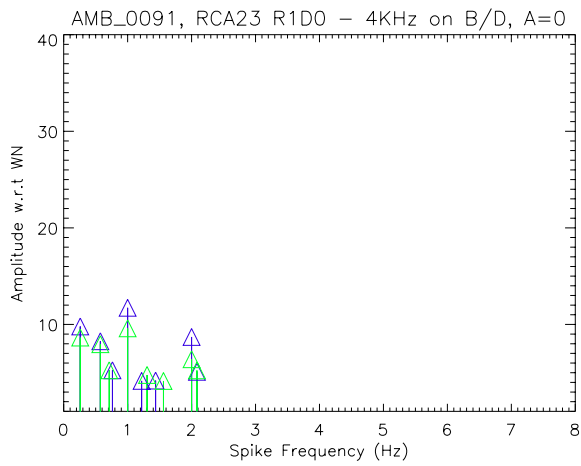
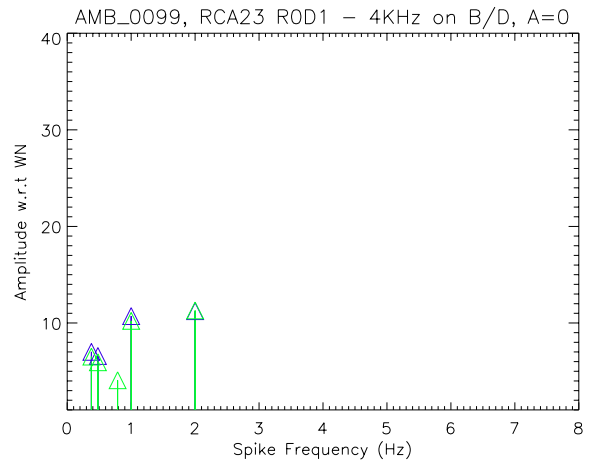
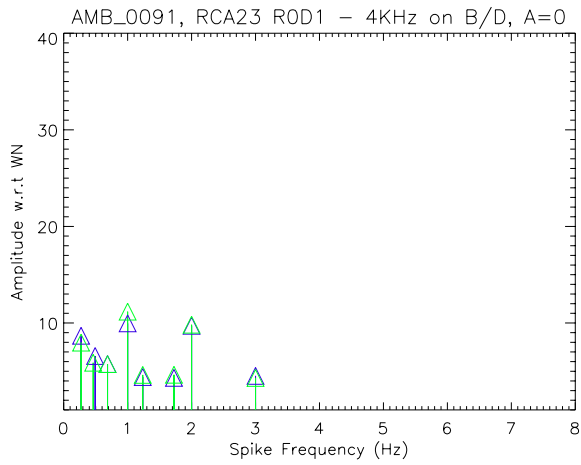
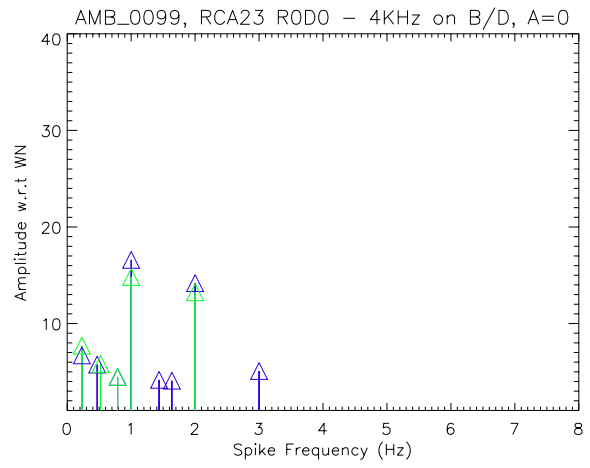
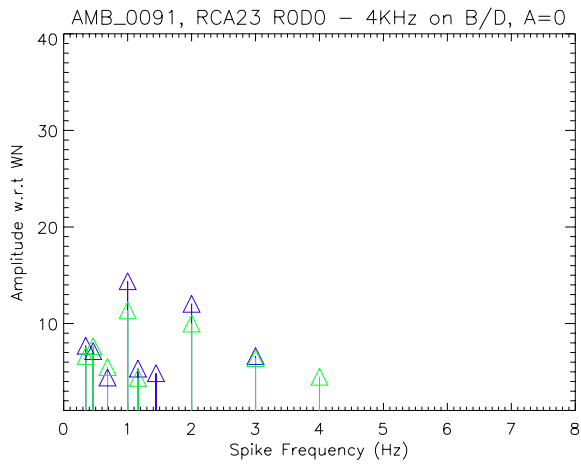


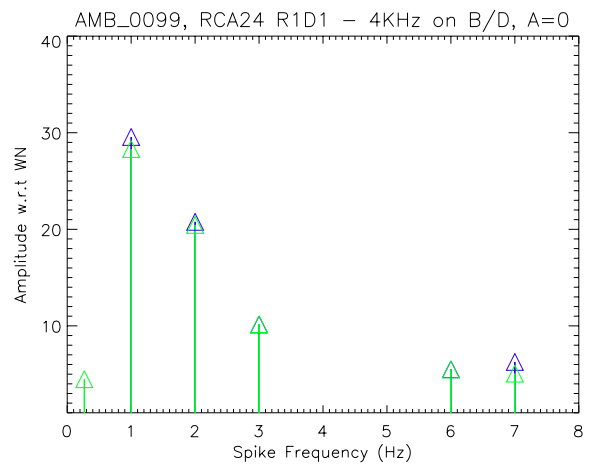
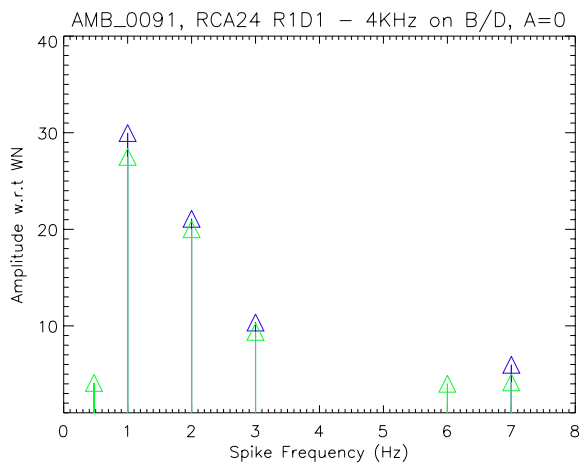
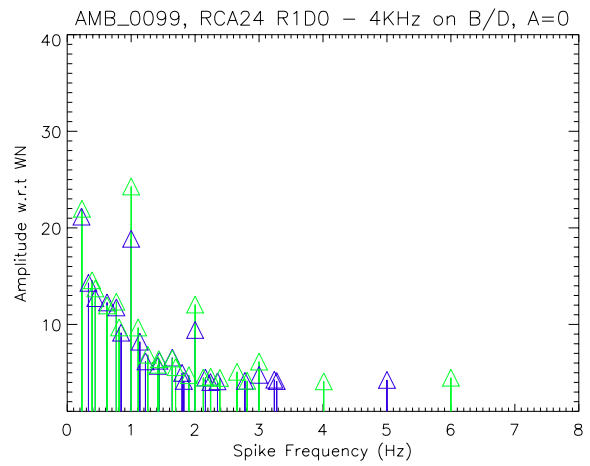
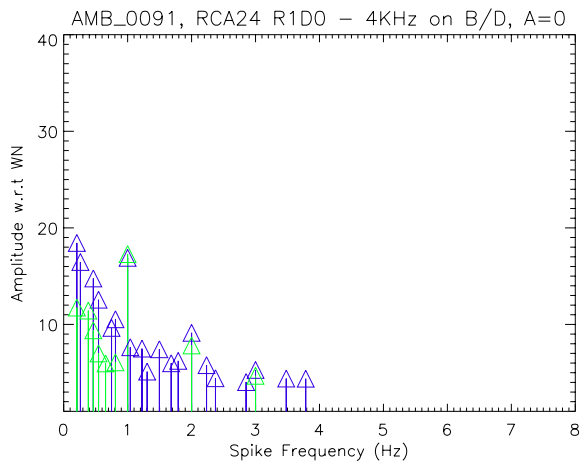
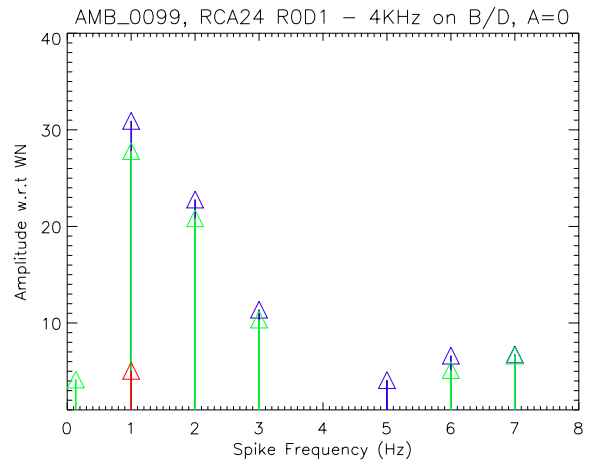
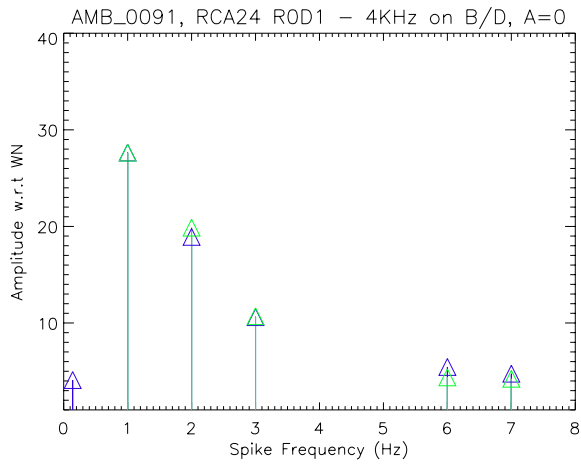
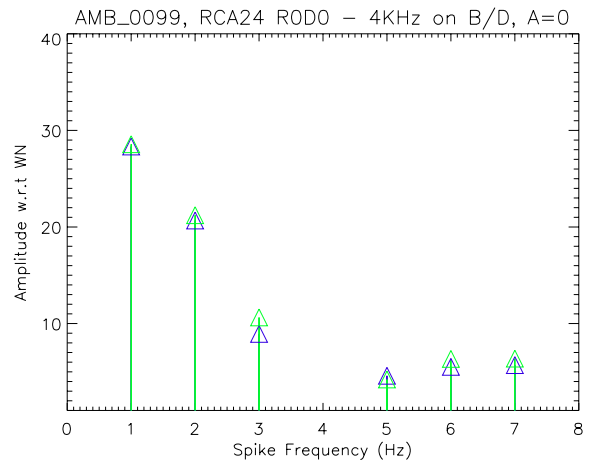
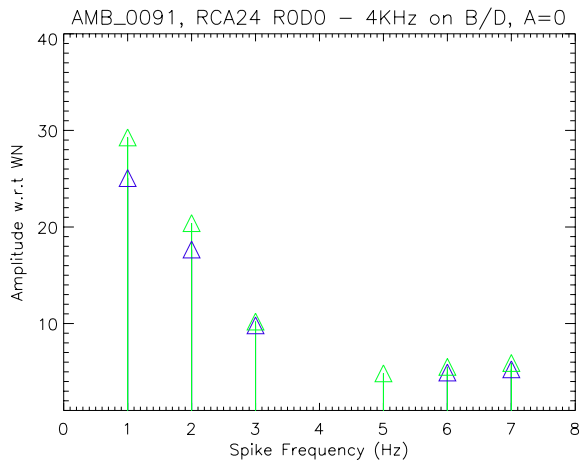


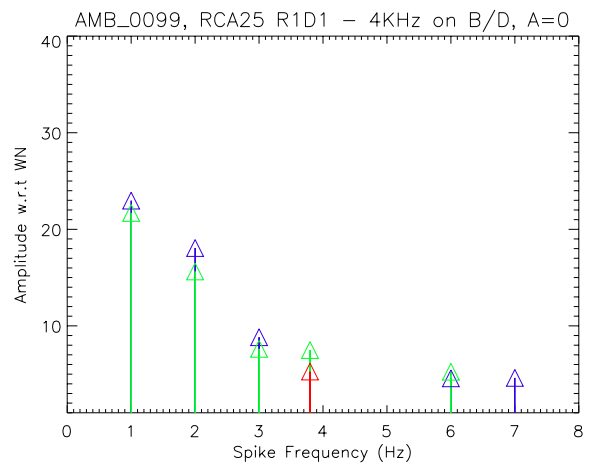
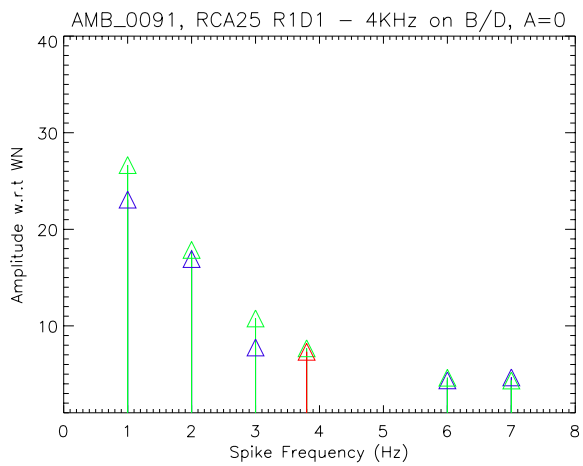
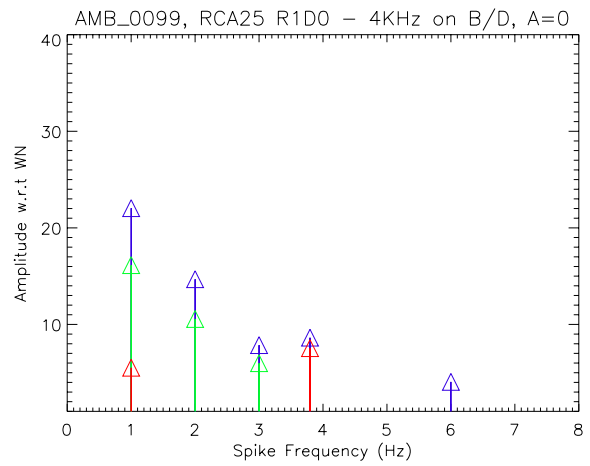
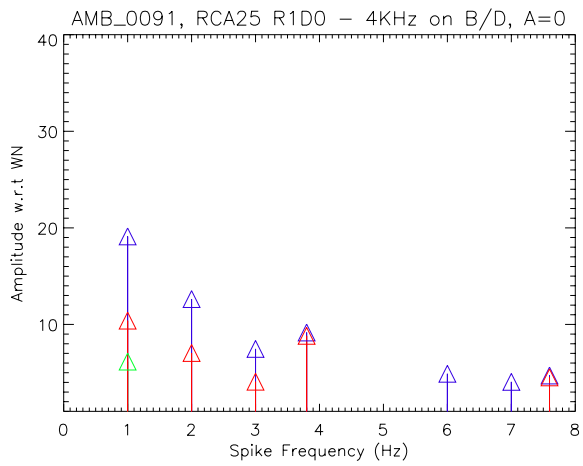
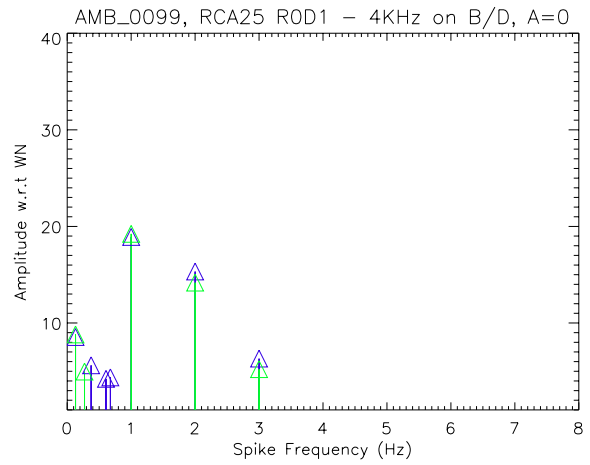
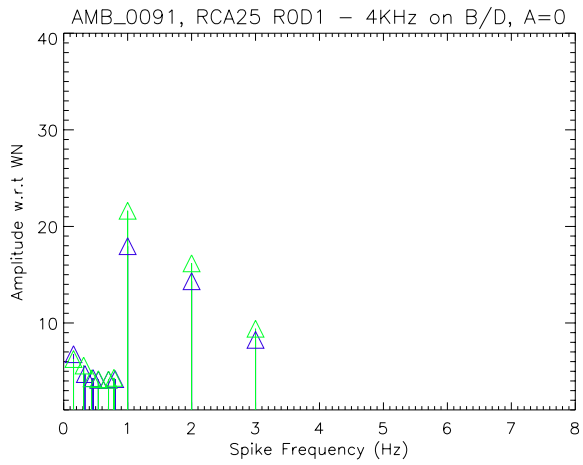
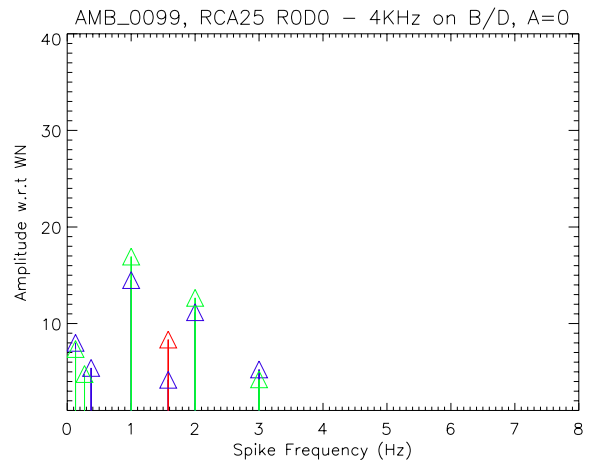
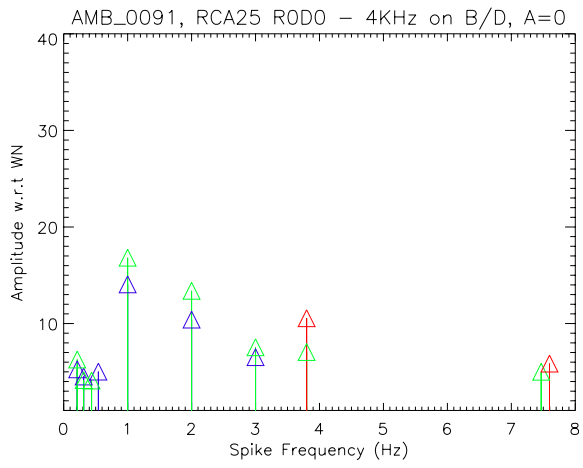


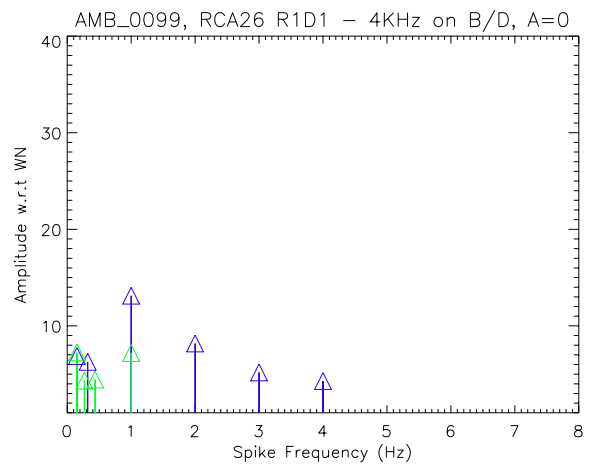
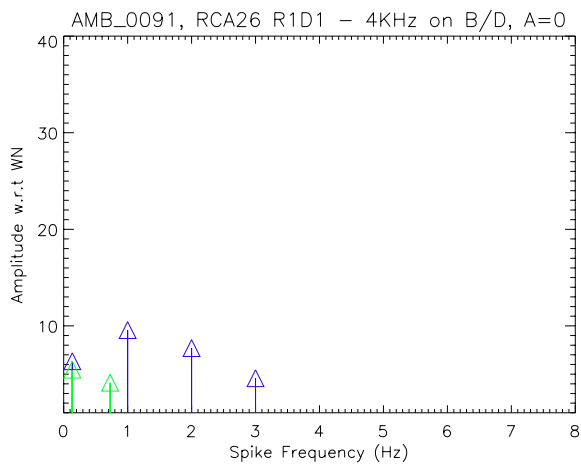
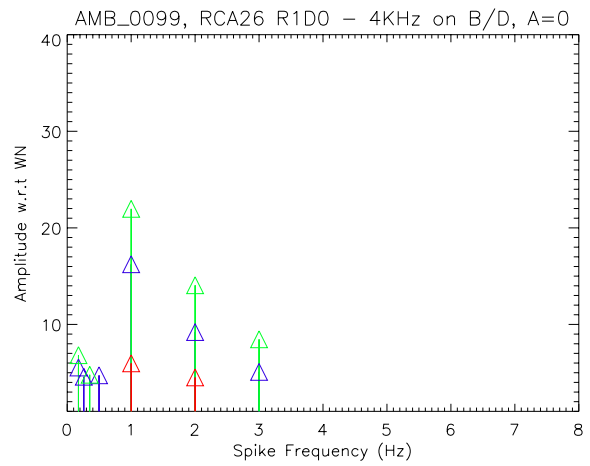
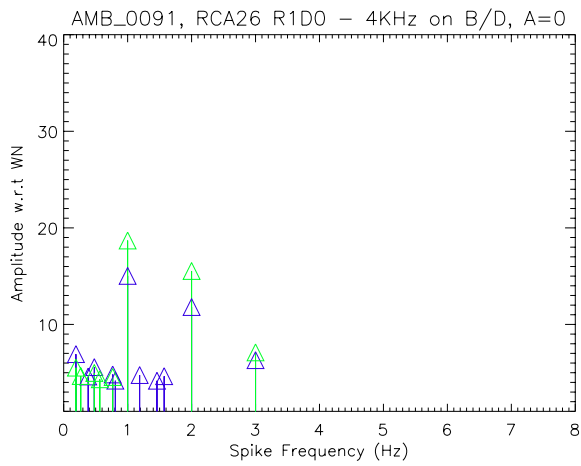
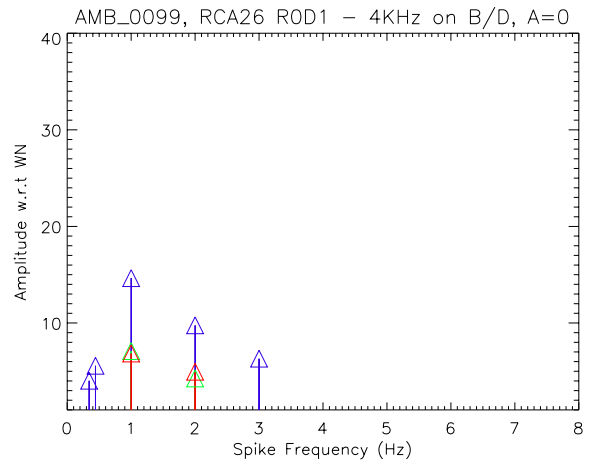
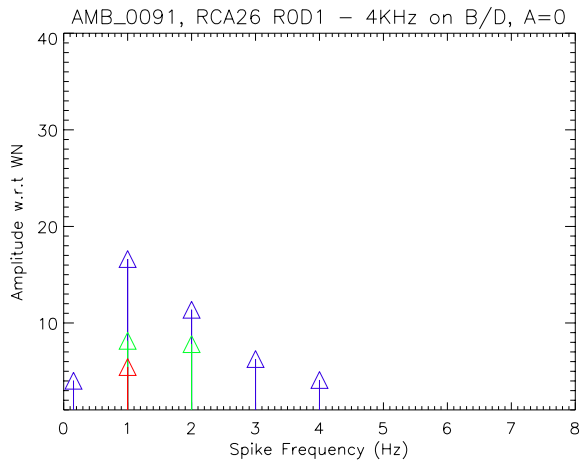
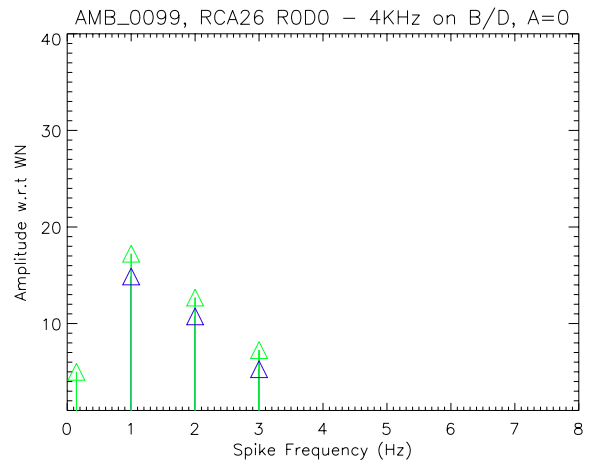
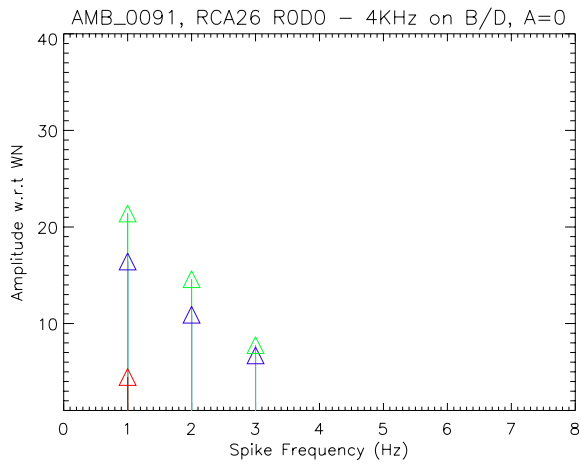


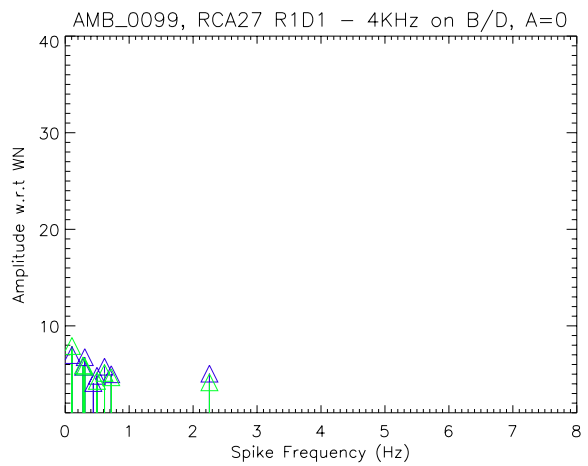
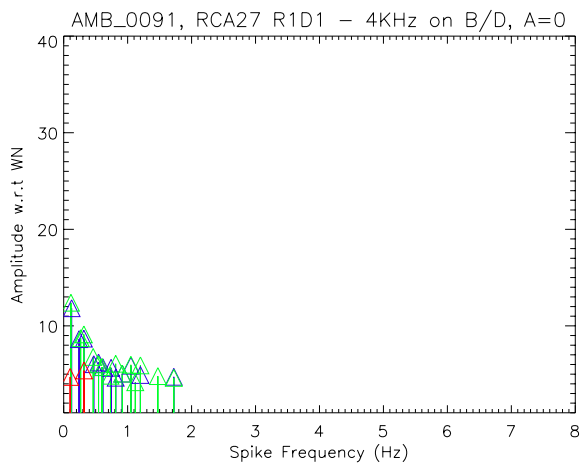
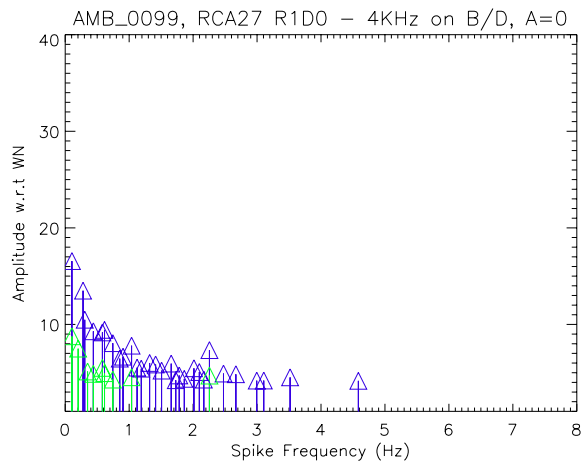
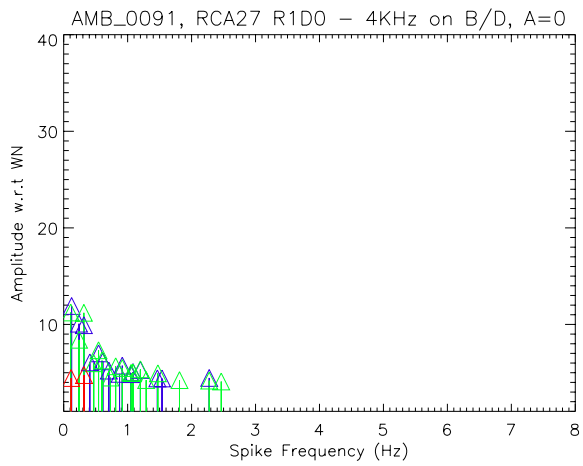
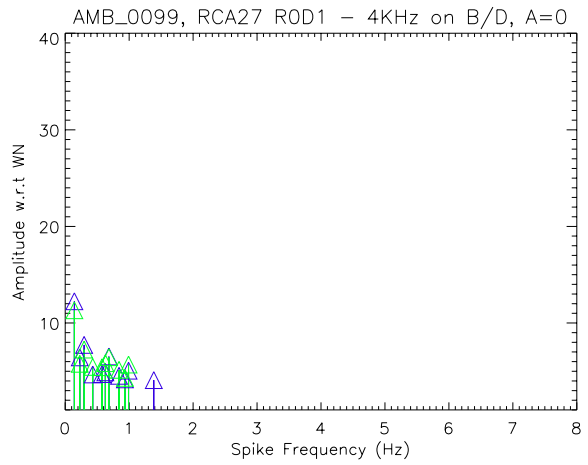
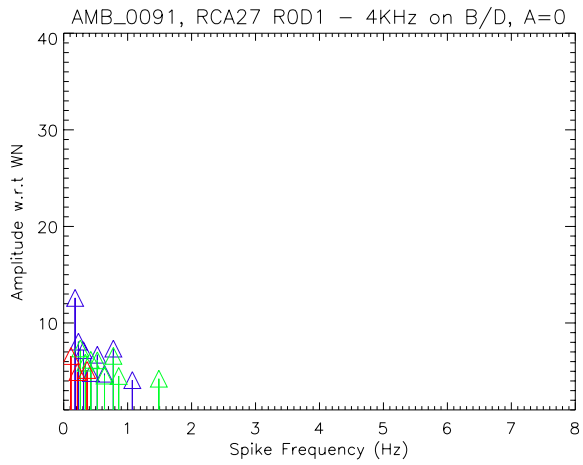
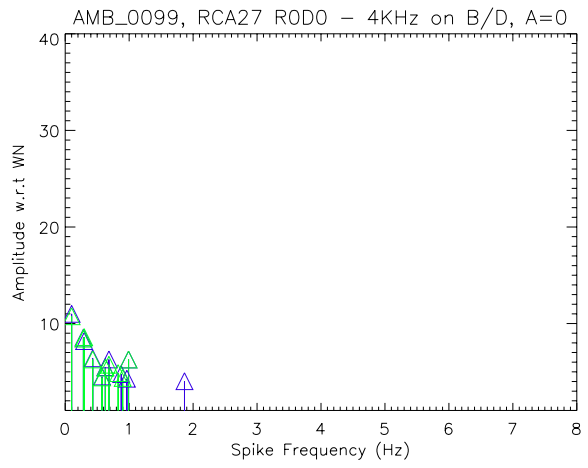
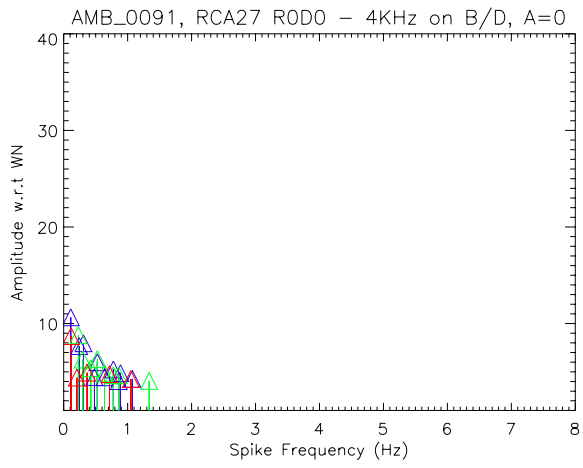


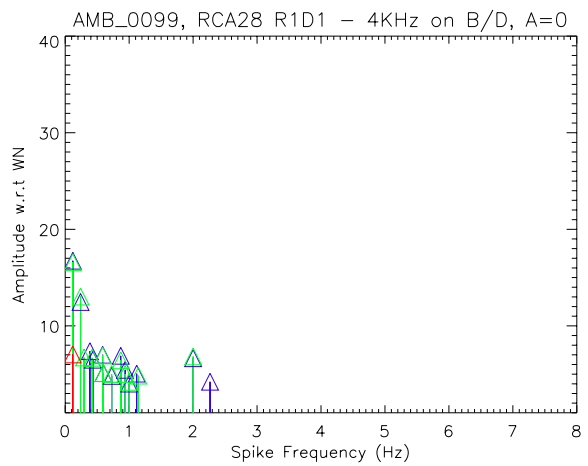
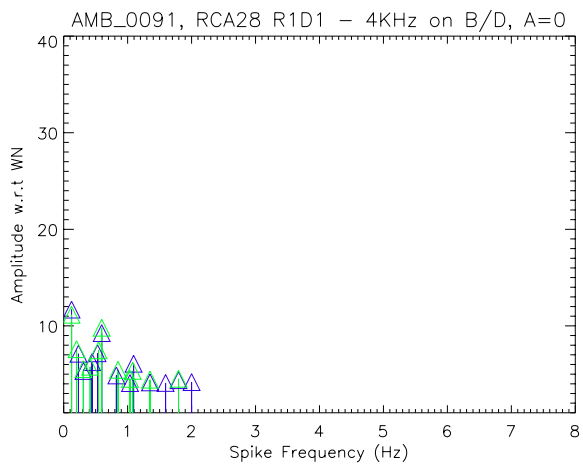
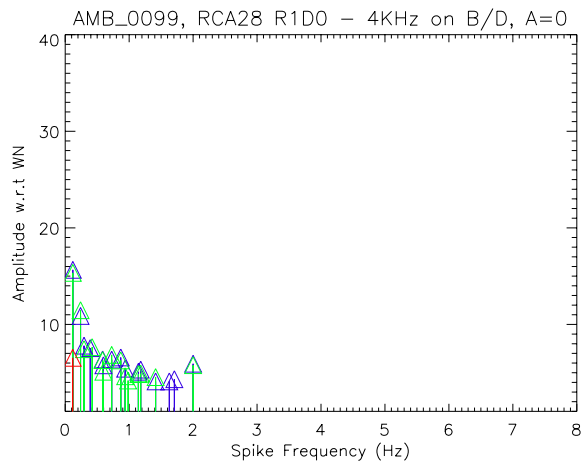
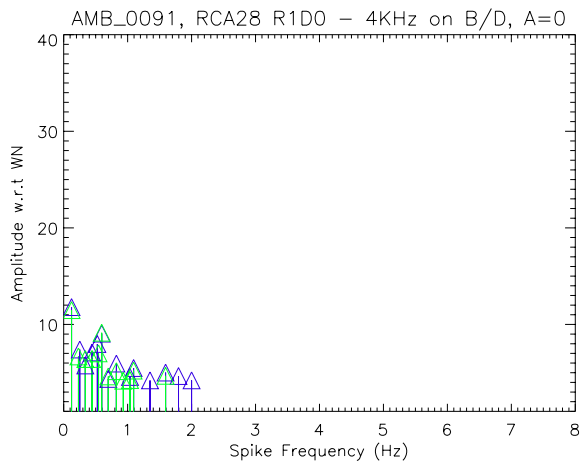
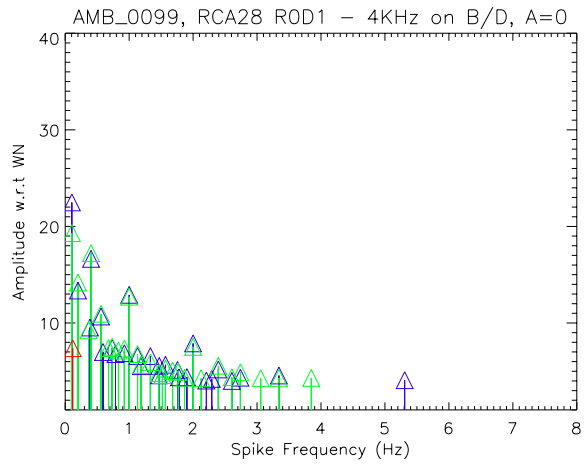
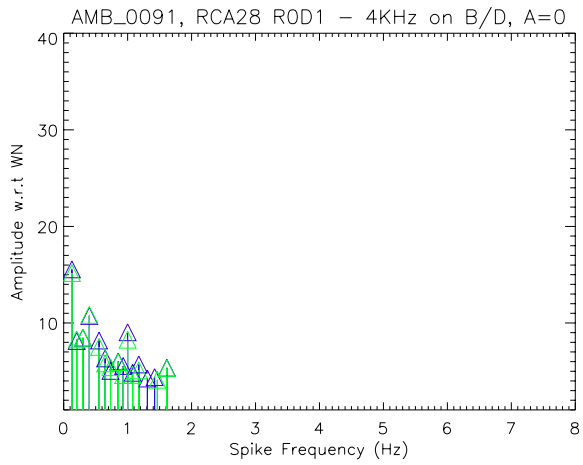
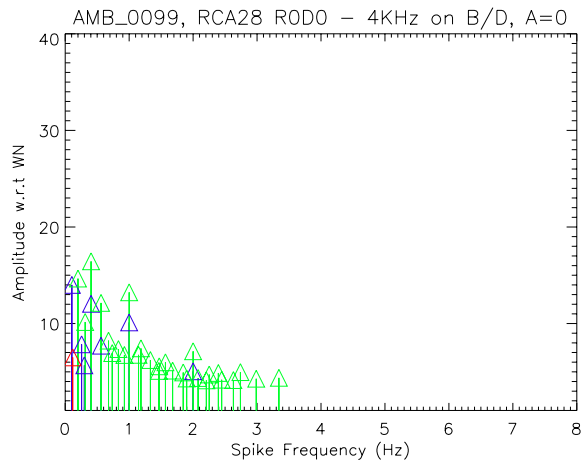
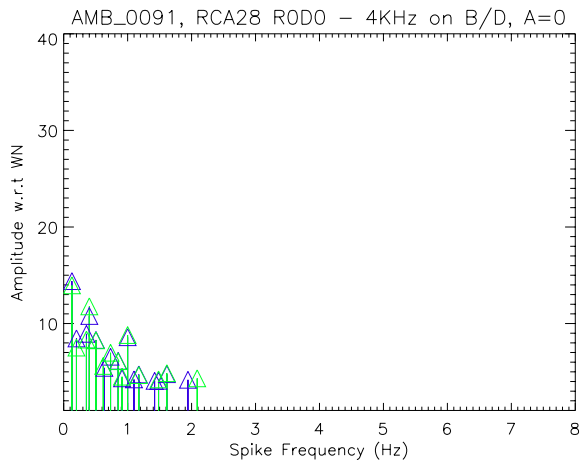


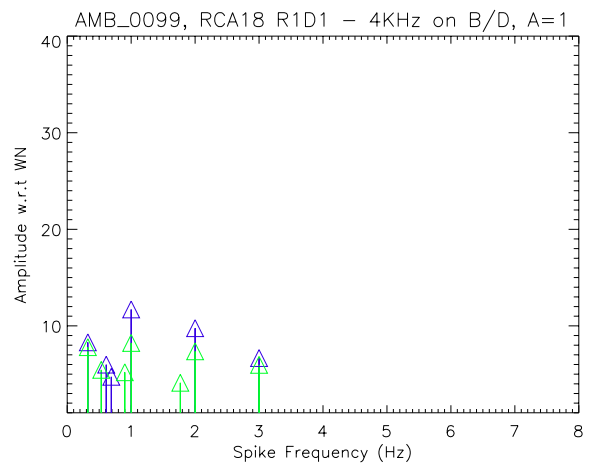
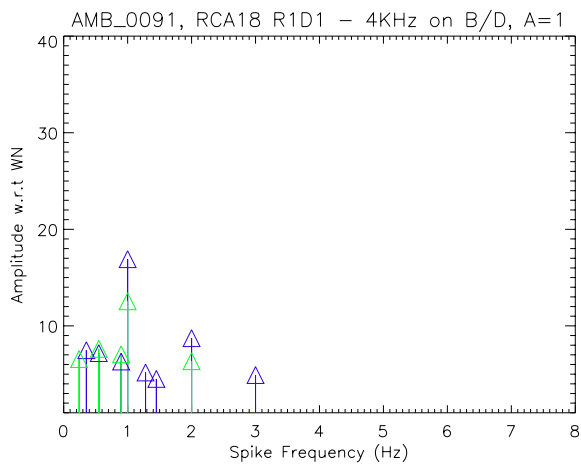
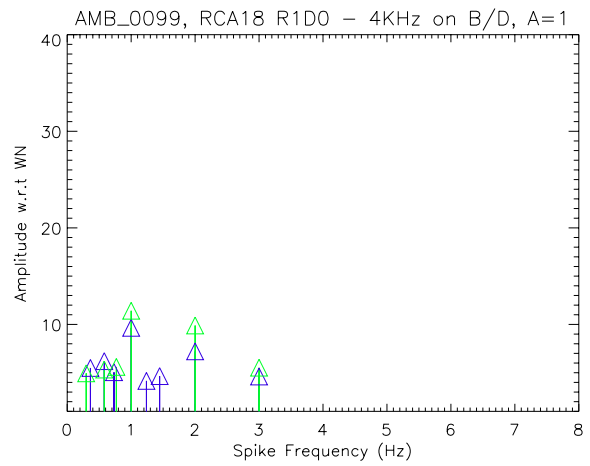
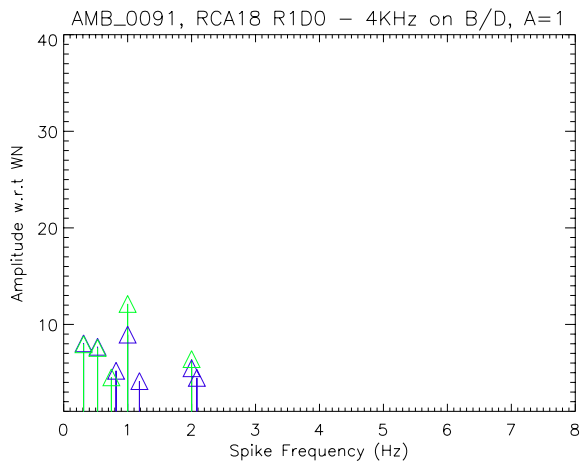
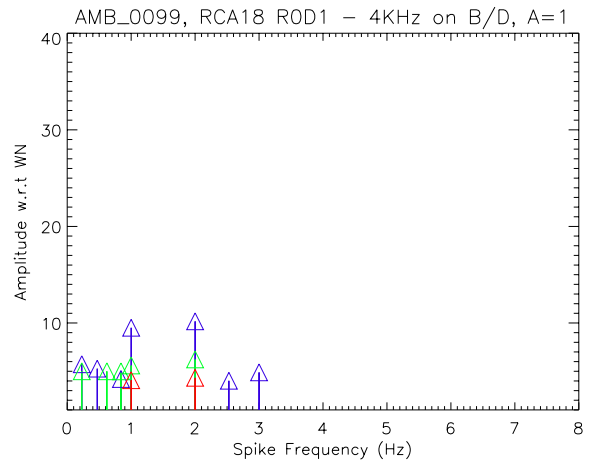
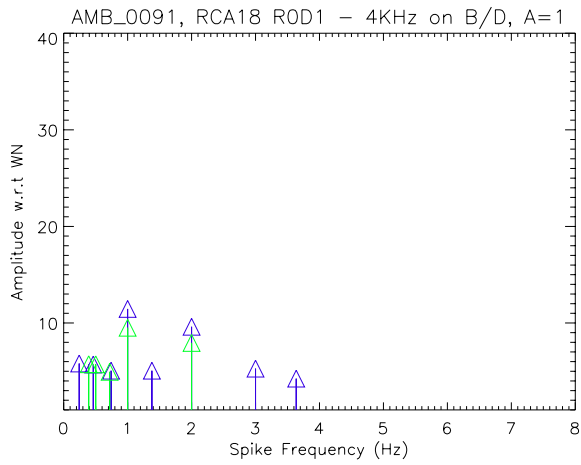
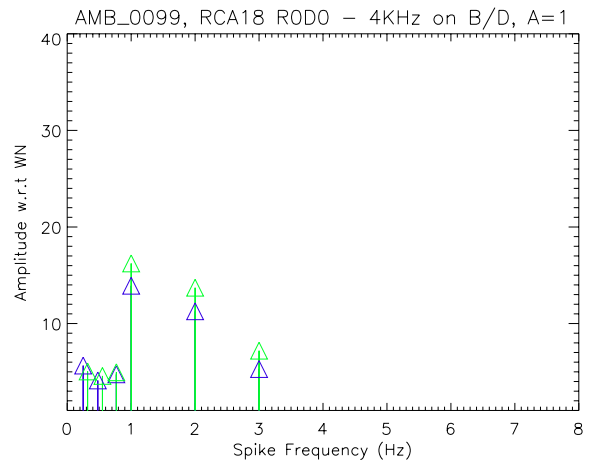
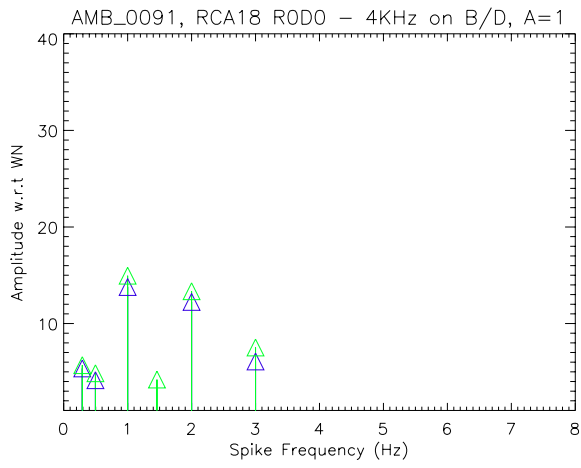


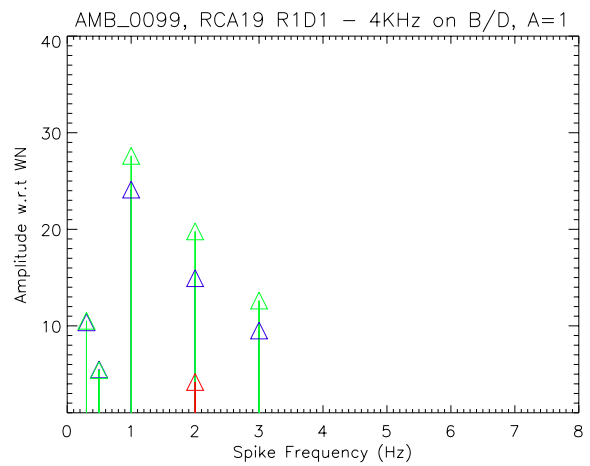
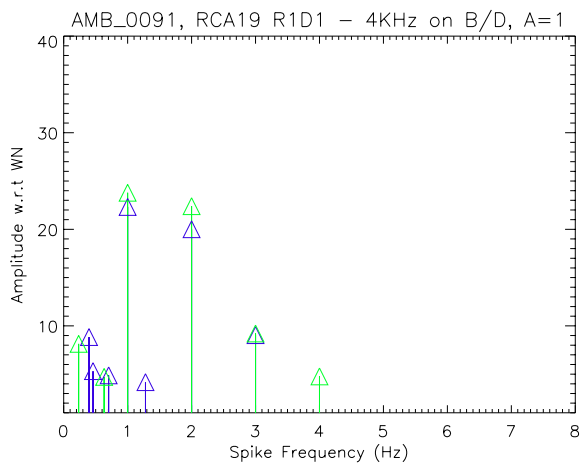
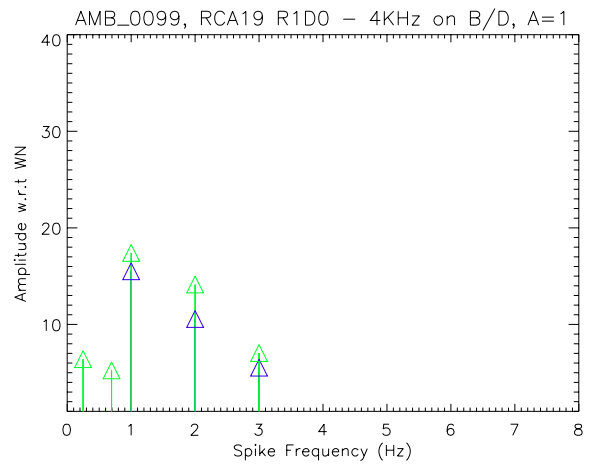
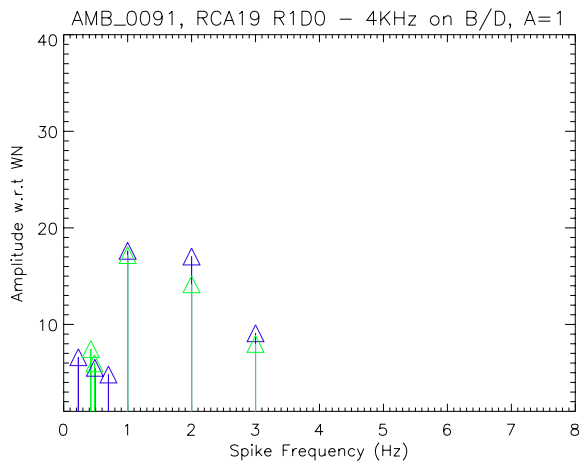
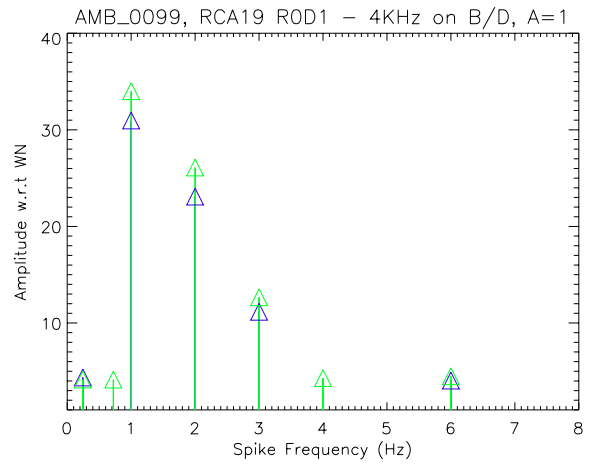
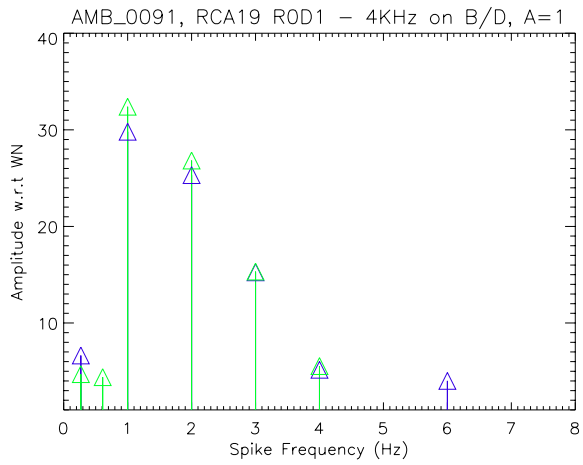
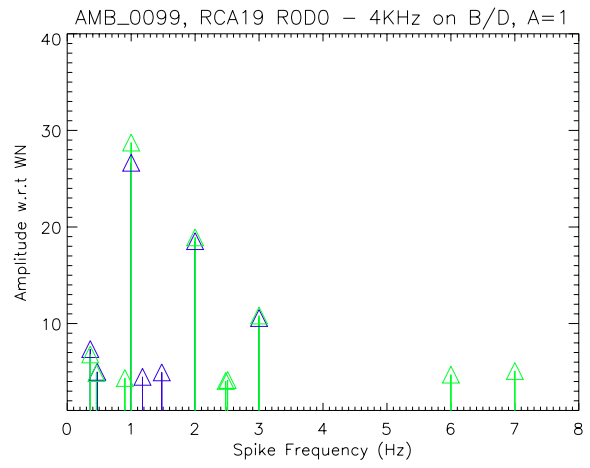
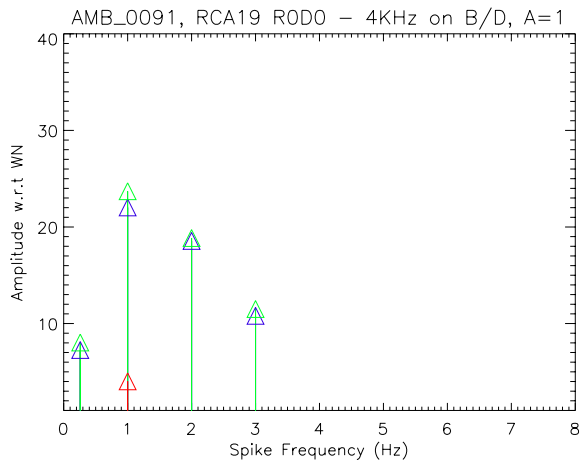




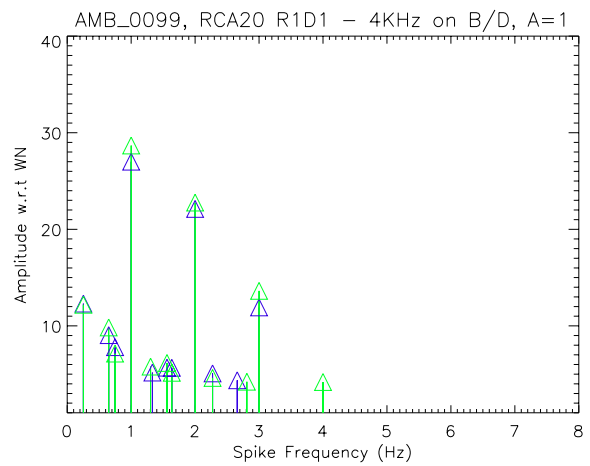
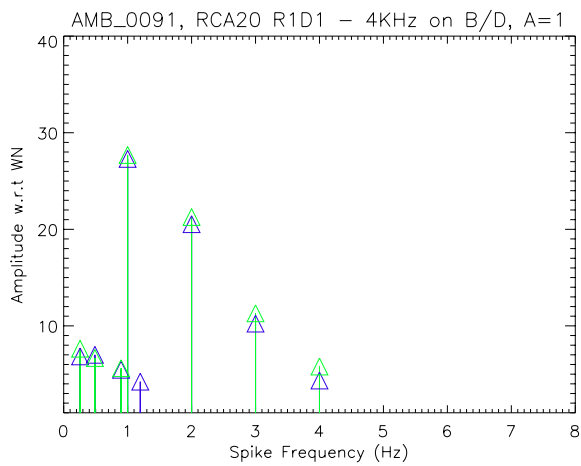
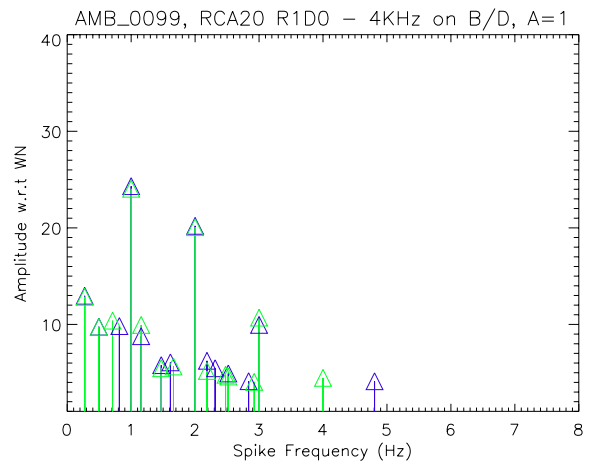
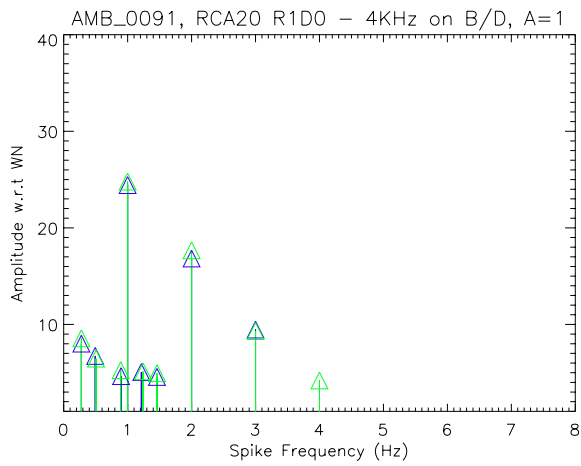
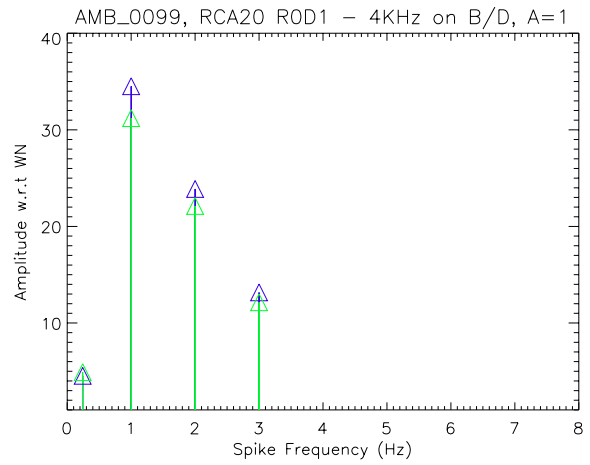
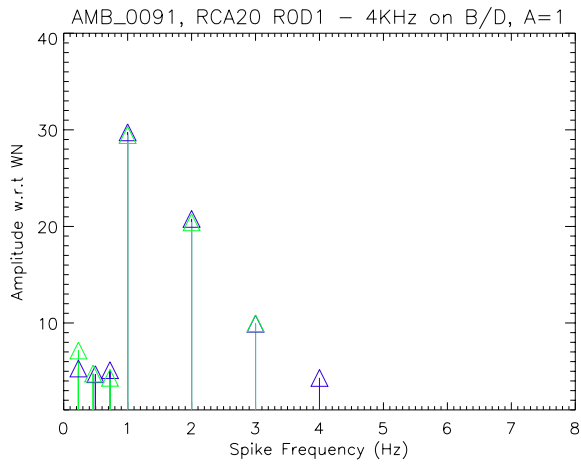
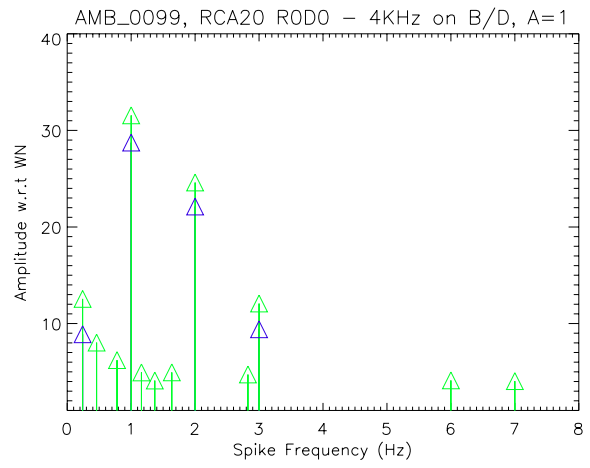
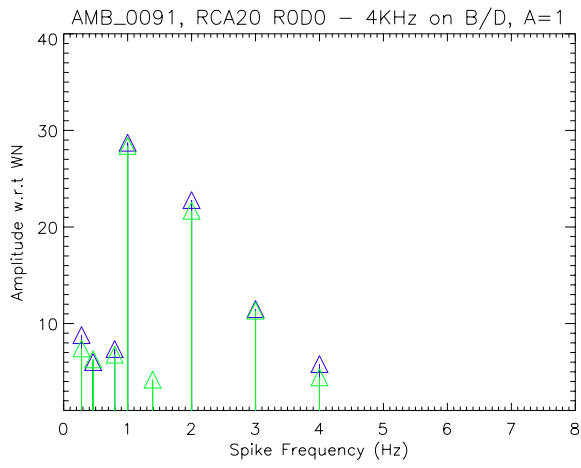


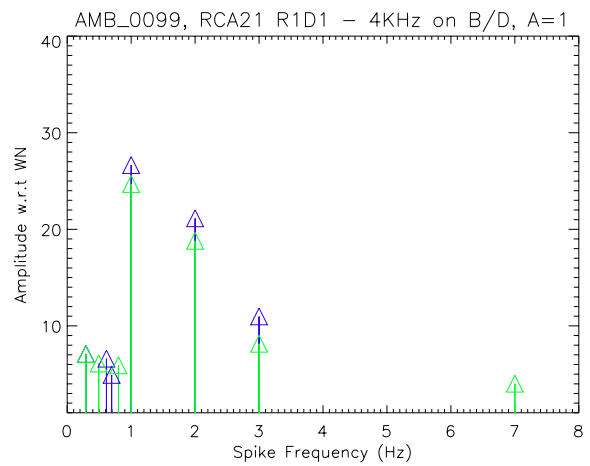
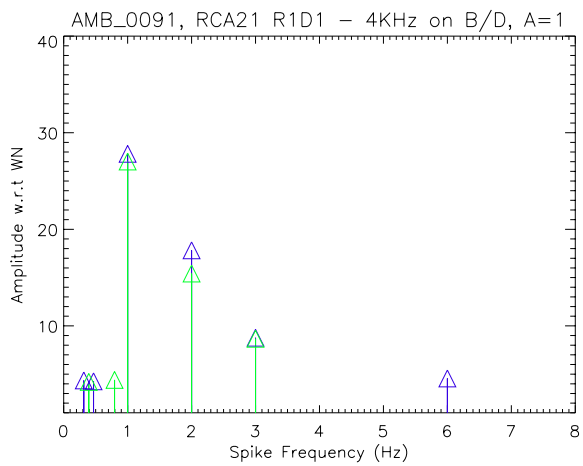
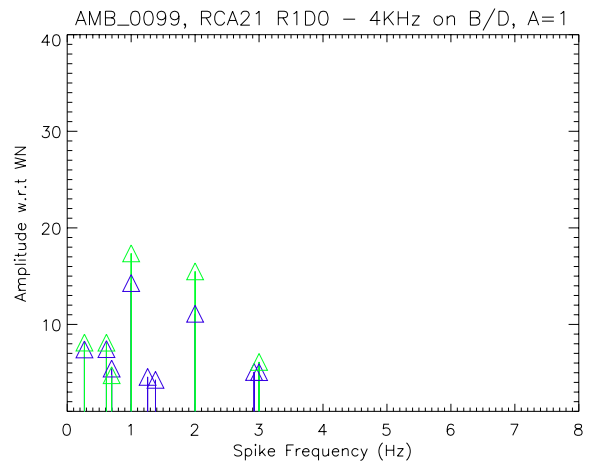
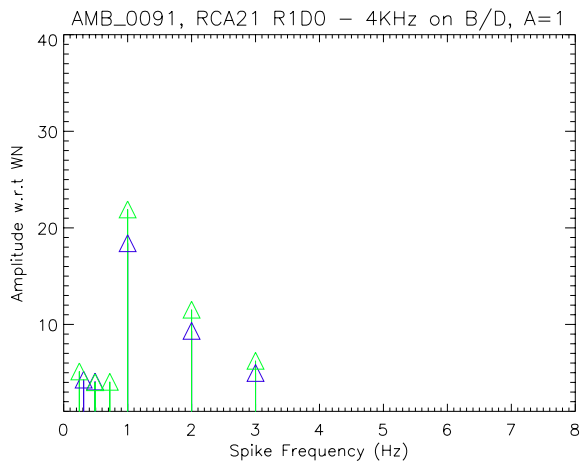
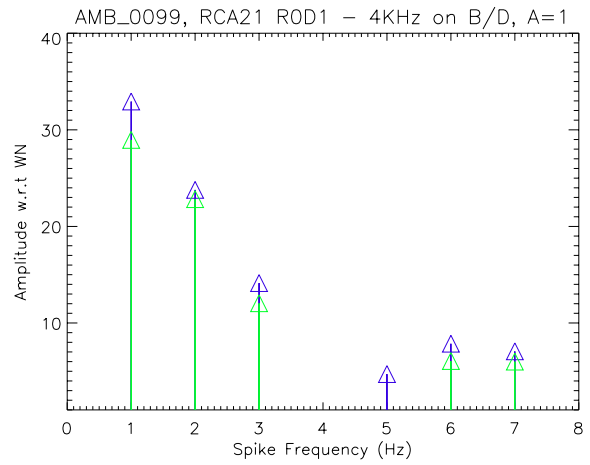
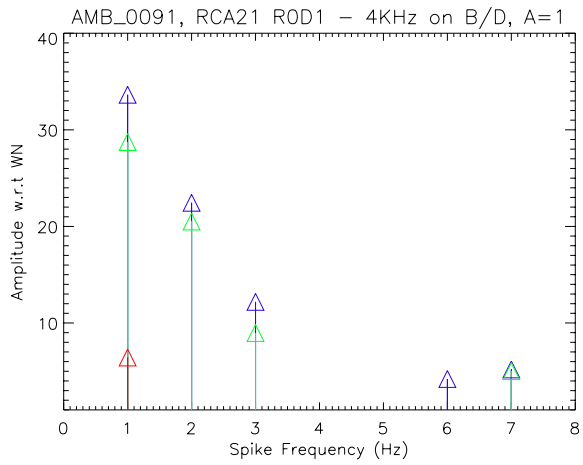
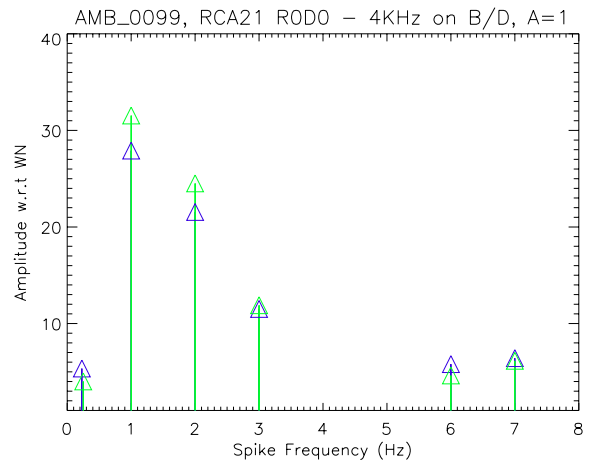
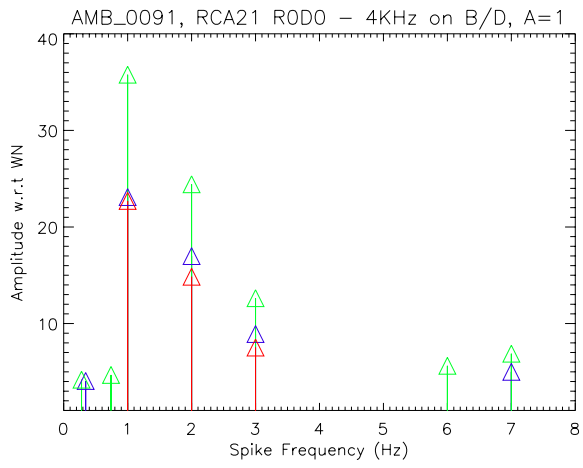


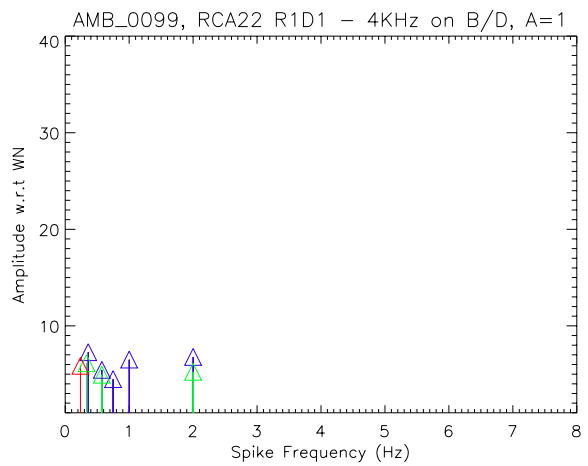
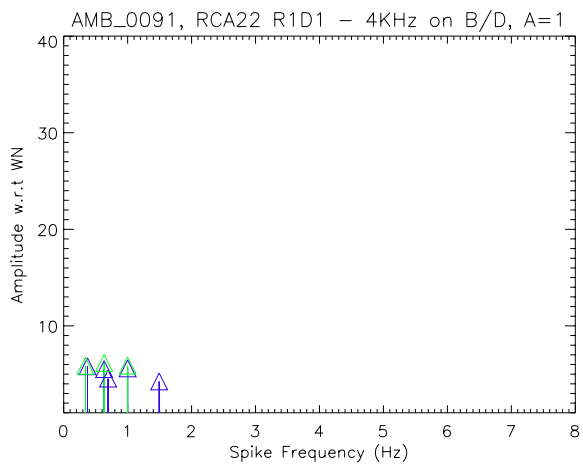
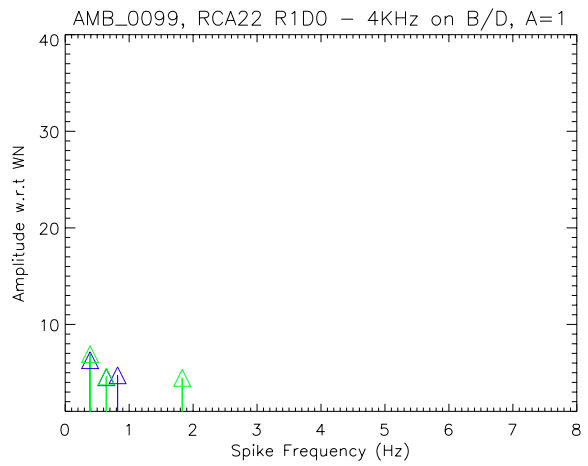
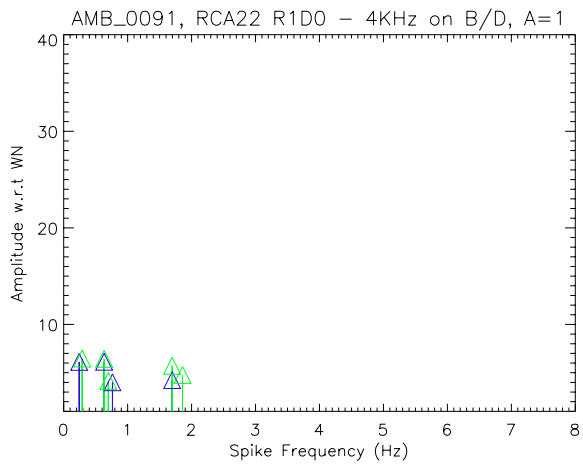
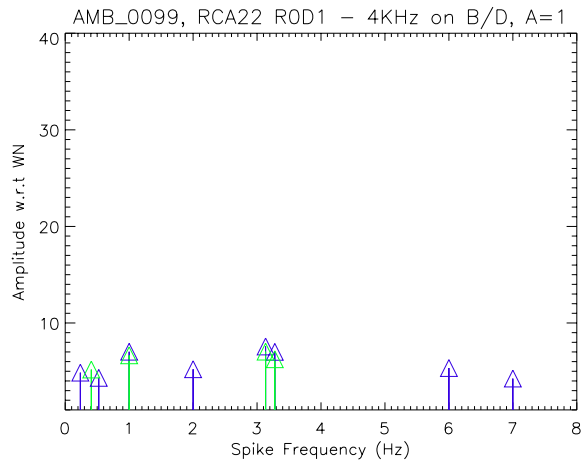
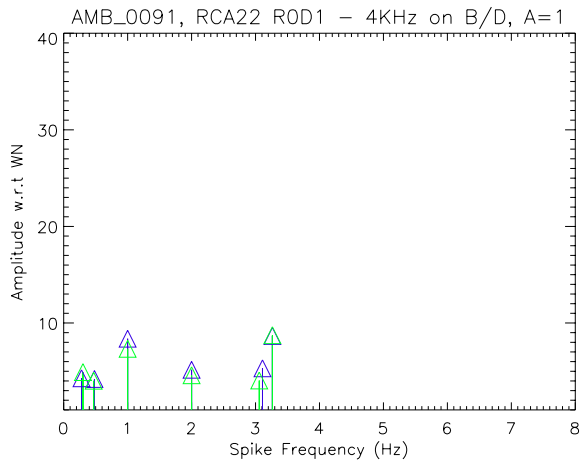
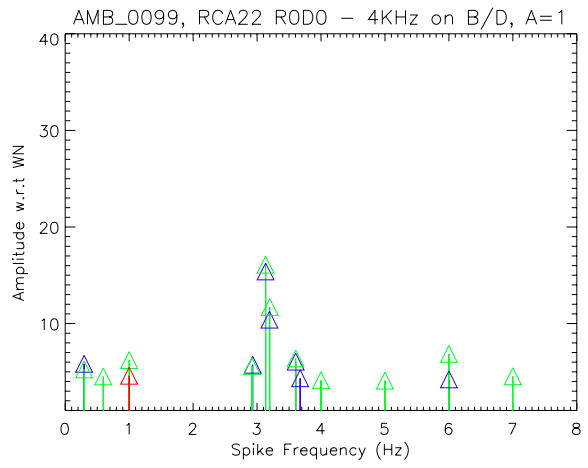
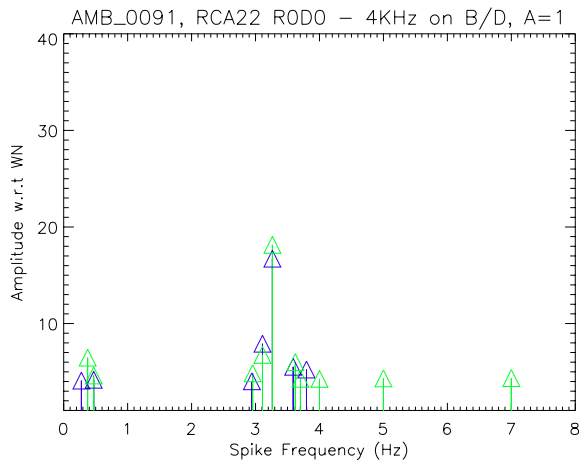


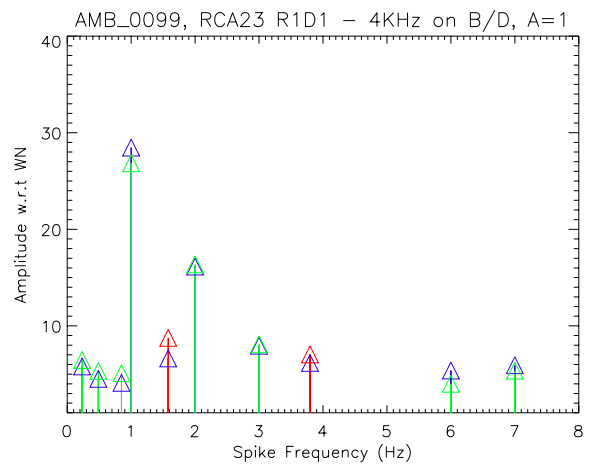
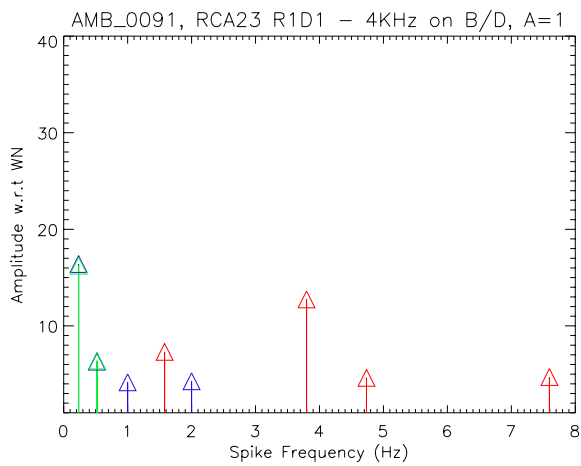
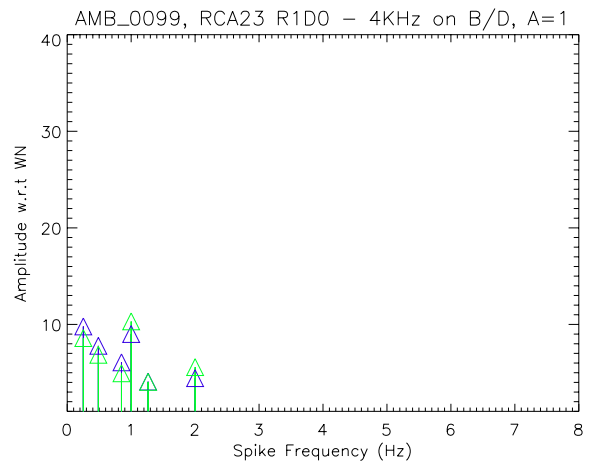
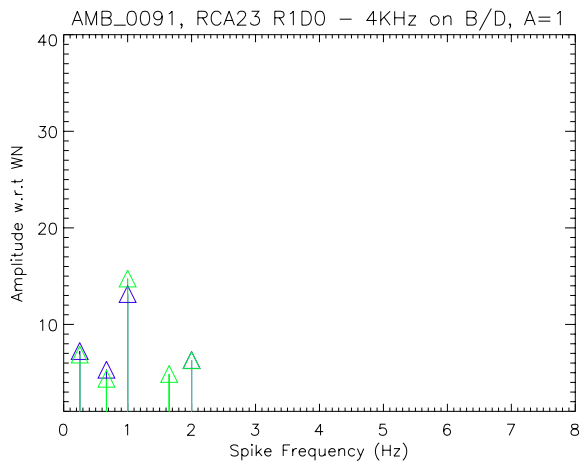
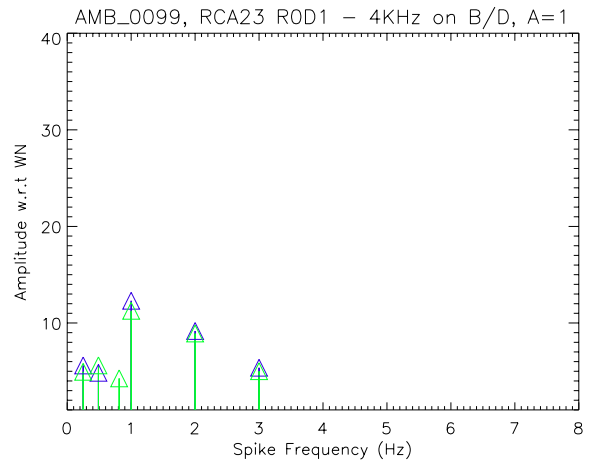
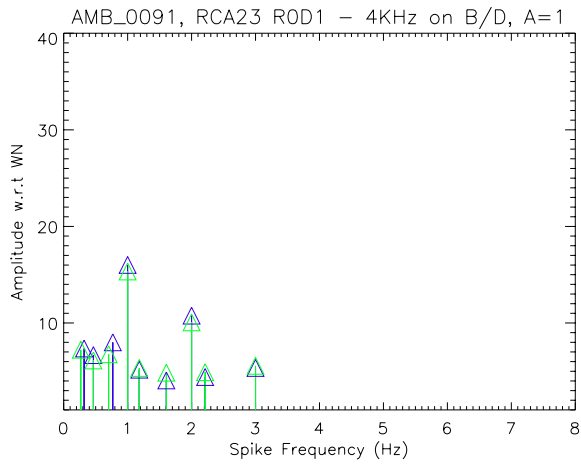
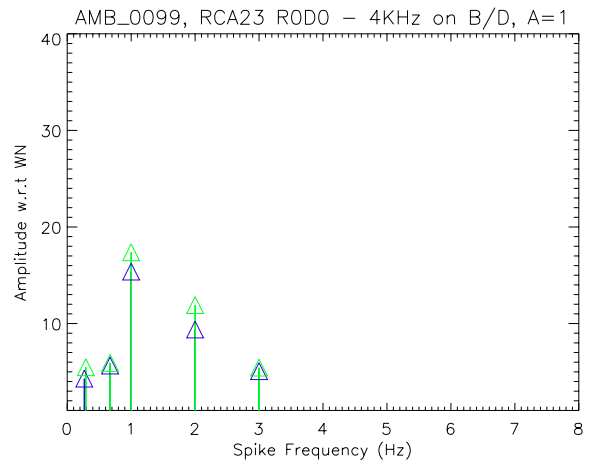
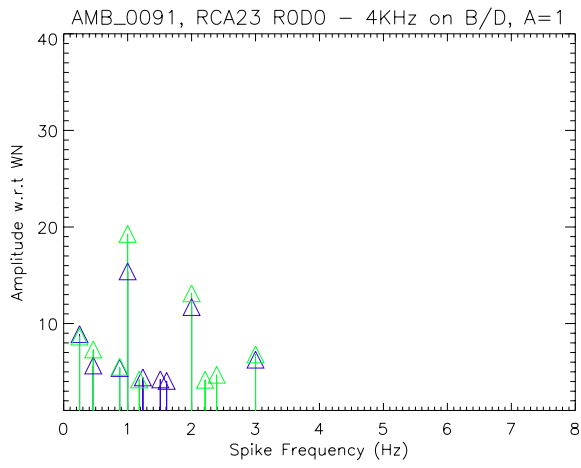


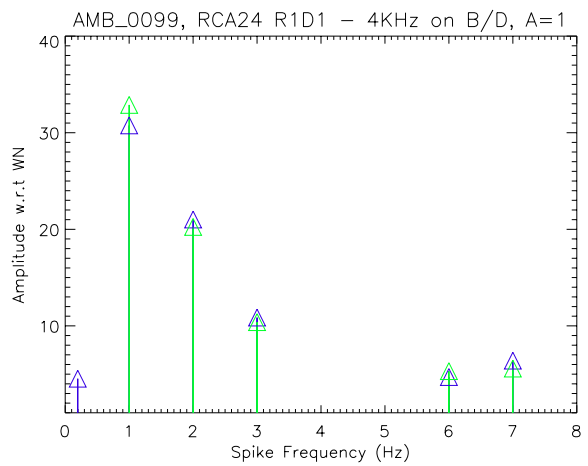
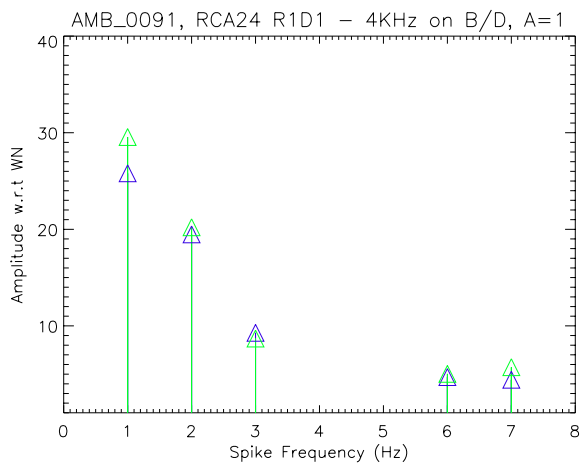
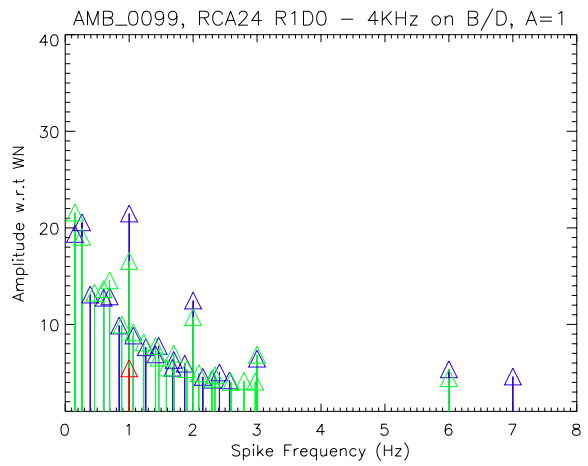
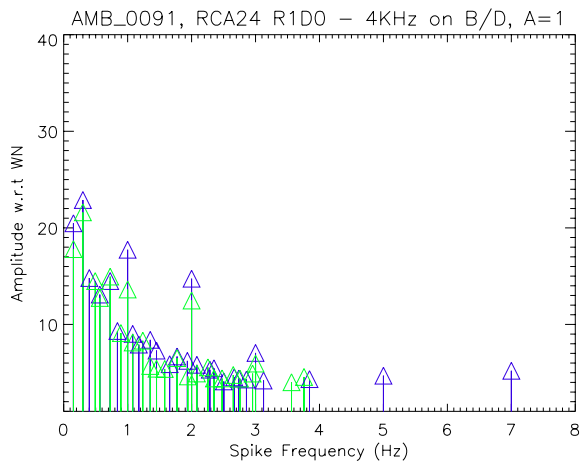
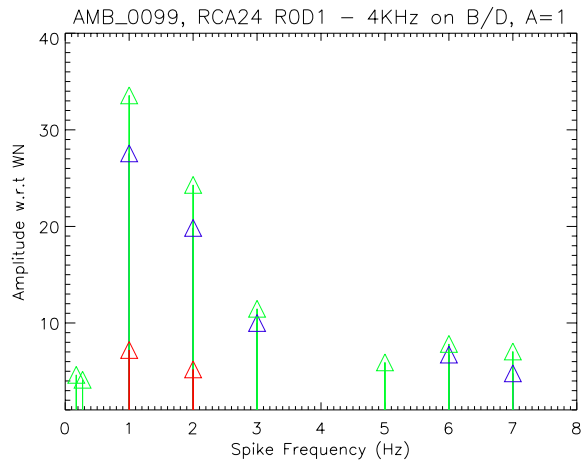
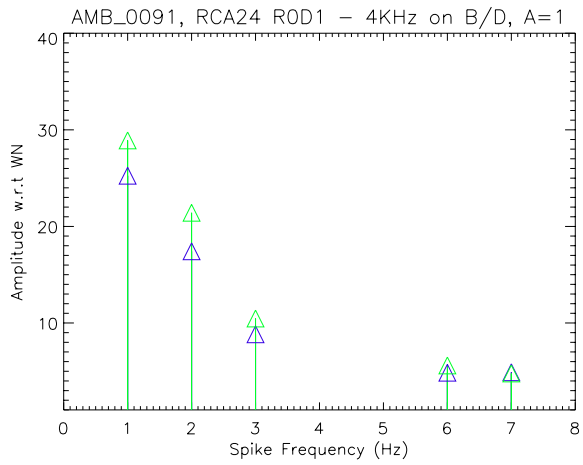
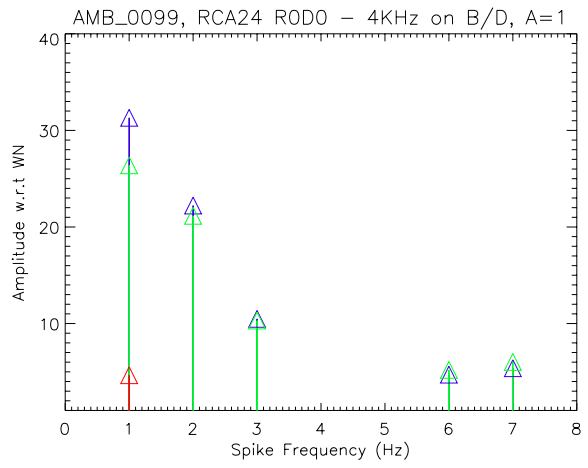
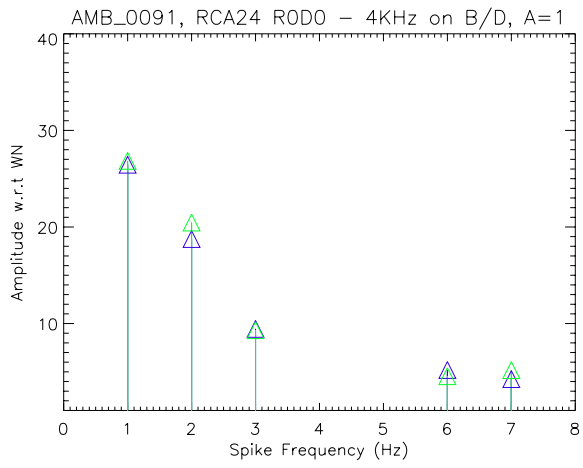


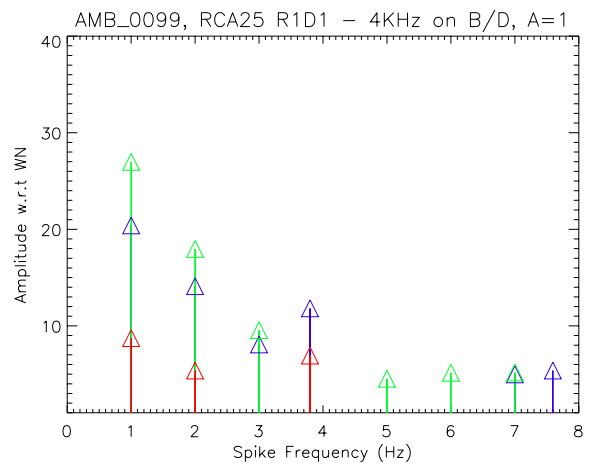
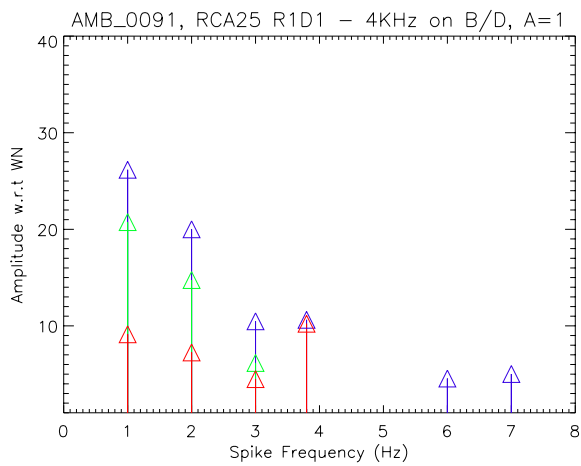
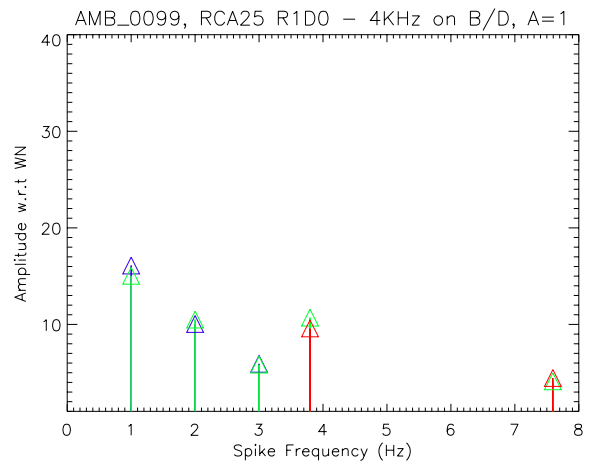
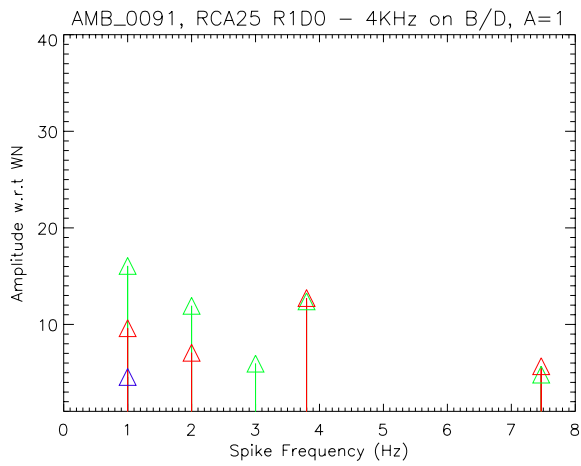
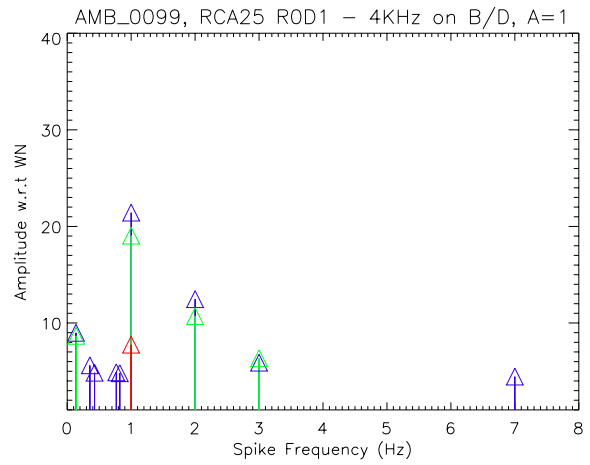
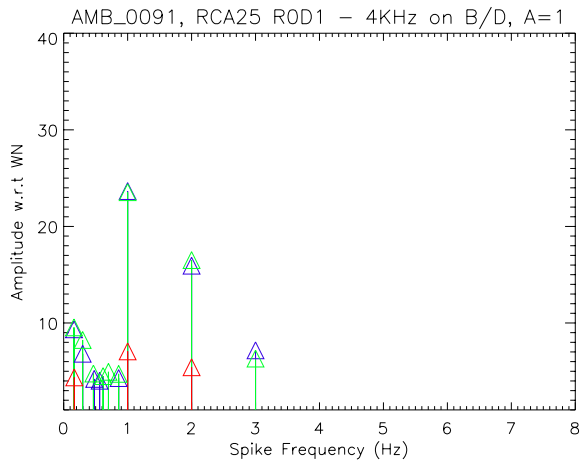
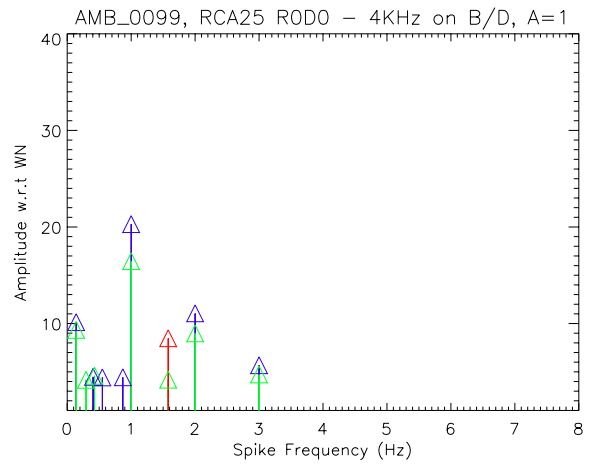
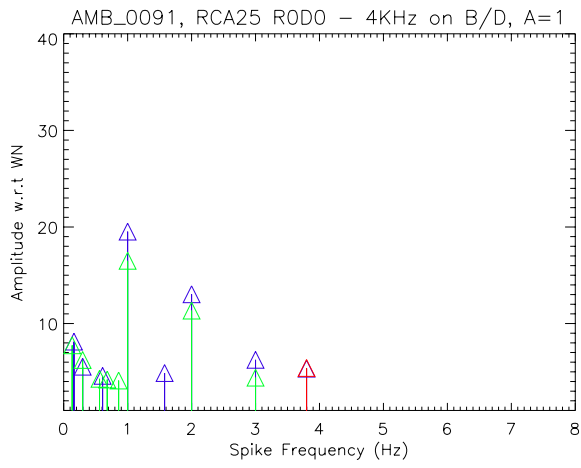


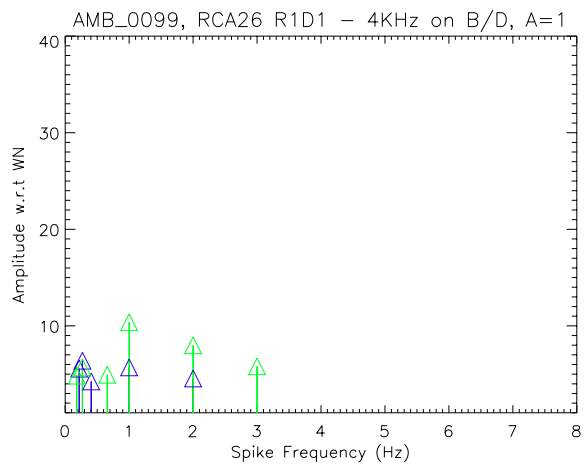
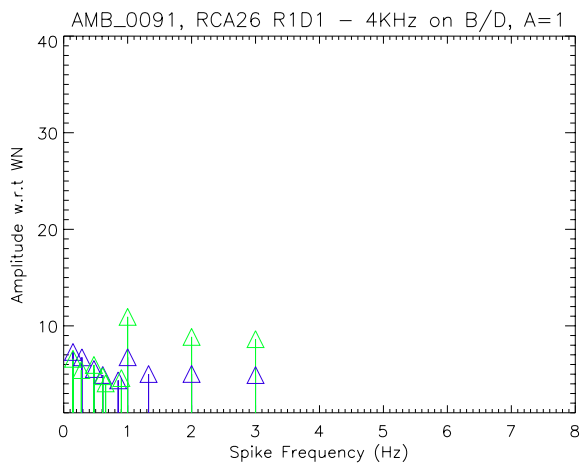
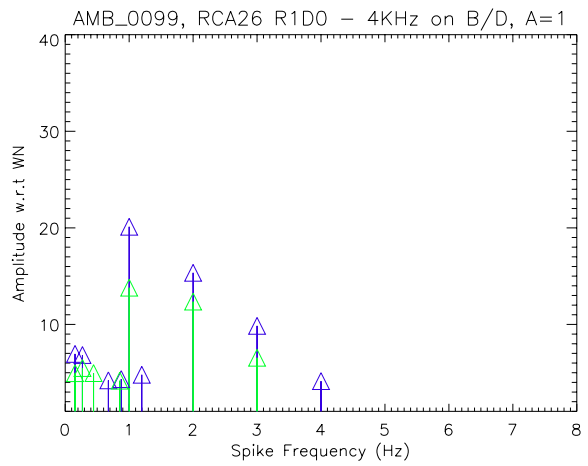
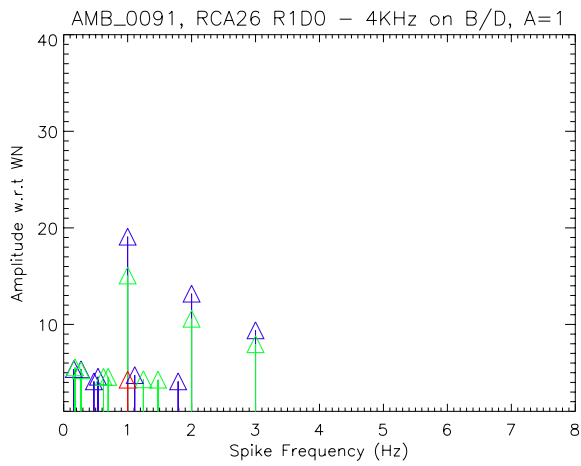
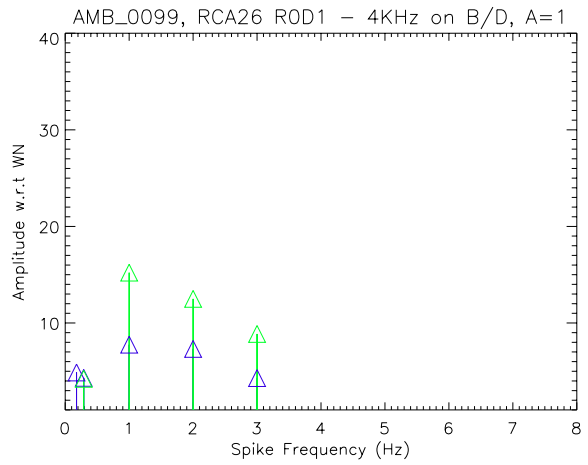
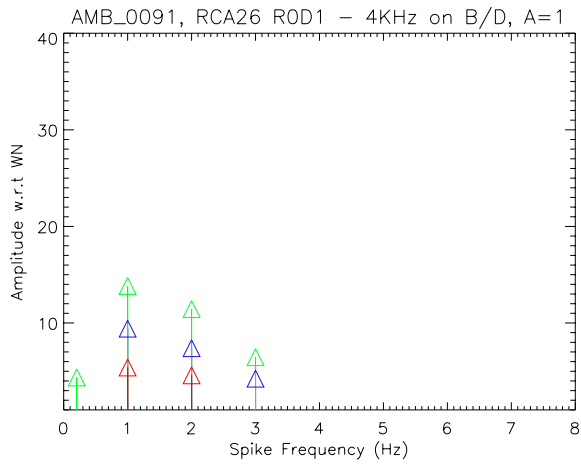
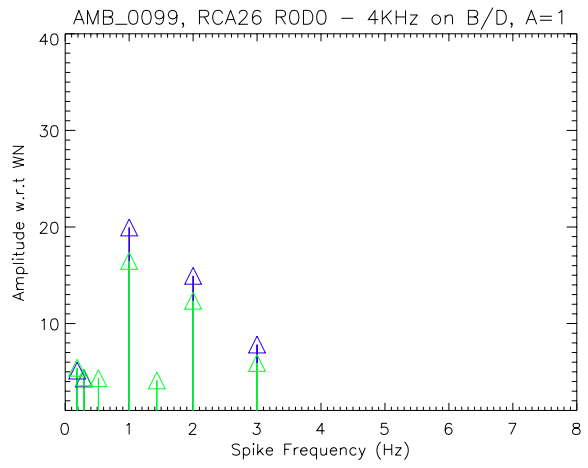
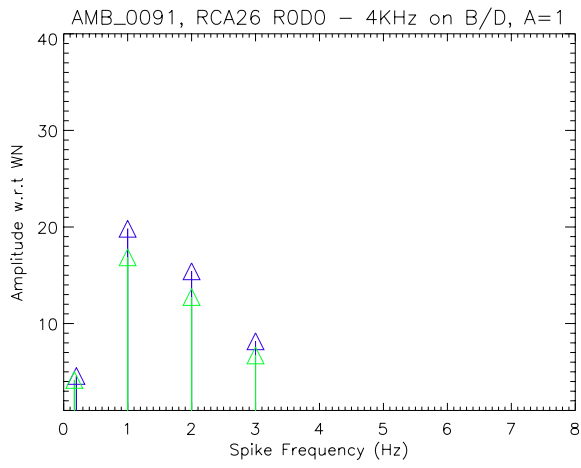


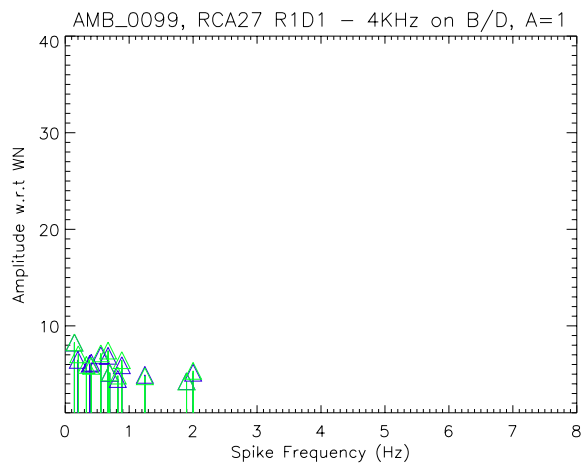
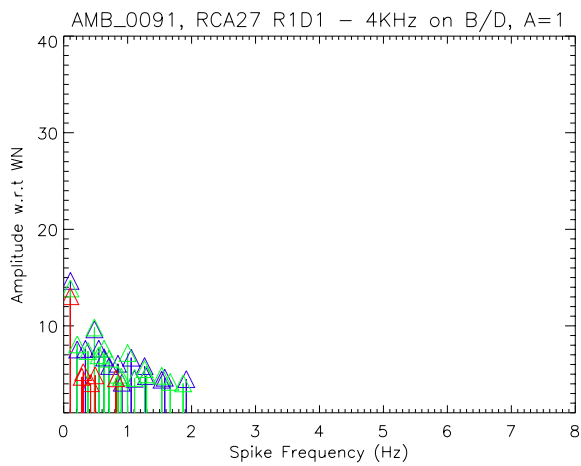
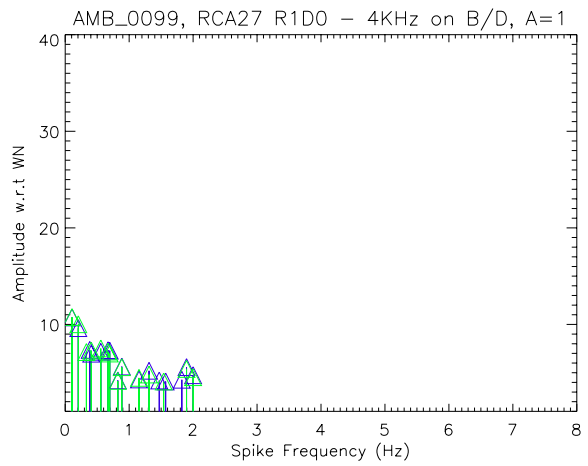
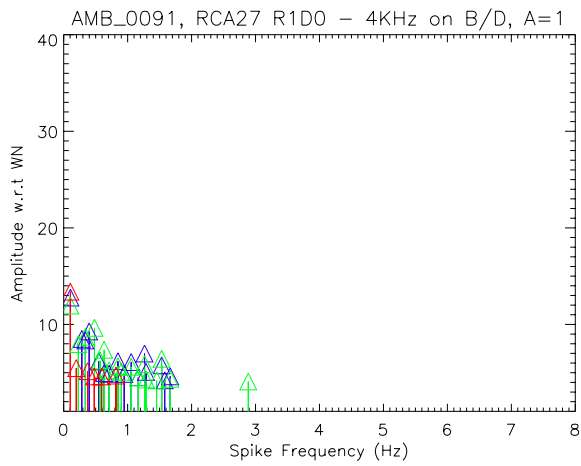
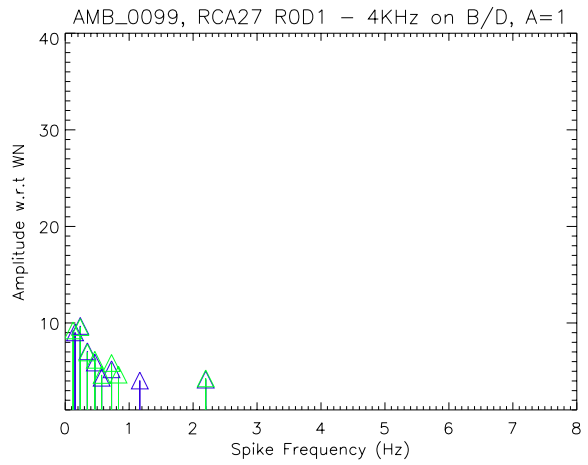
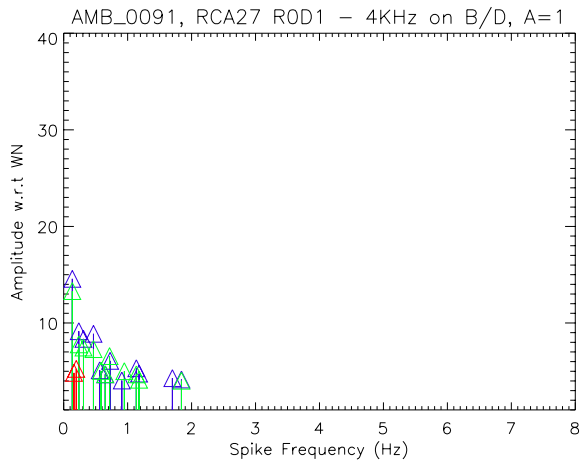
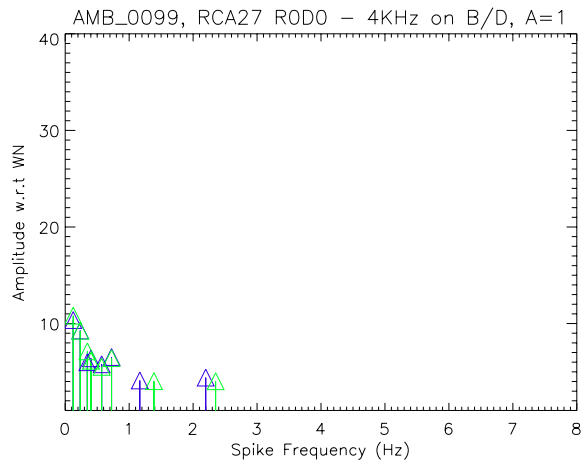
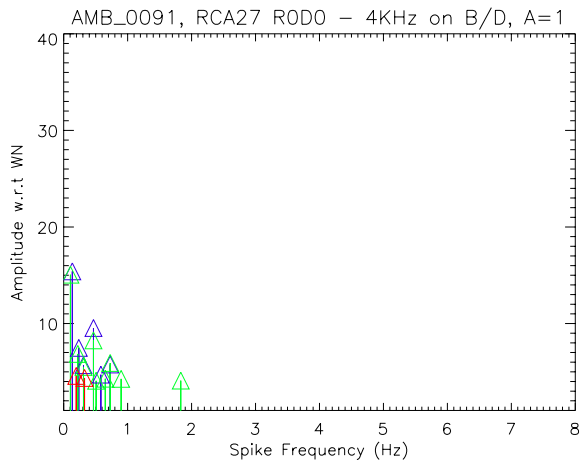




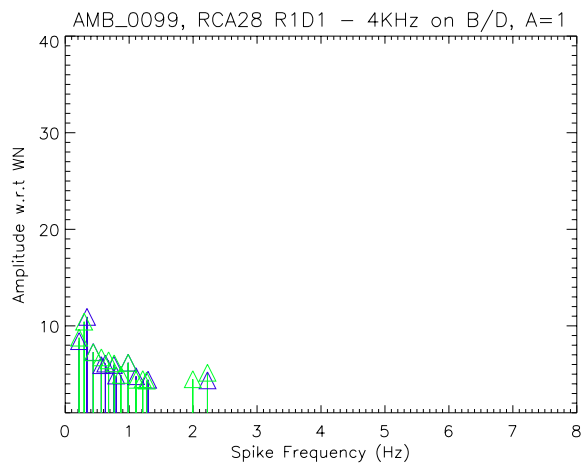
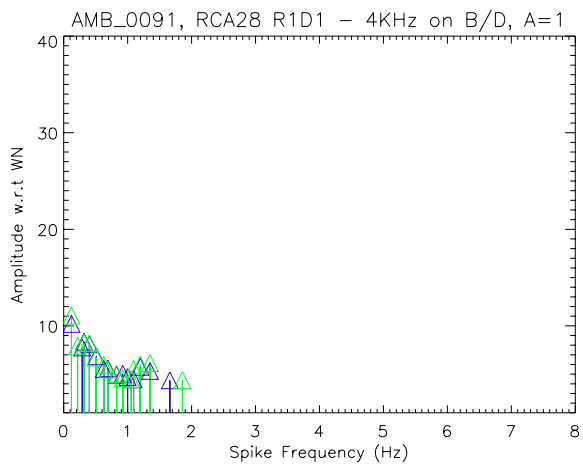
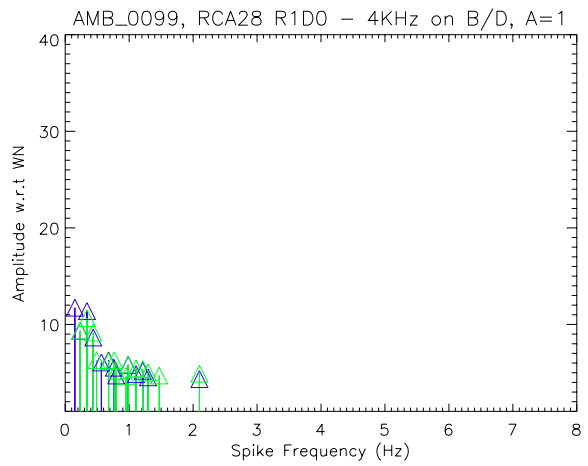
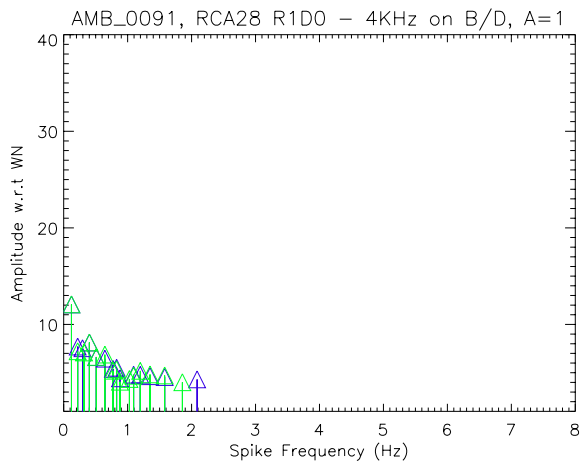
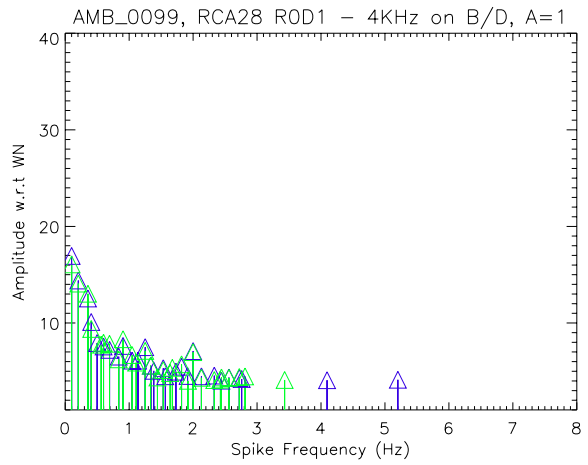
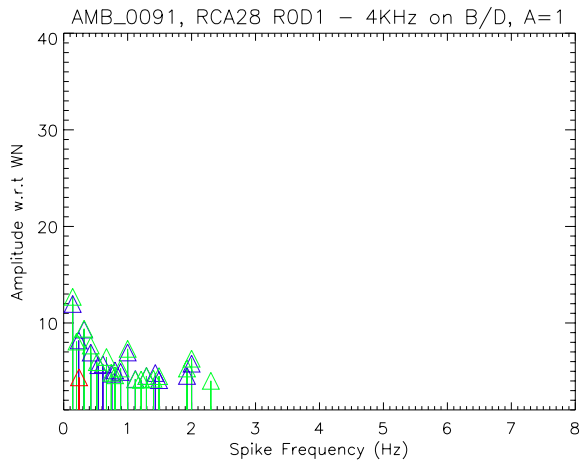
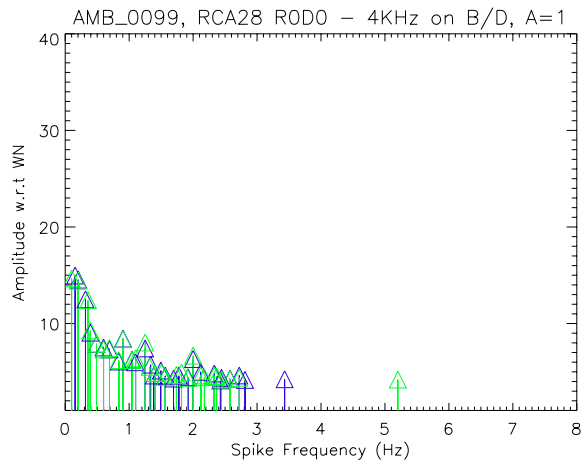
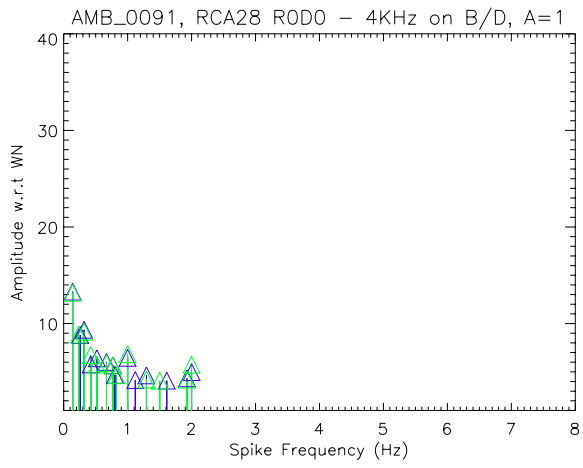




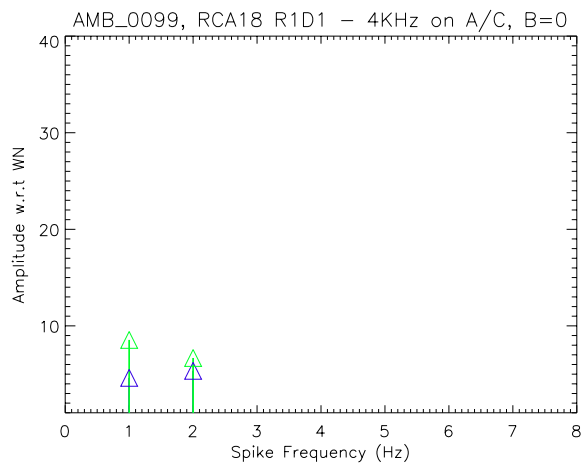
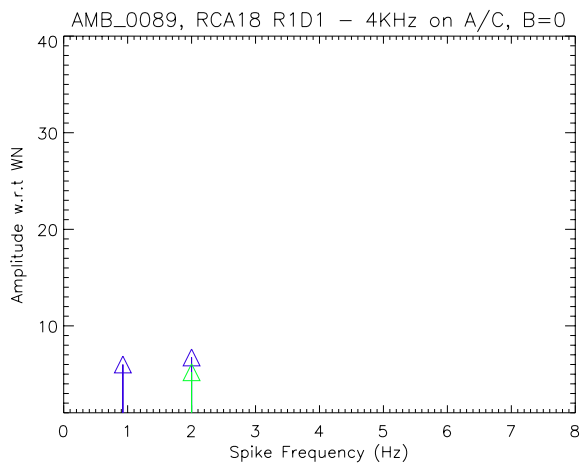
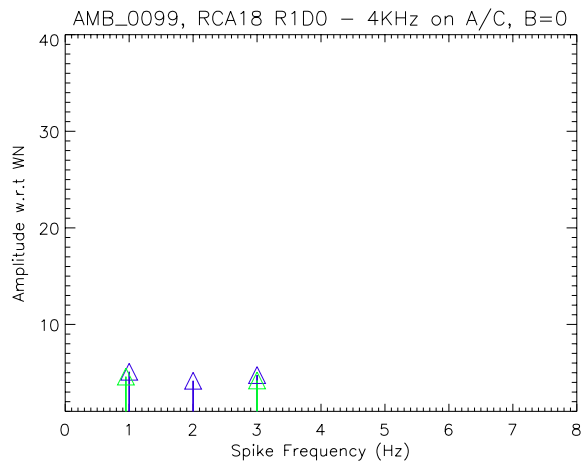
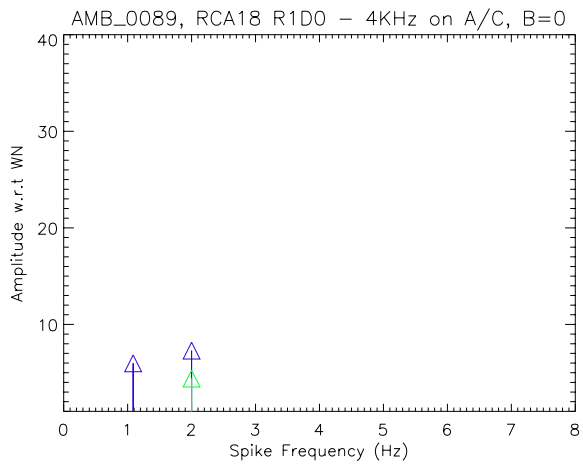
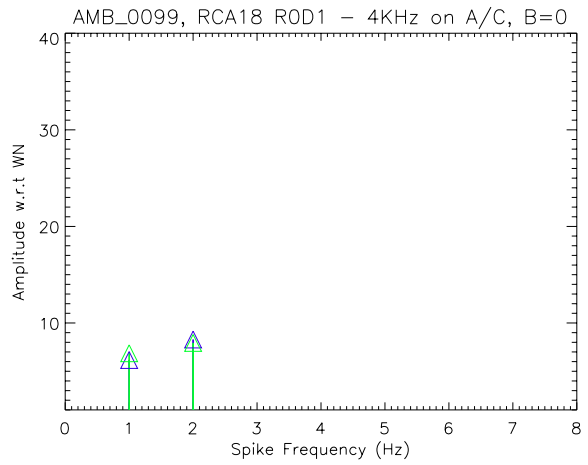
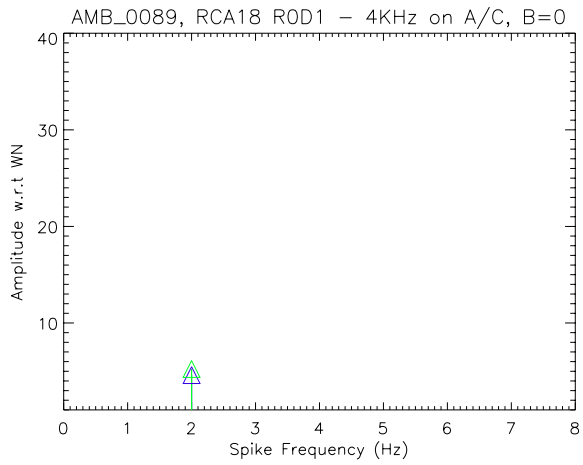
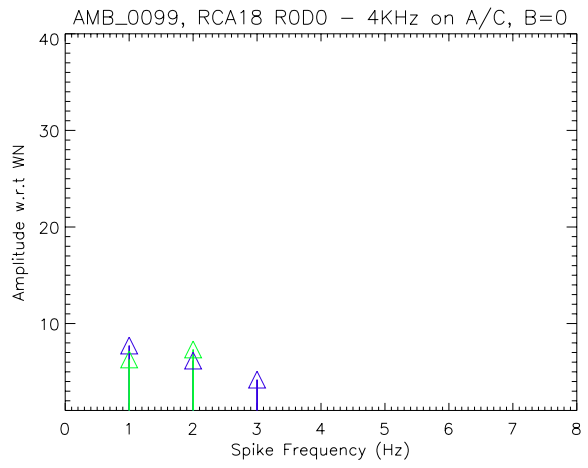
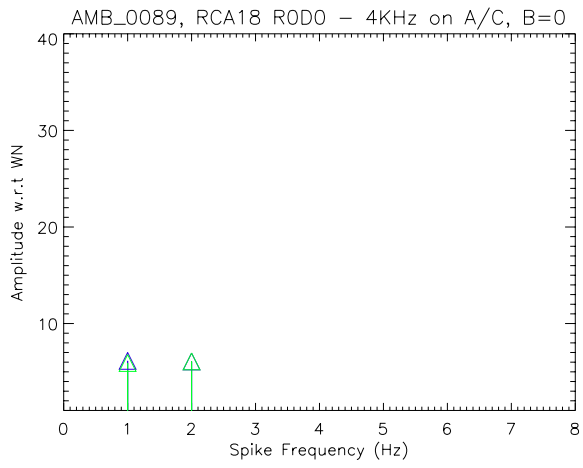


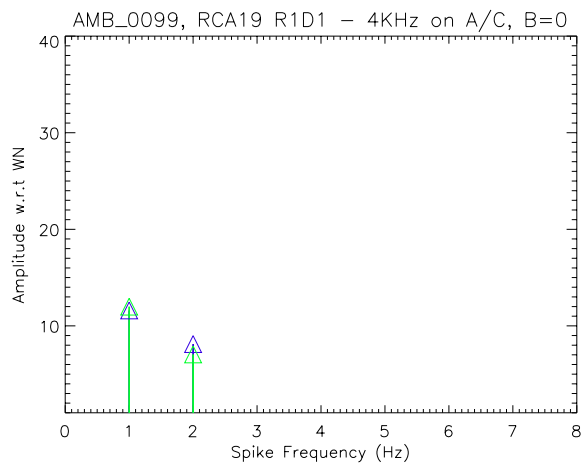
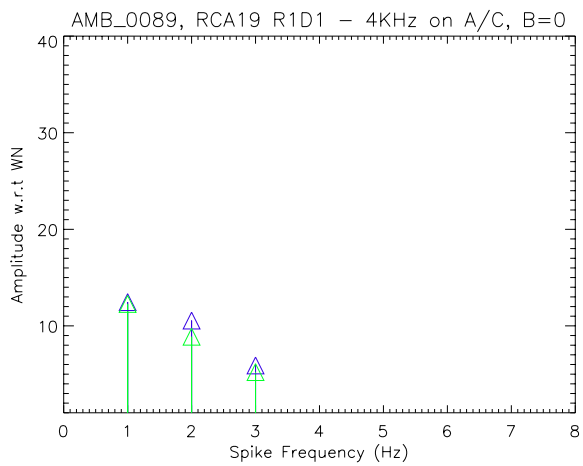
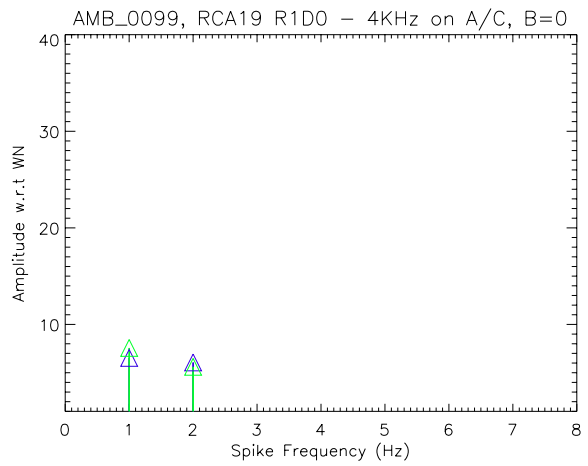
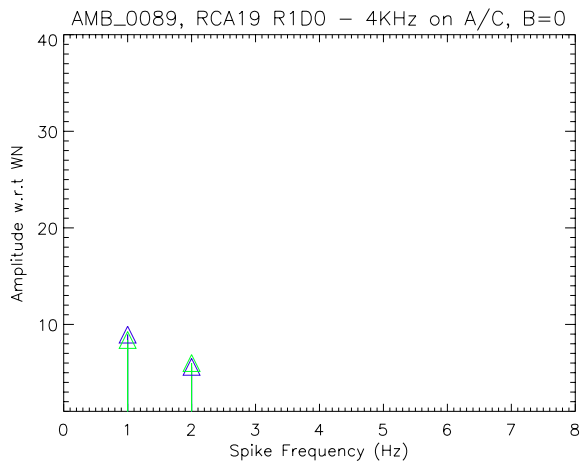
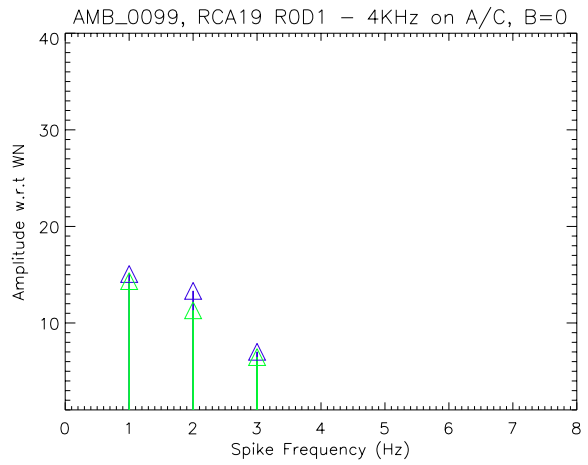
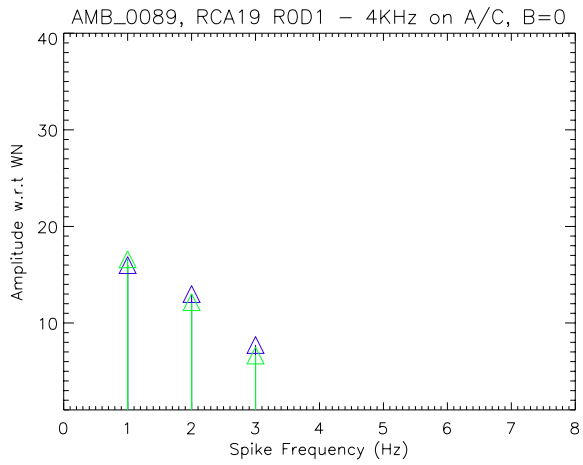
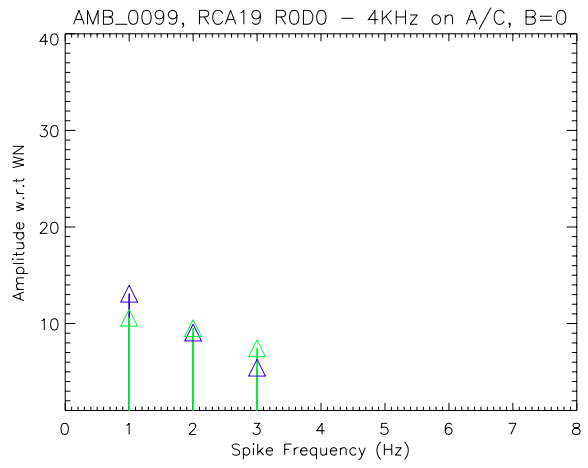
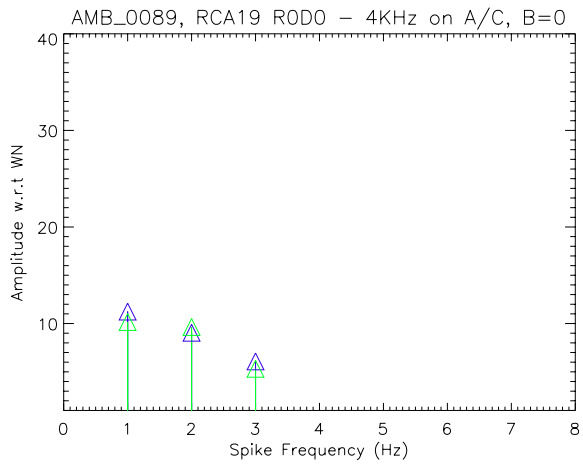


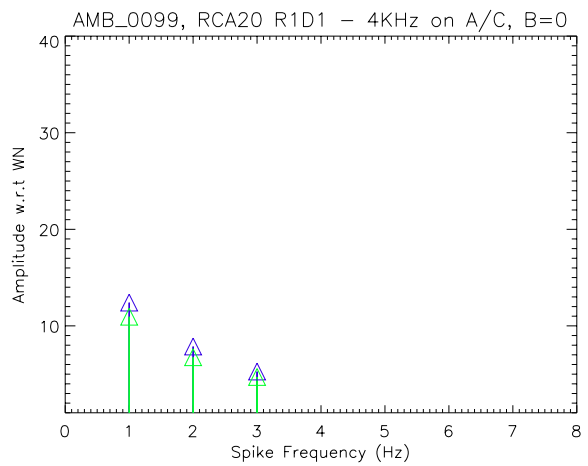
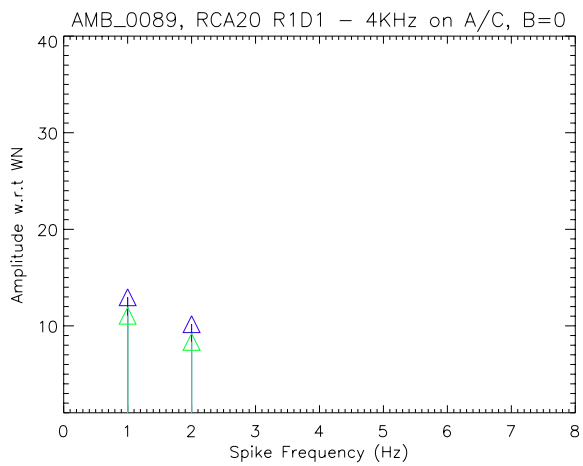
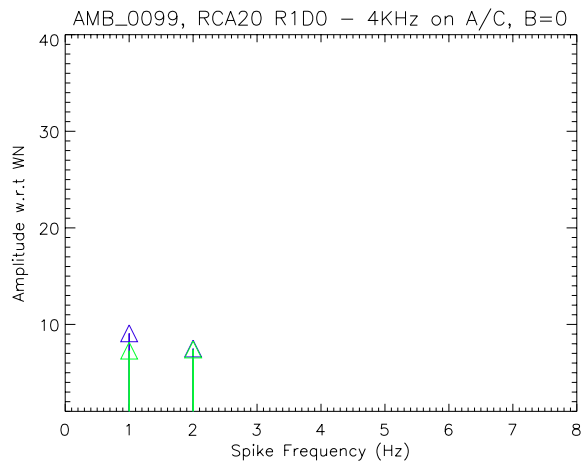
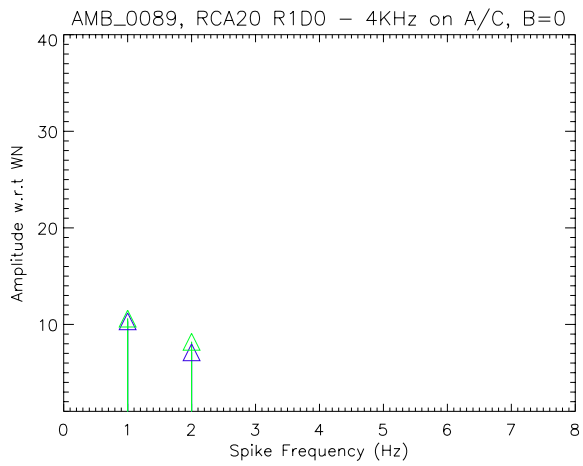
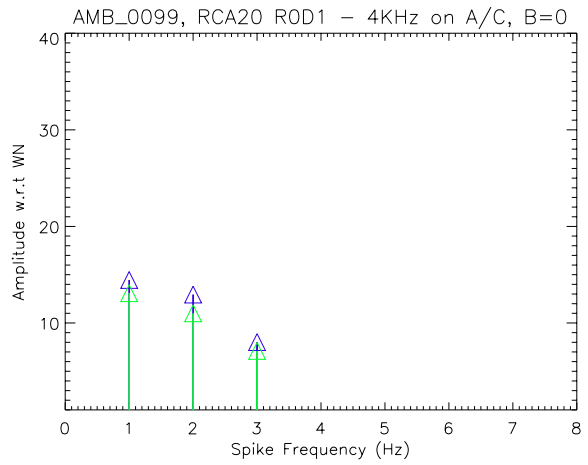
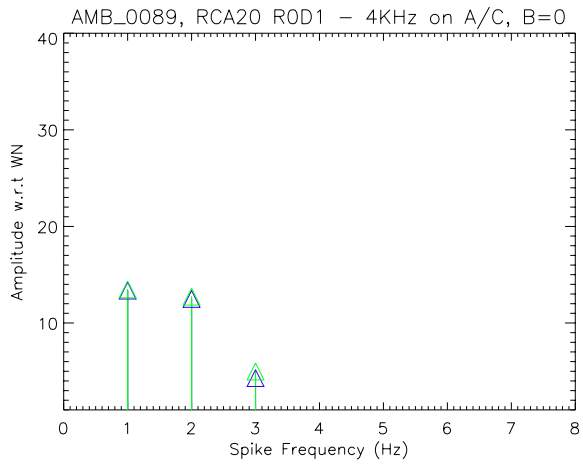
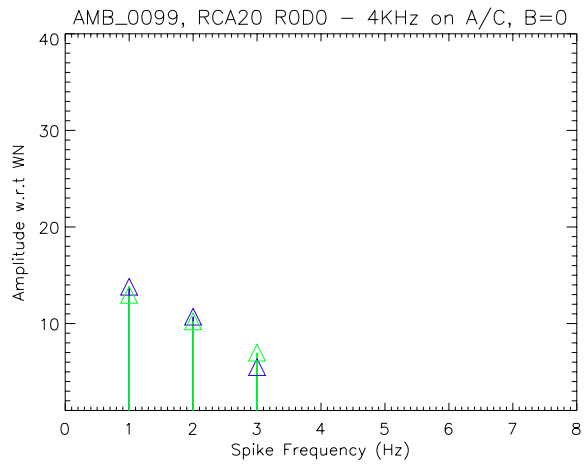
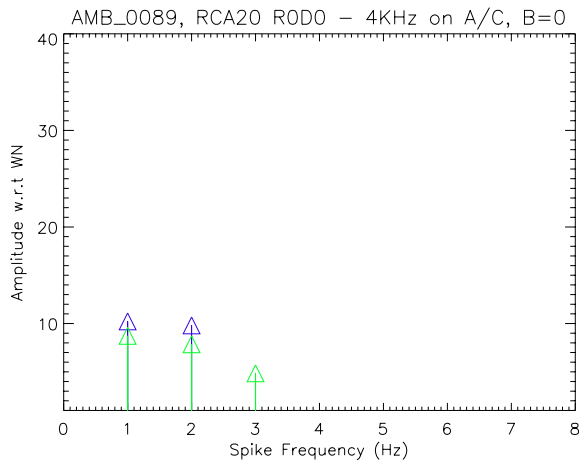


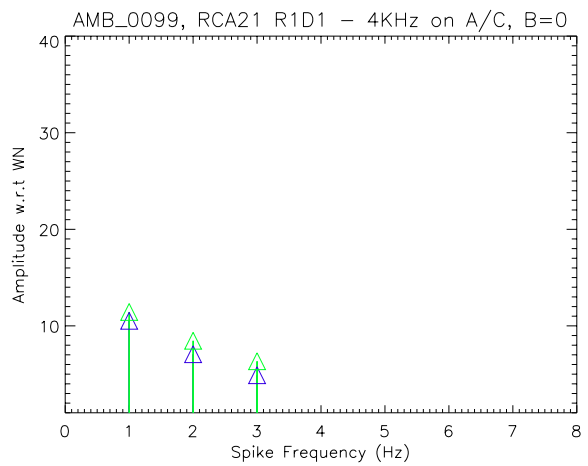
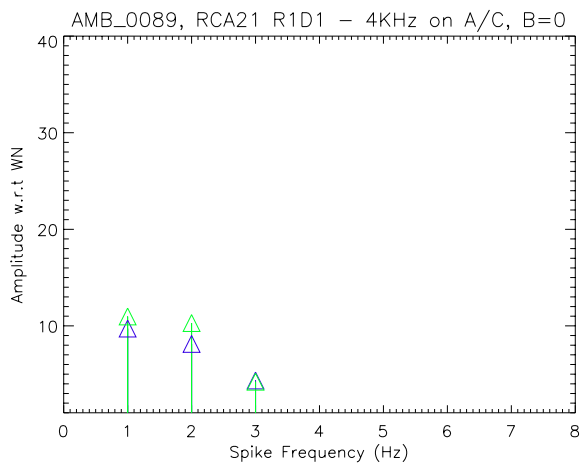
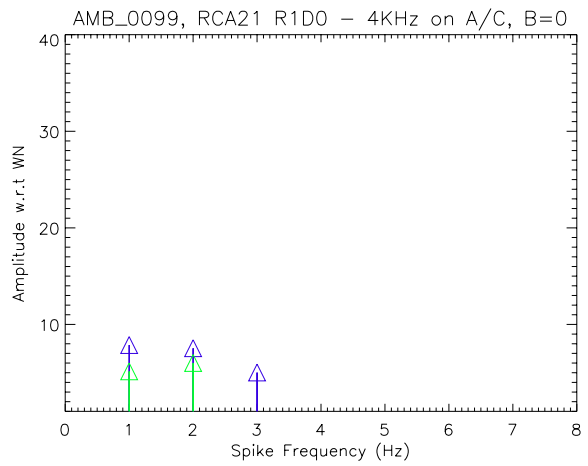
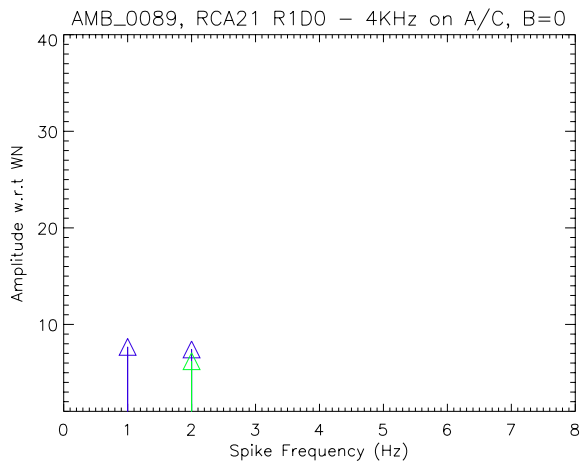
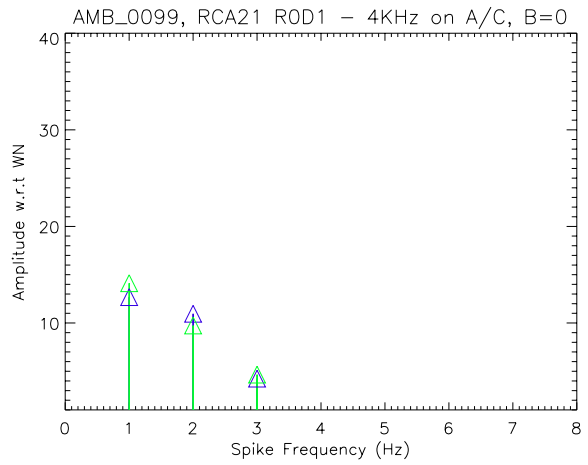
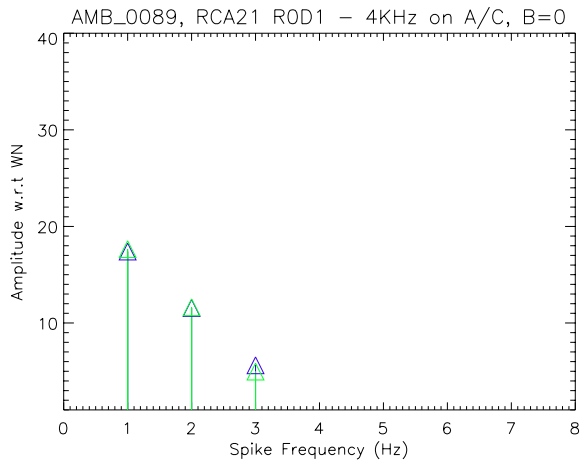
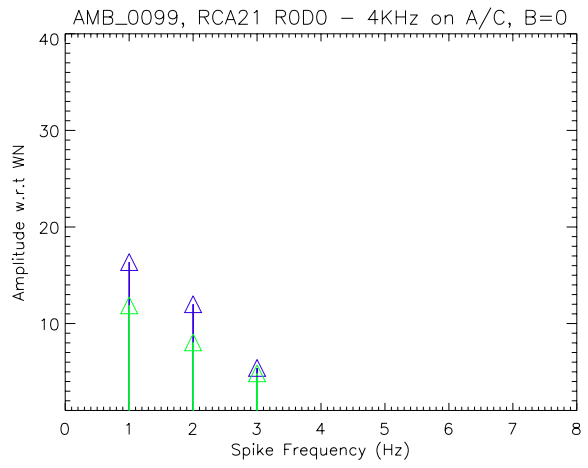
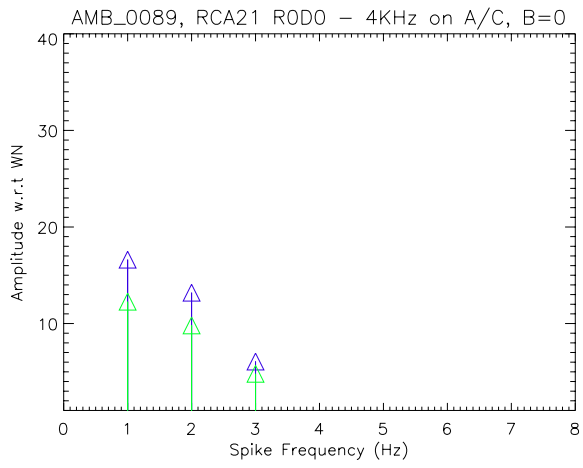


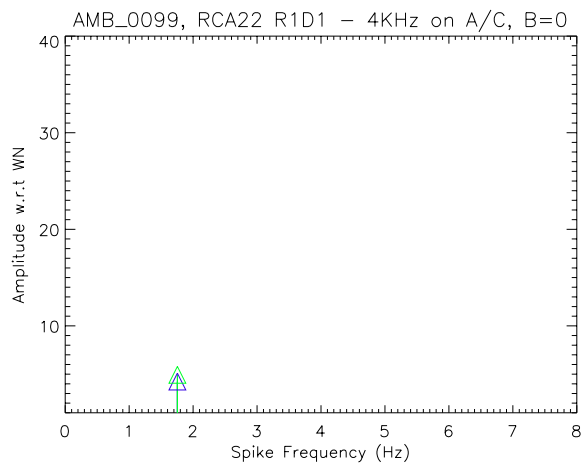
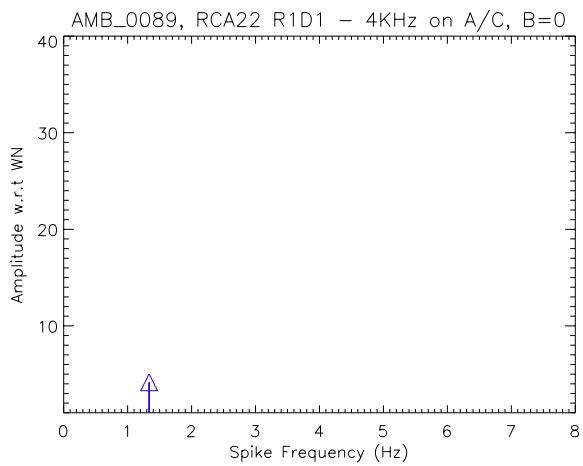
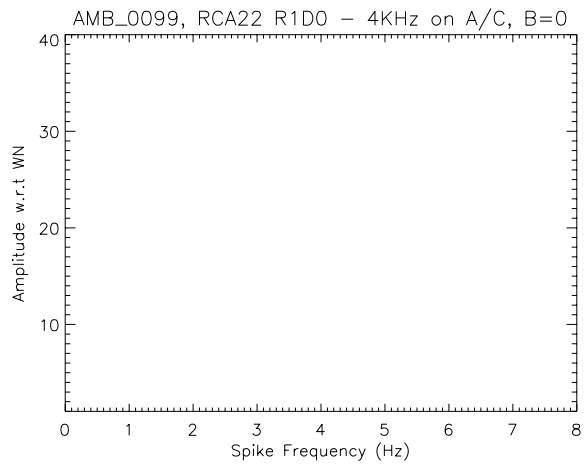
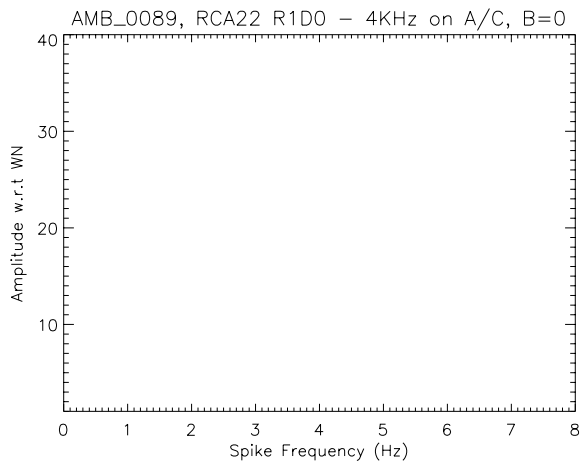
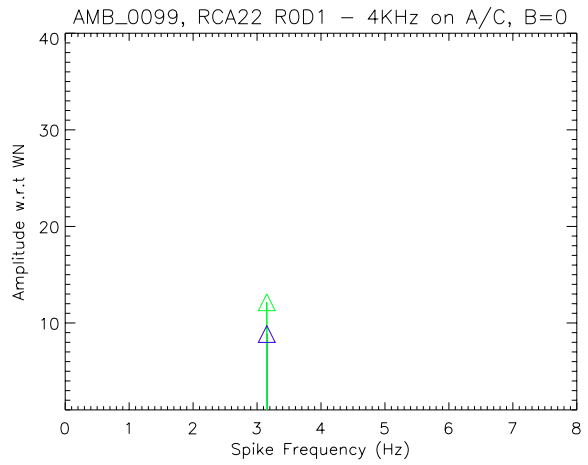
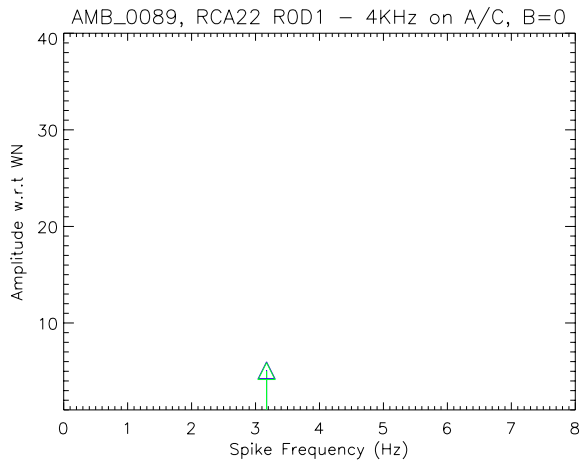
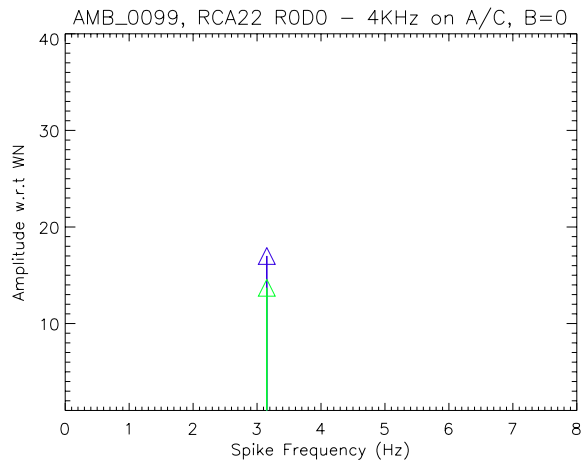
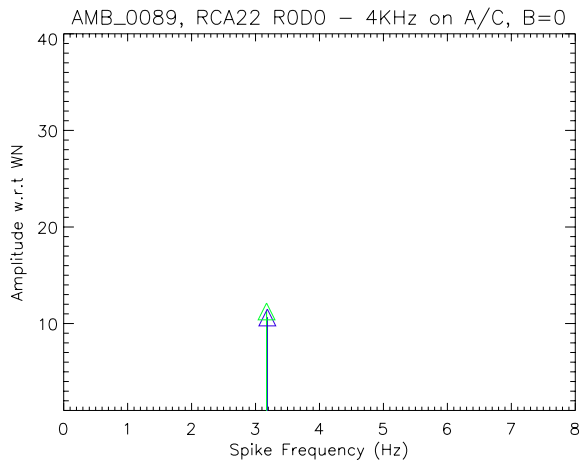
**WFT in Cannes vs SFT in Cannes**  
**(300 sec)**

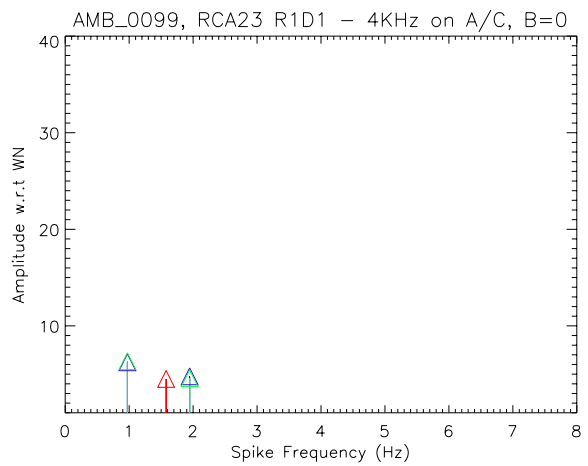
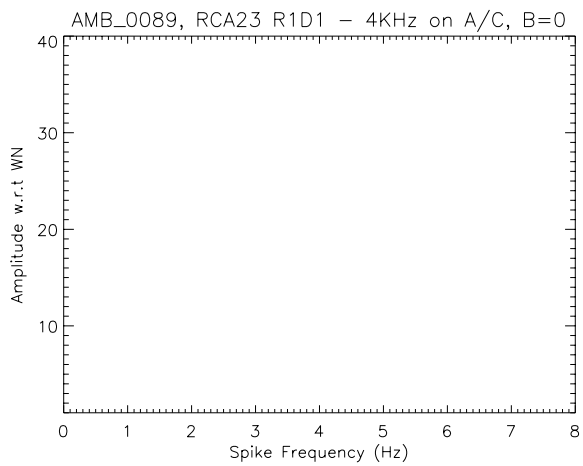
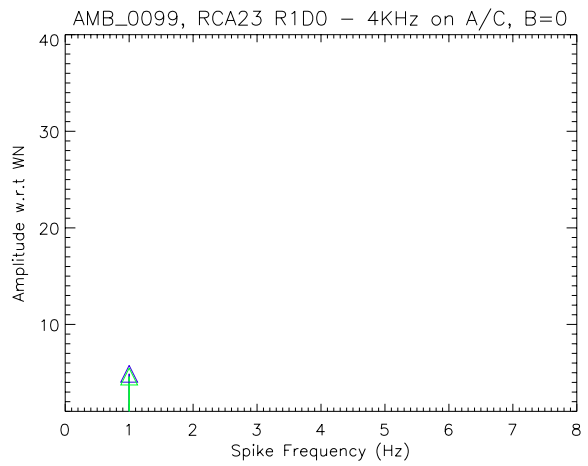
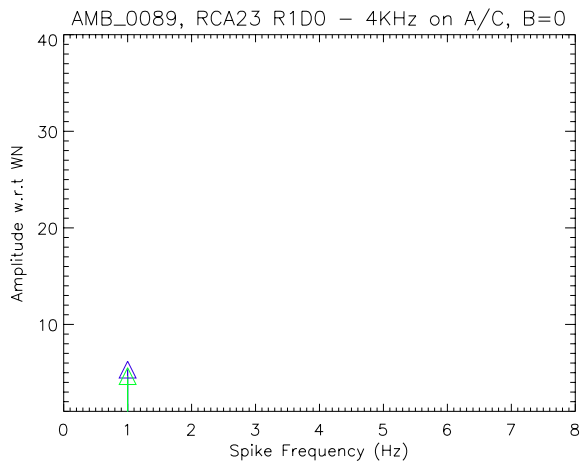
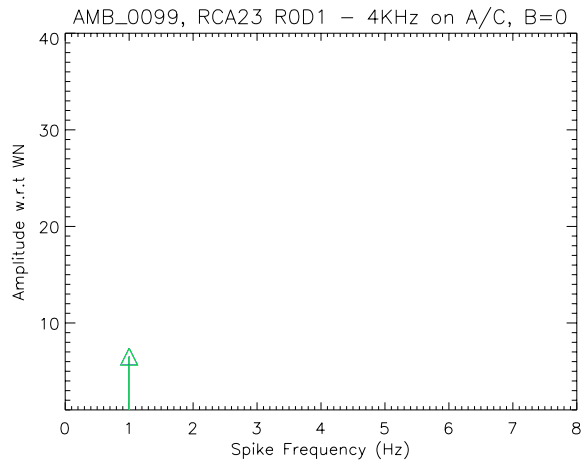
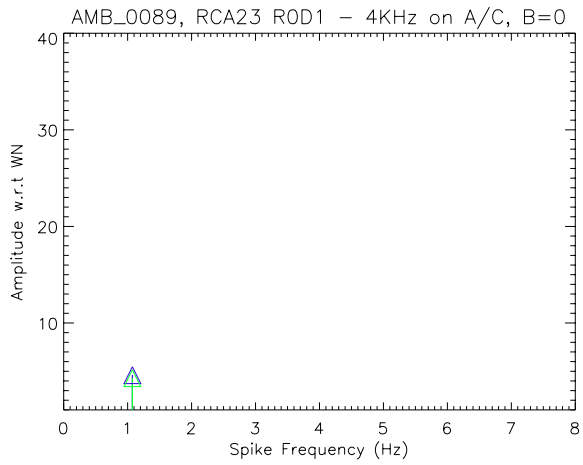
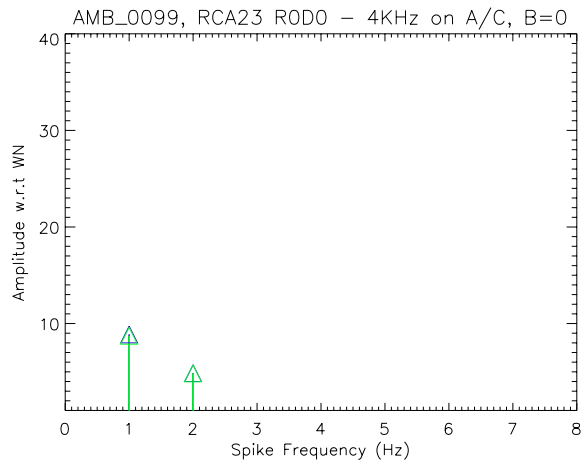
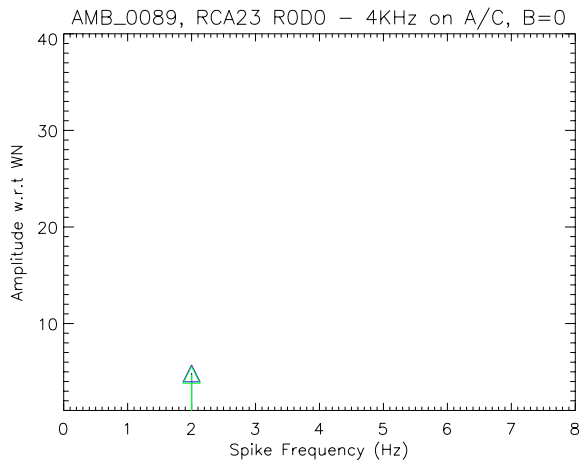




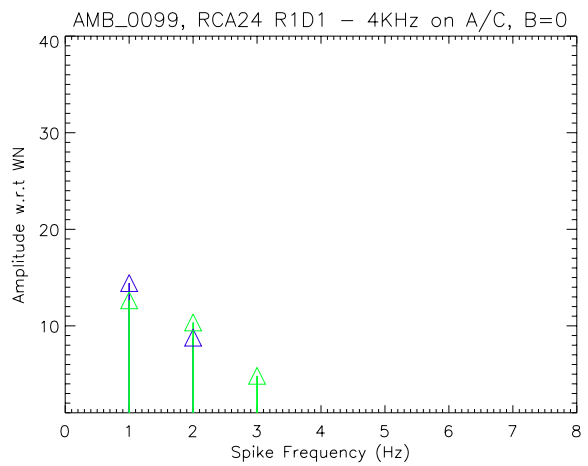
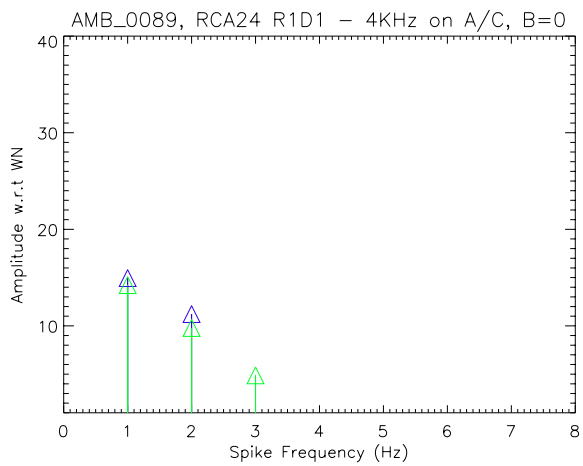
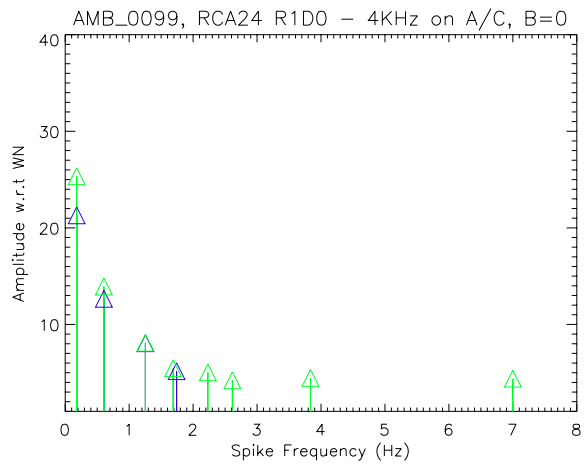
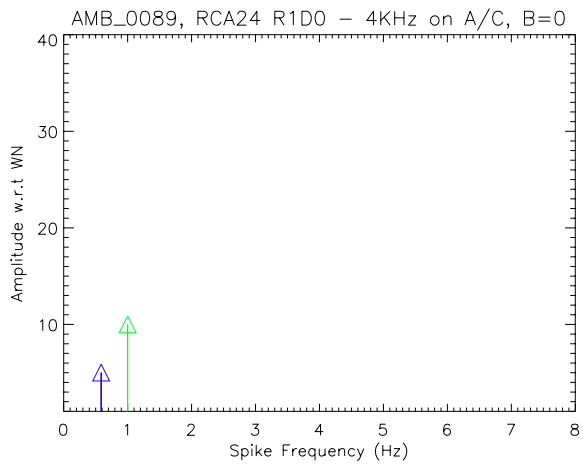
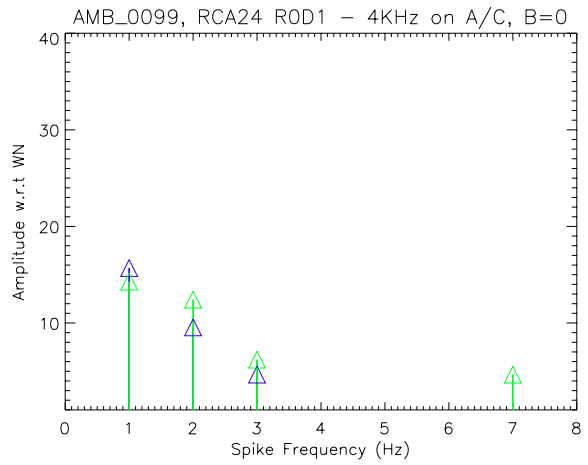
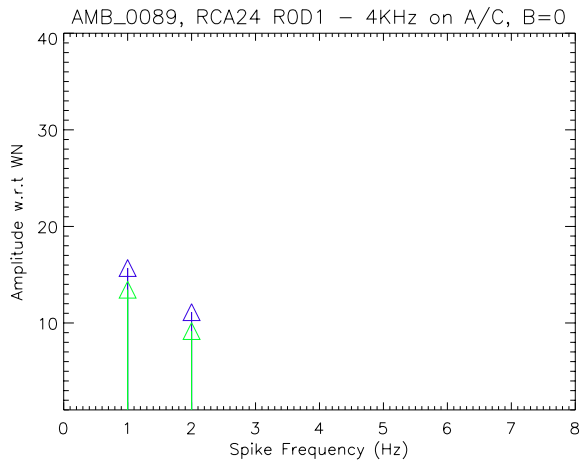
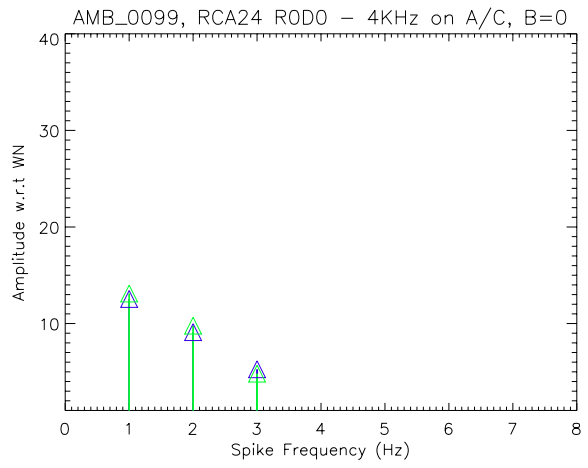
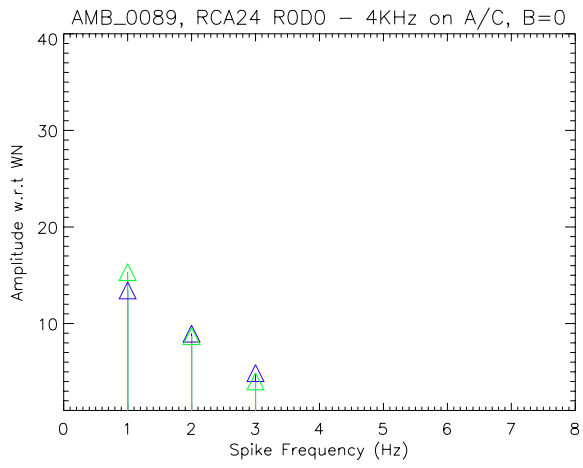


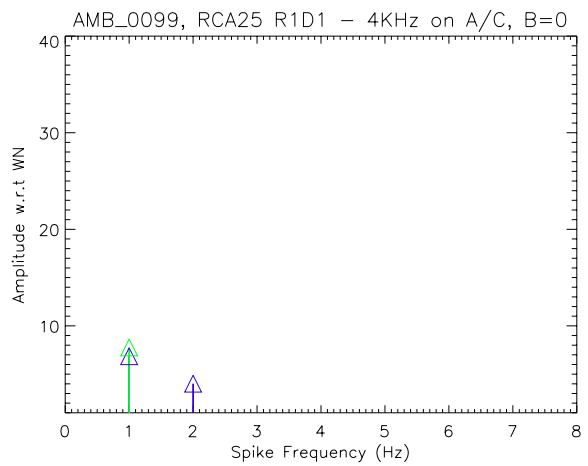
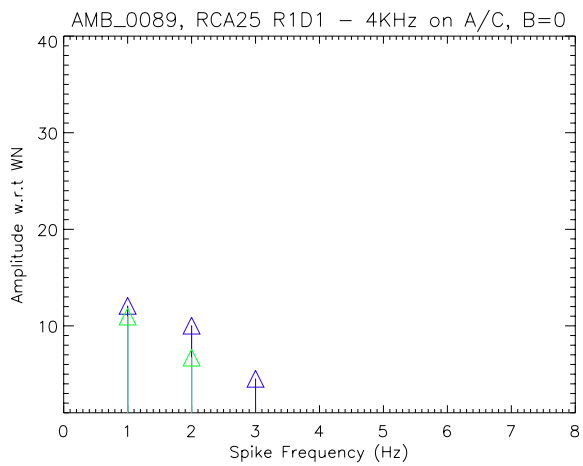
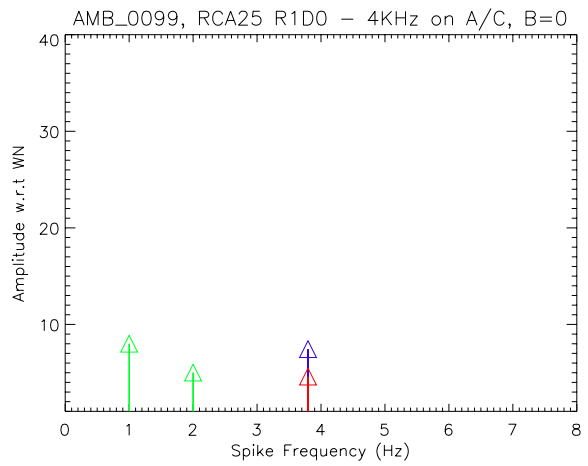
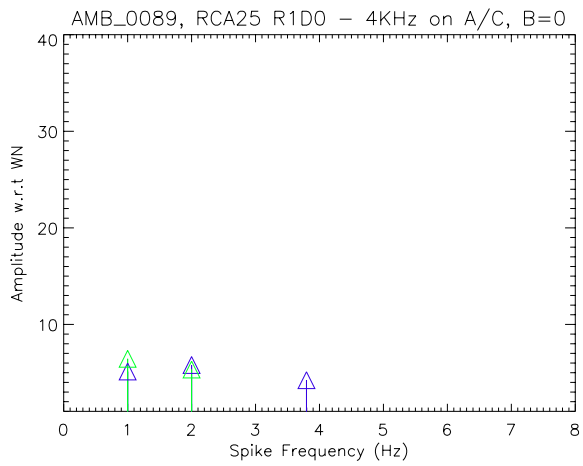
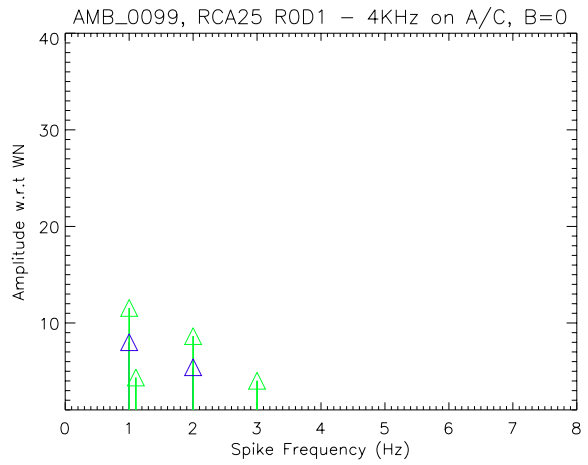
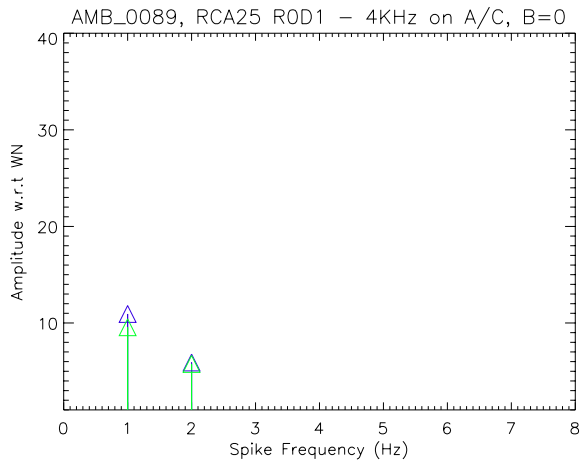
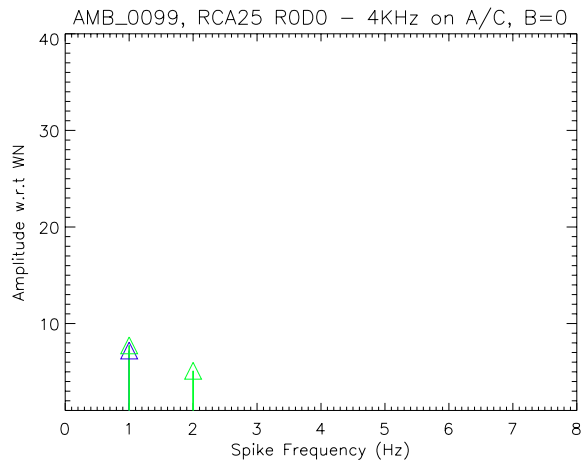
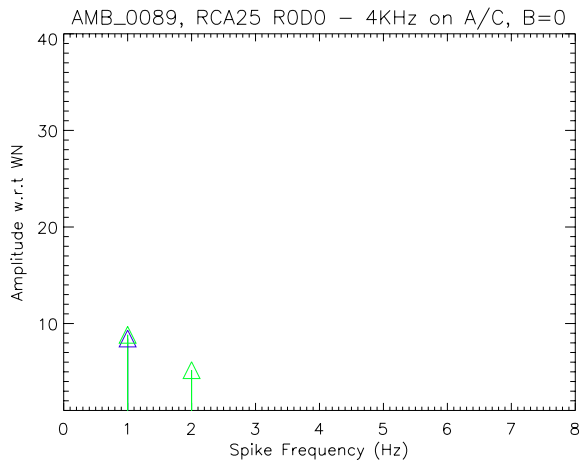


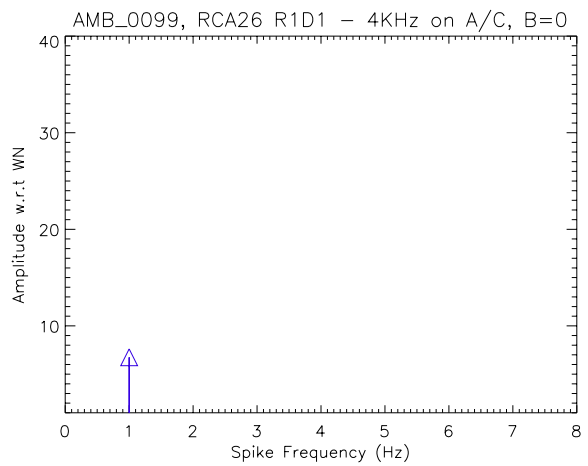
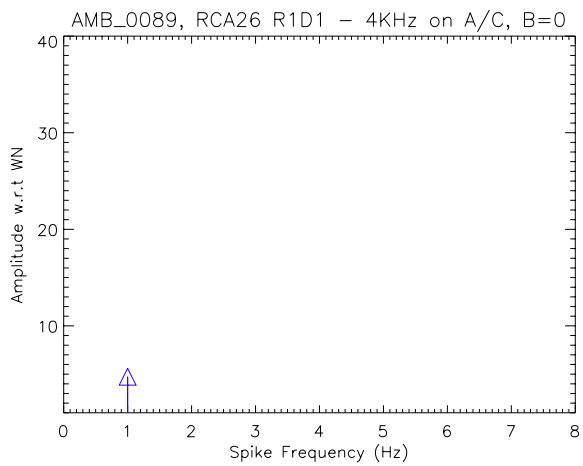
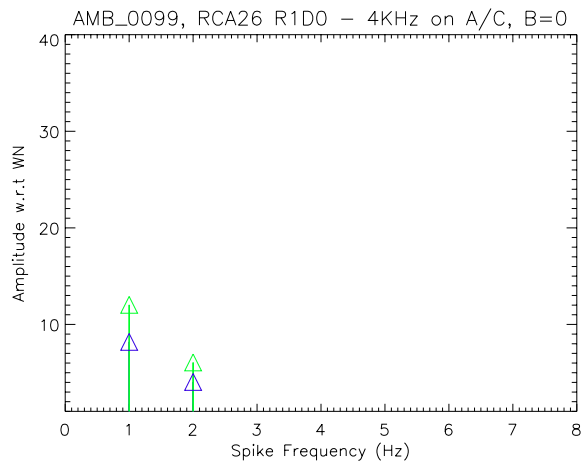
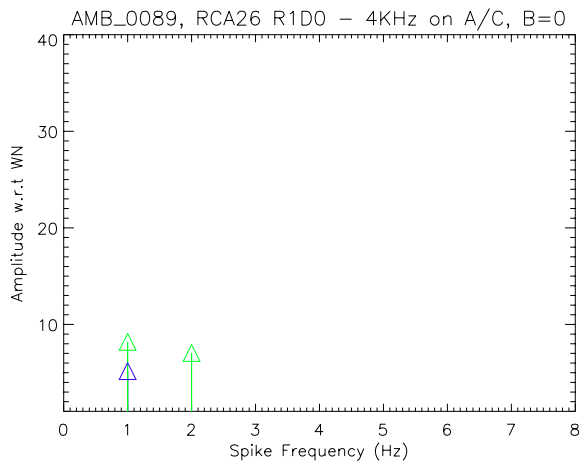
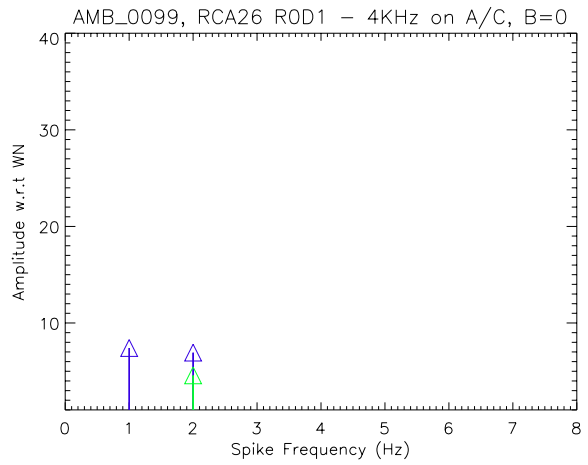
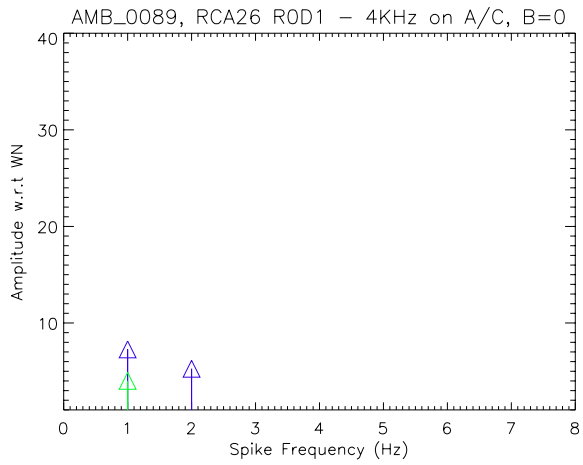
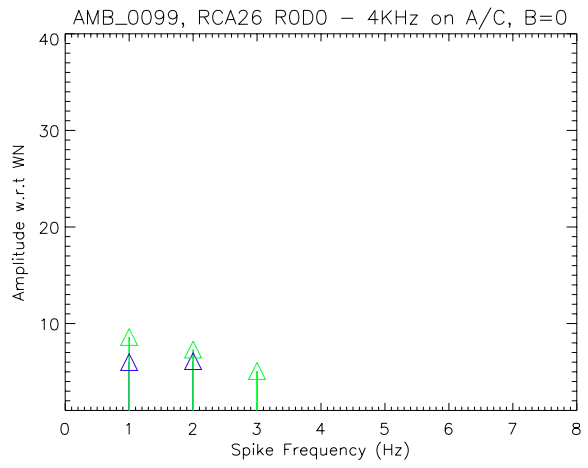
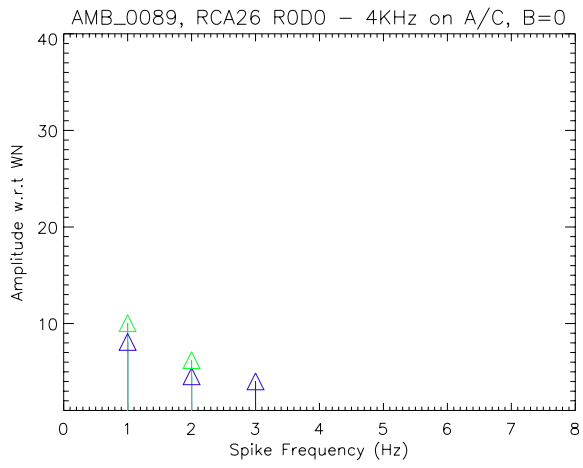


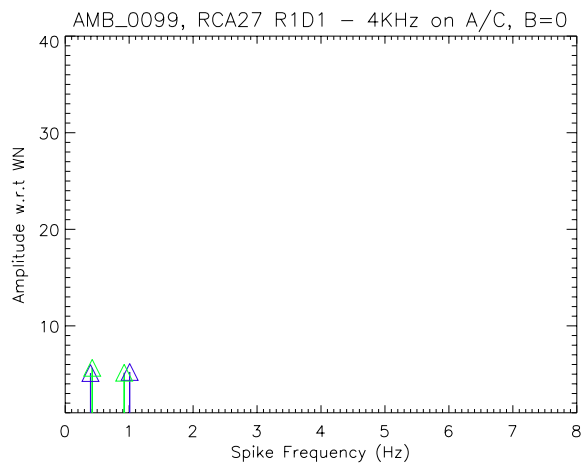
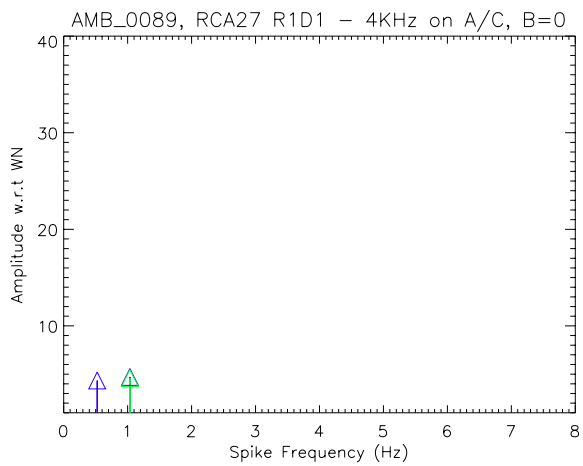
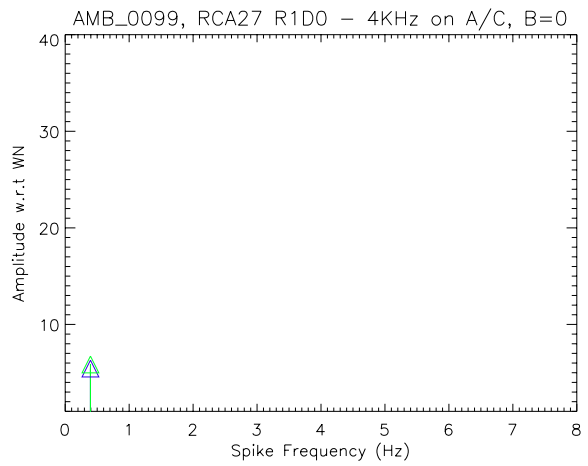
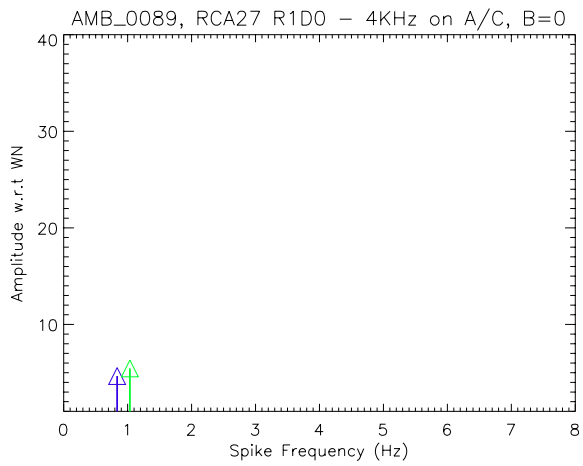
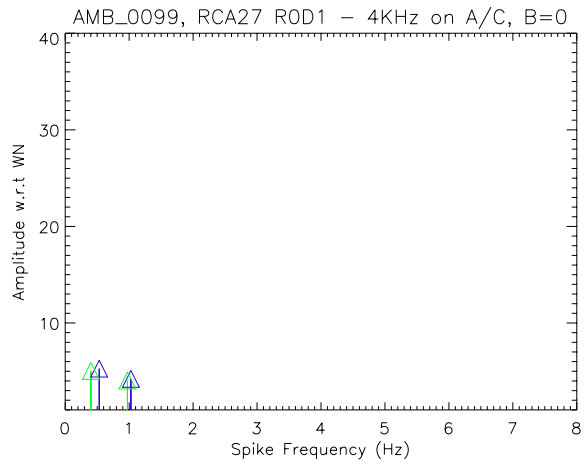
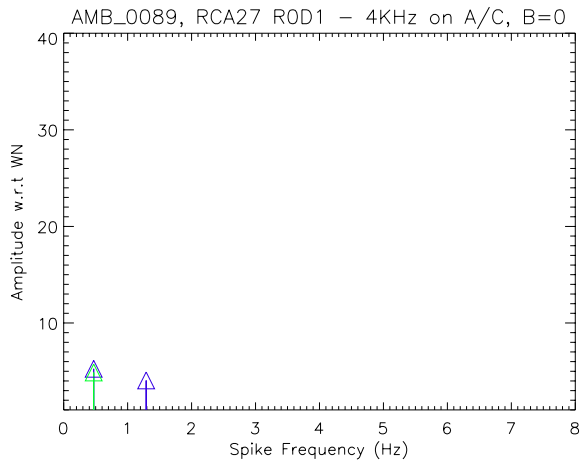
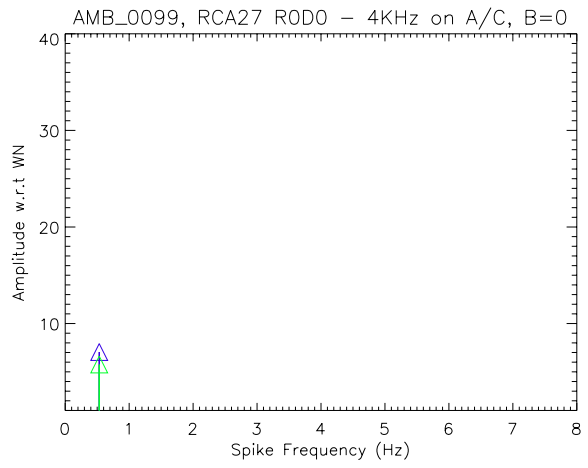
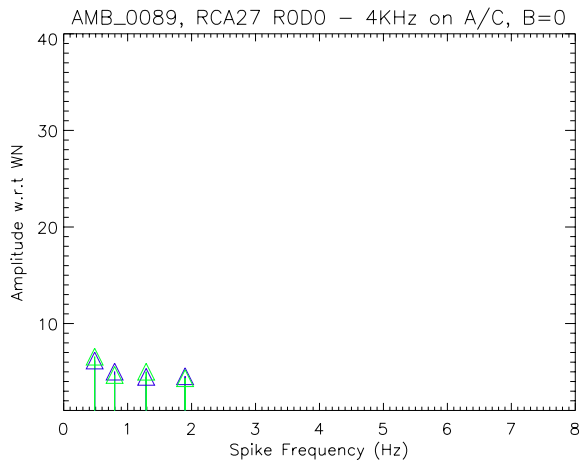


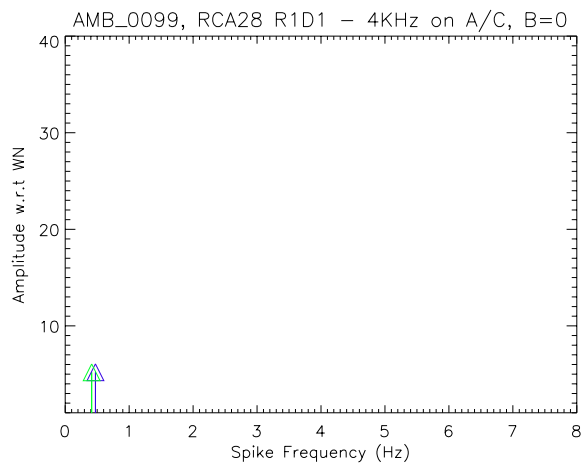
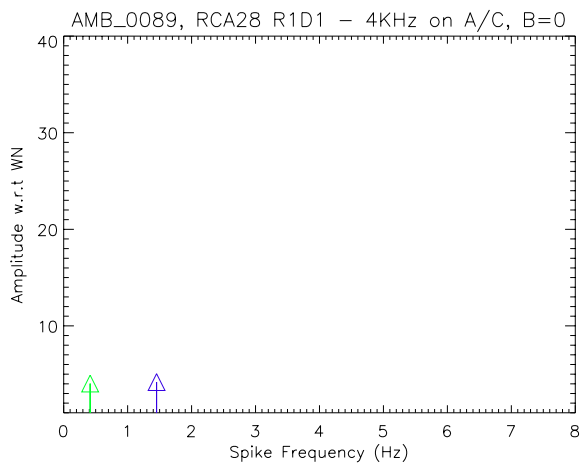
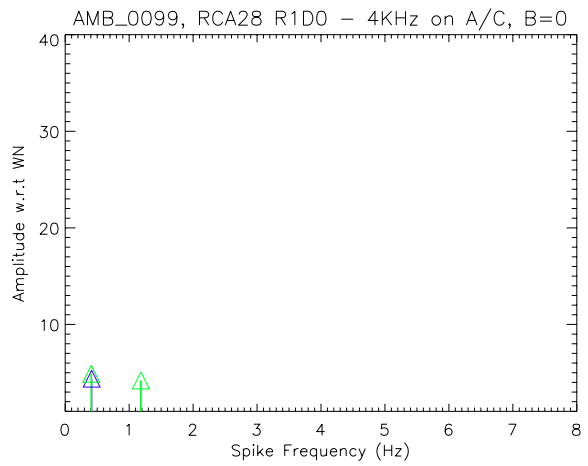
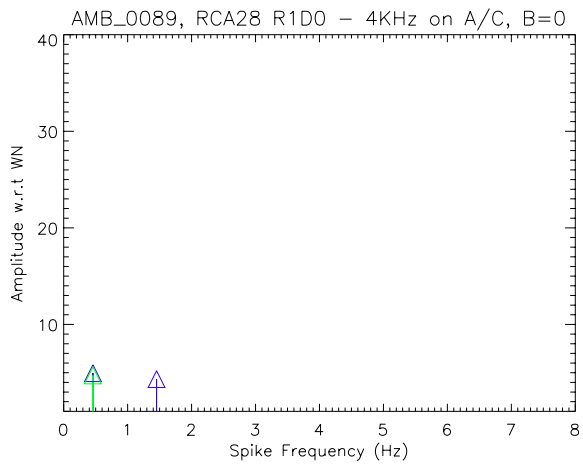
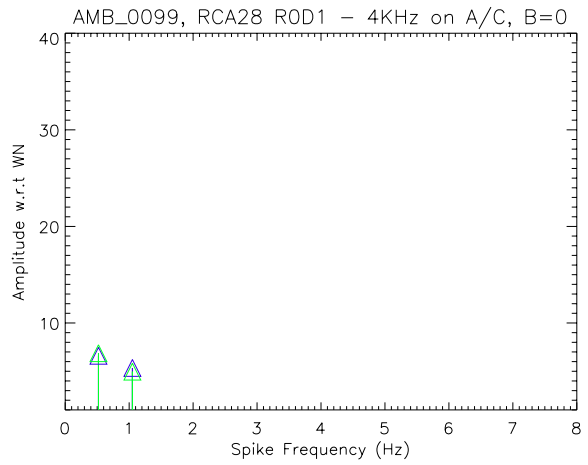
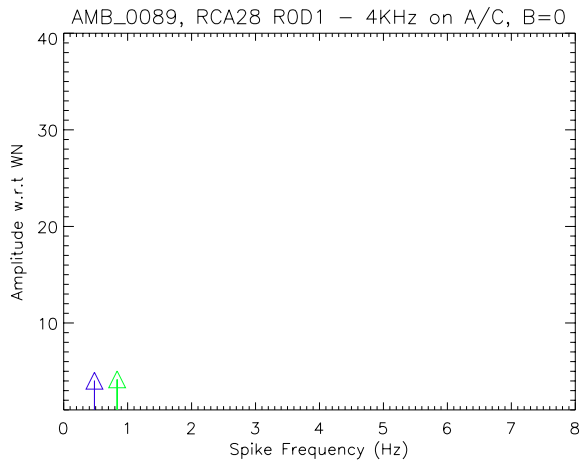
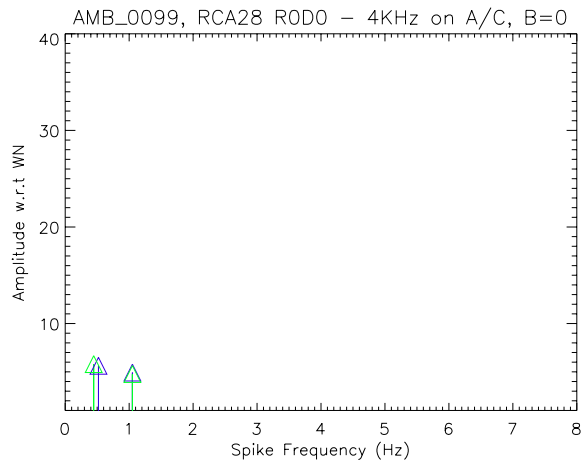
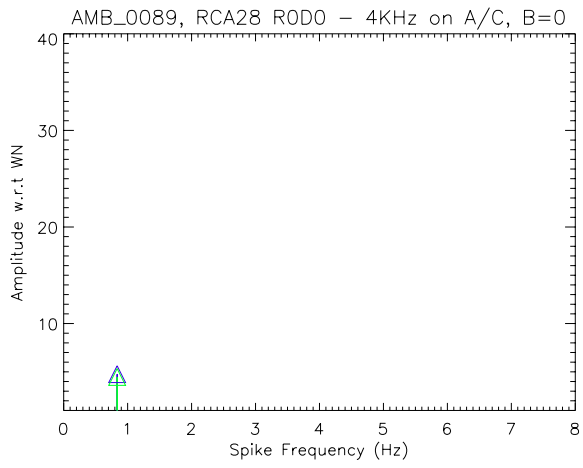


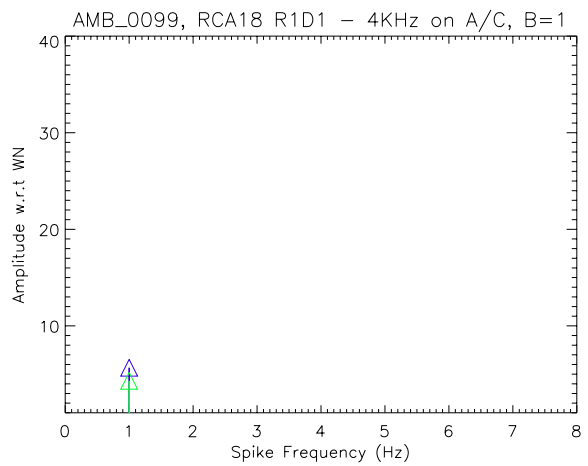
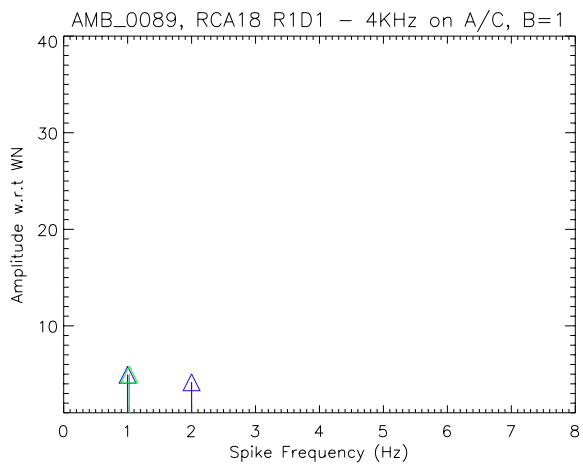
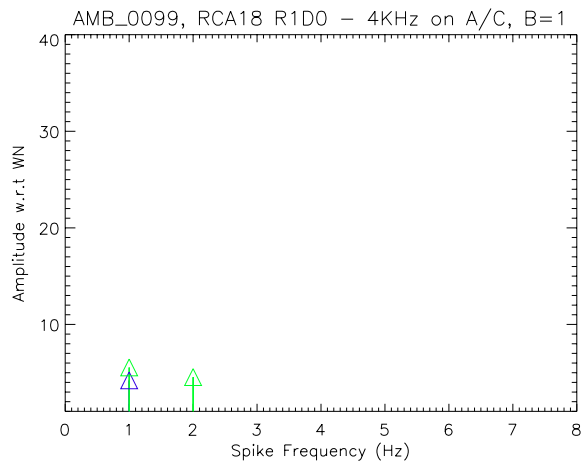
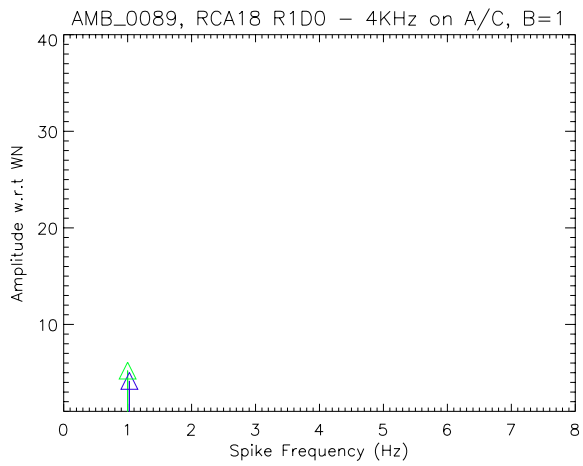
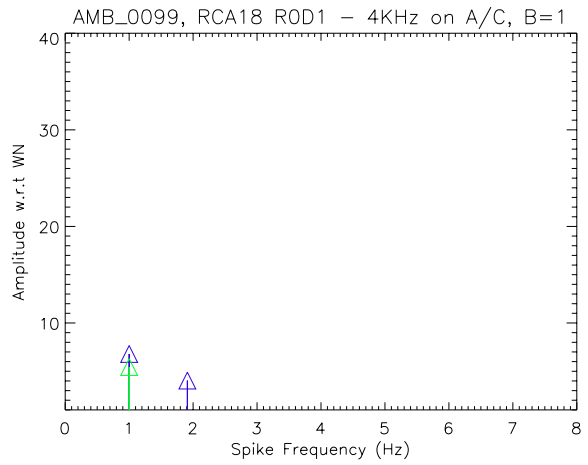
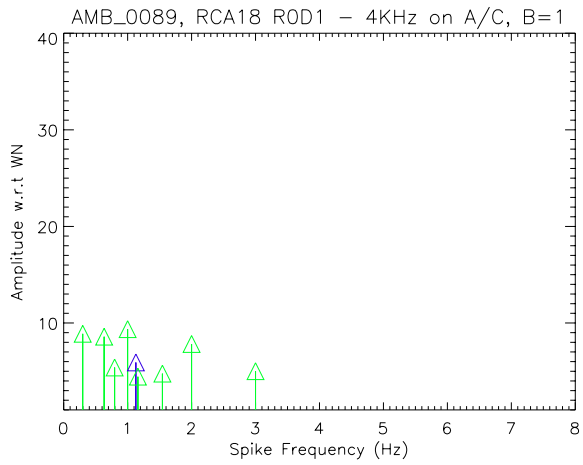
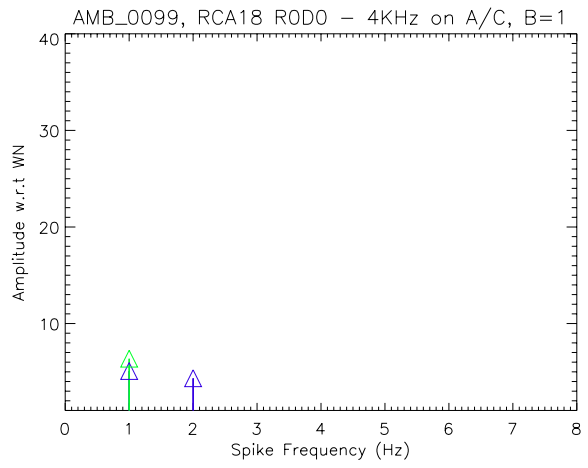
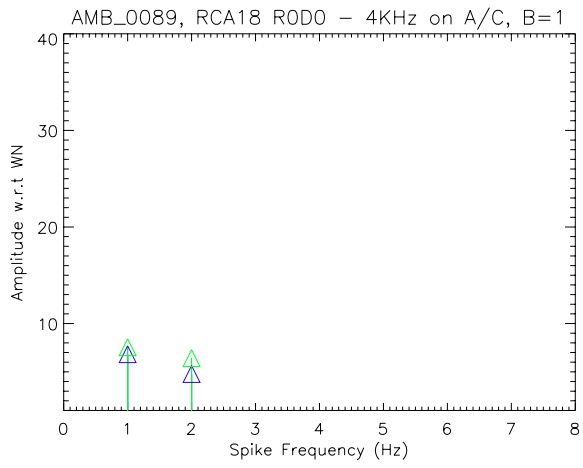


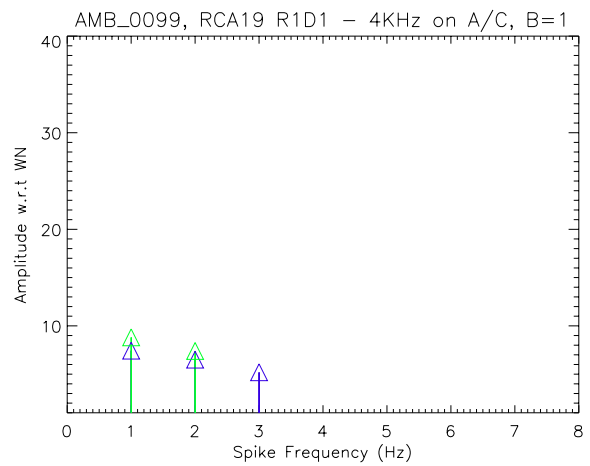
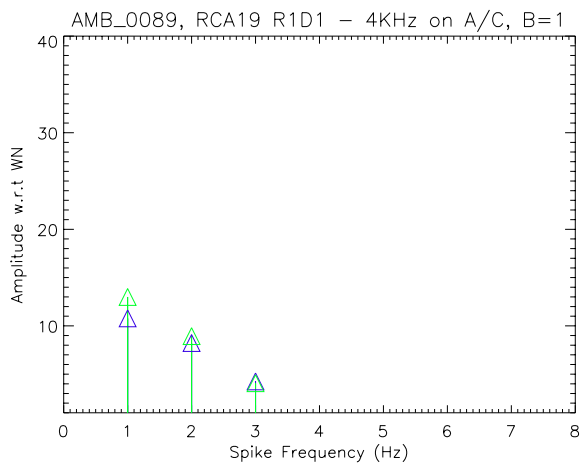
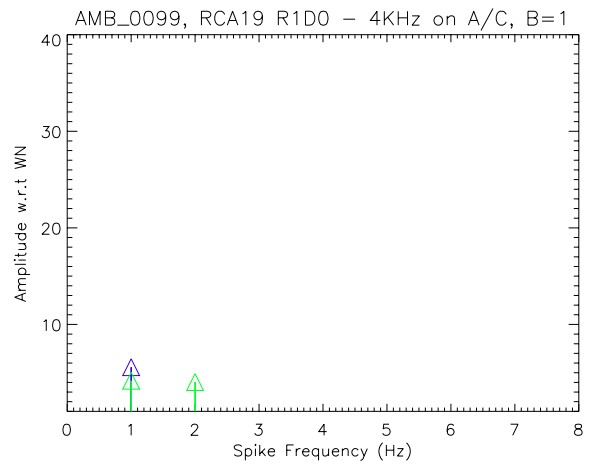
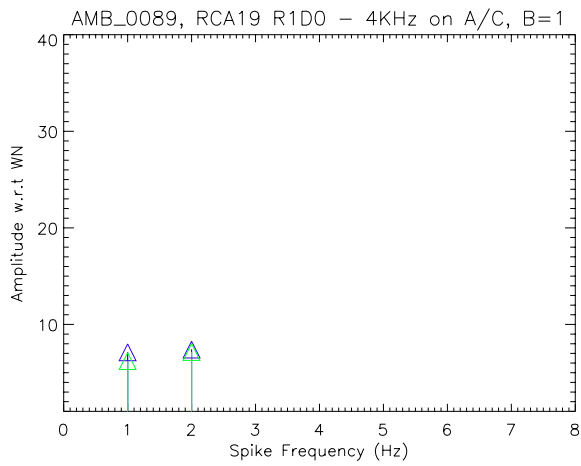
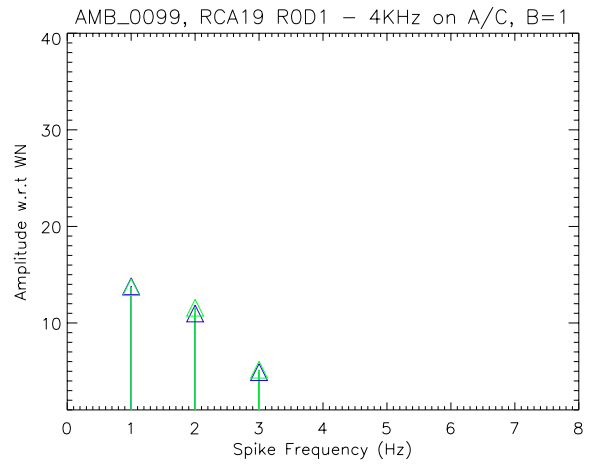
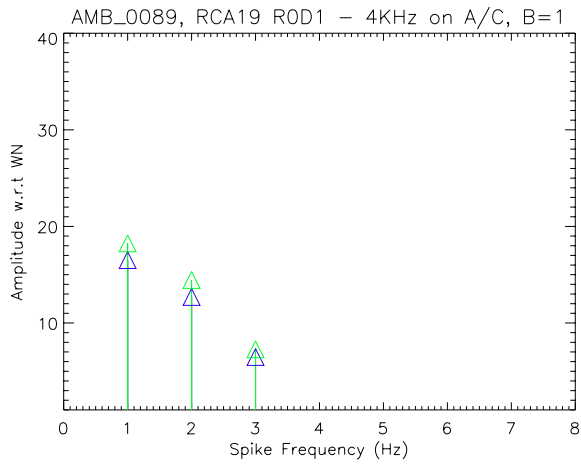
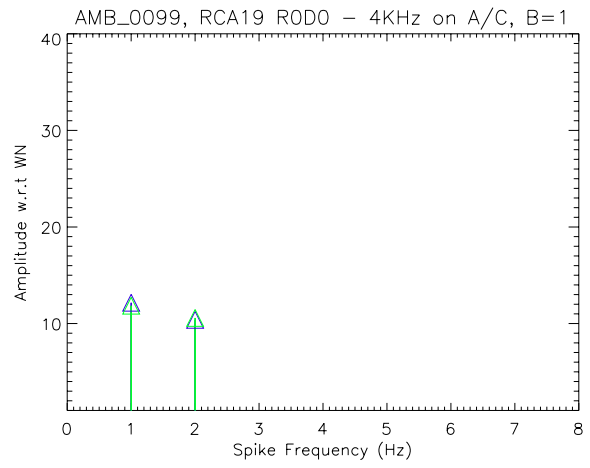
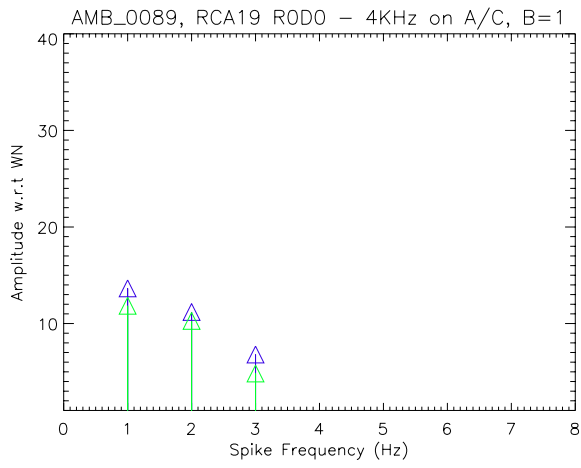


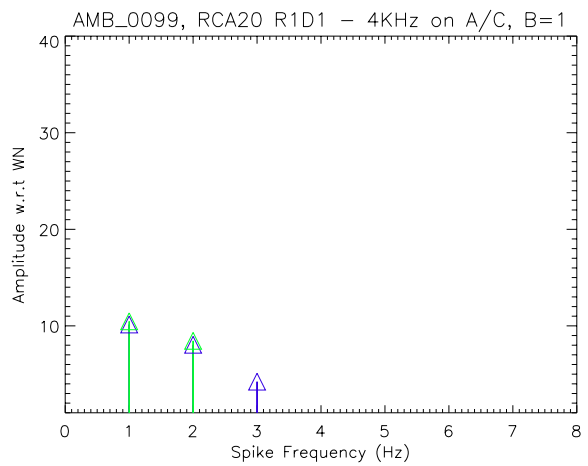
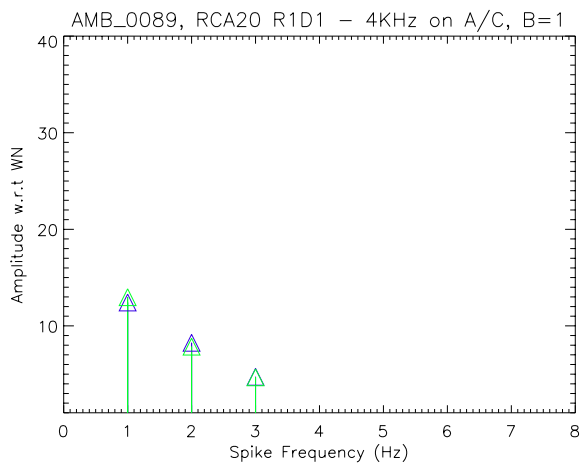
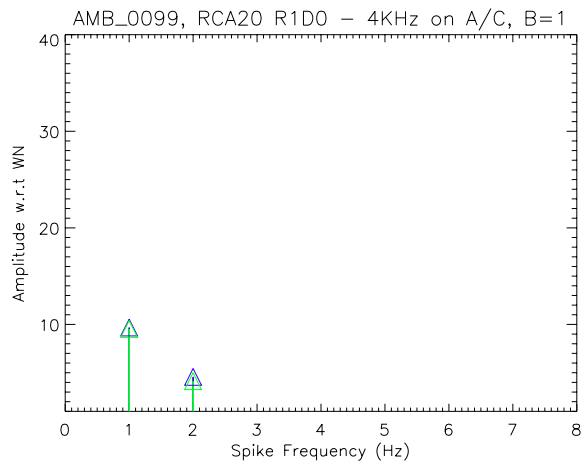
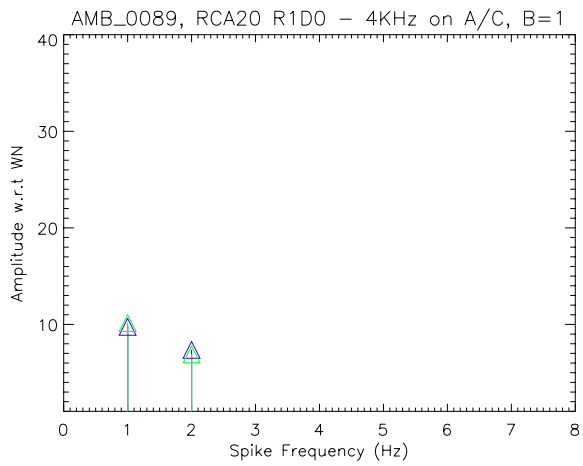
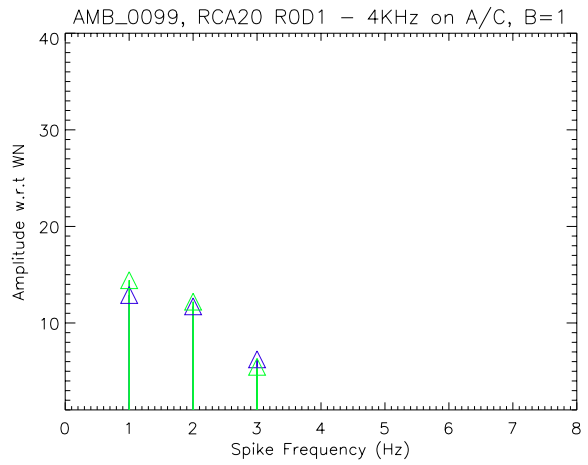
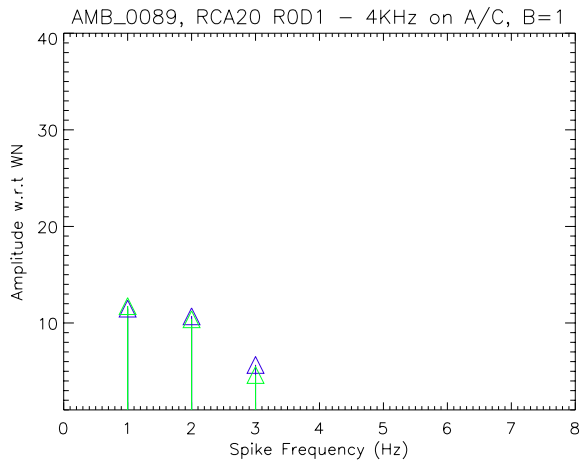
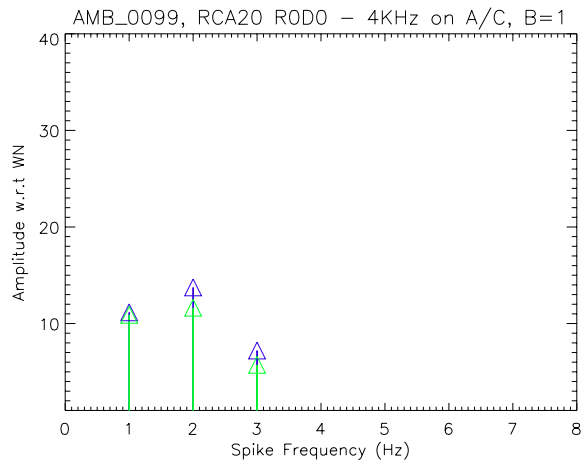
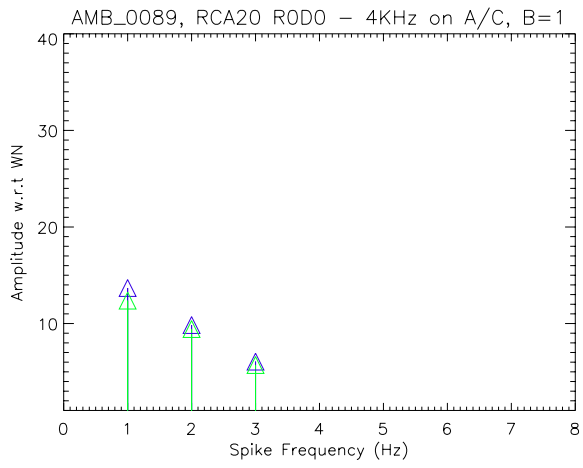




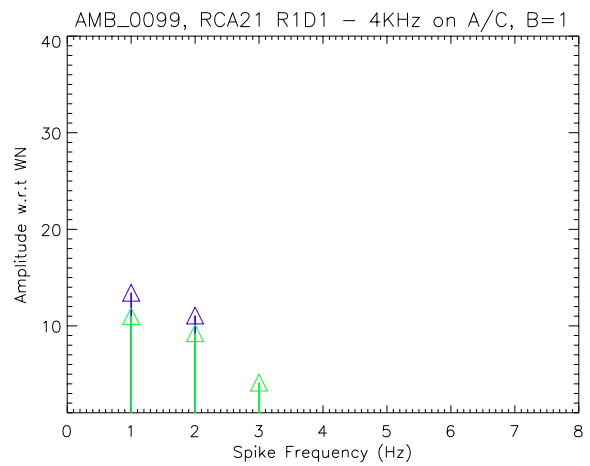
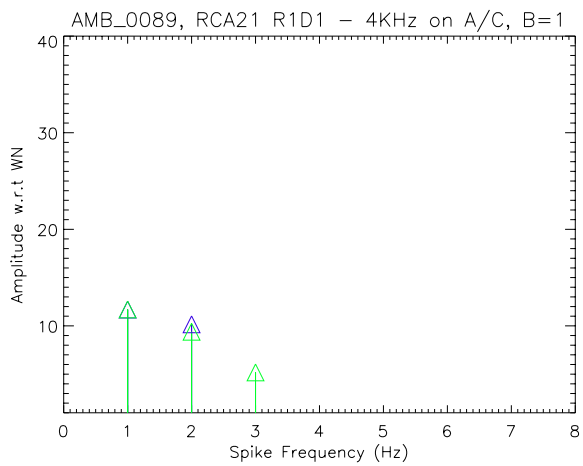
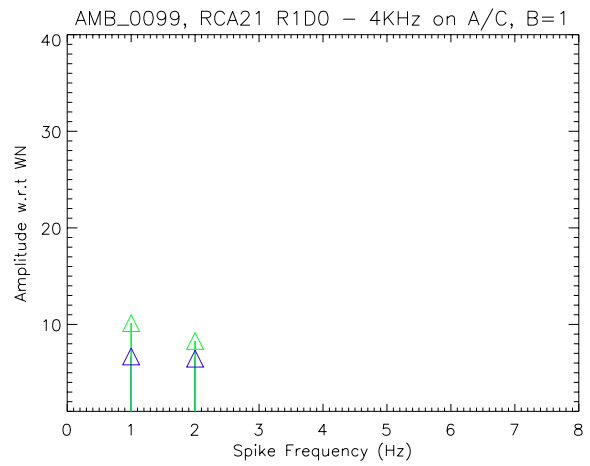
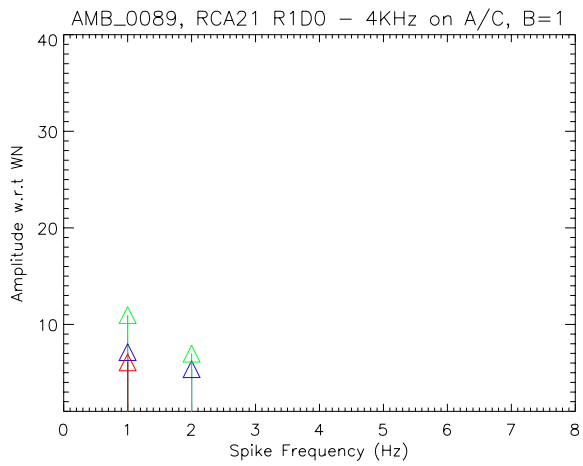
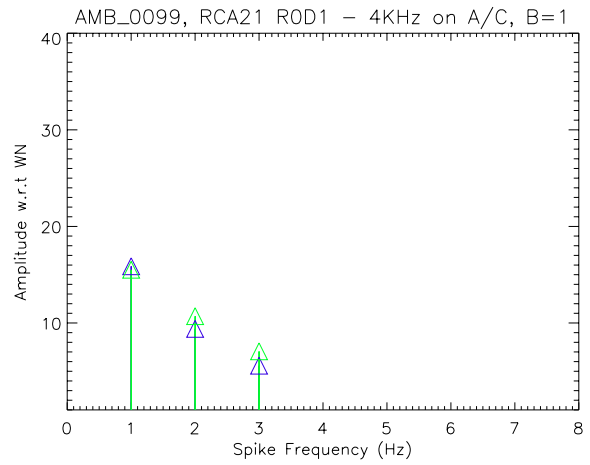
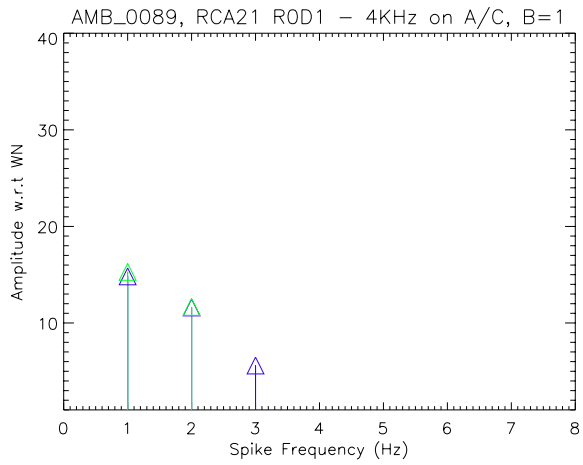
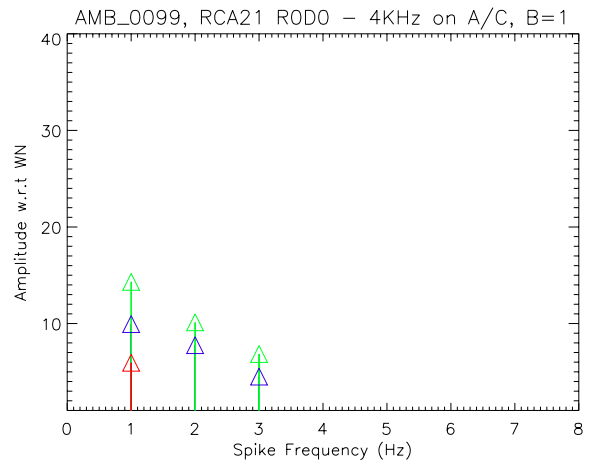
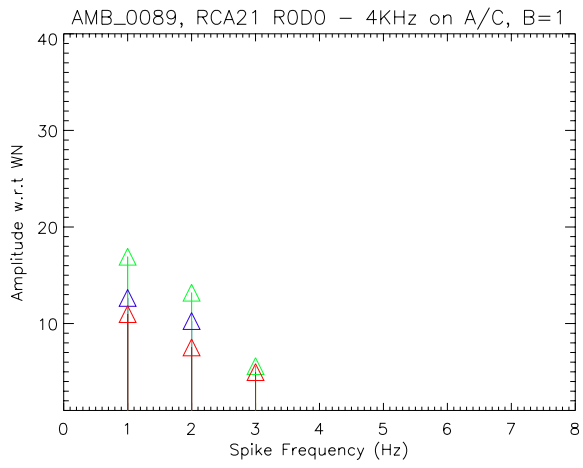


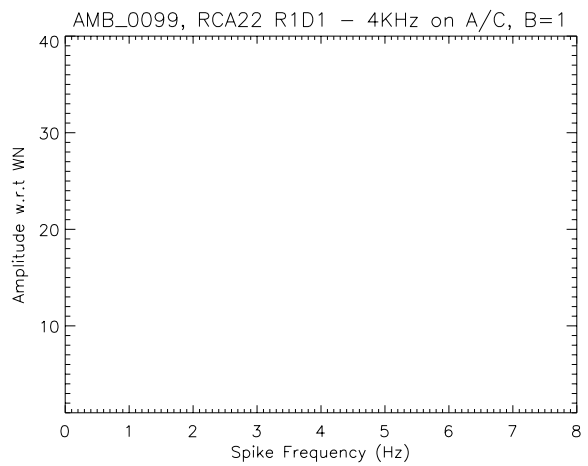
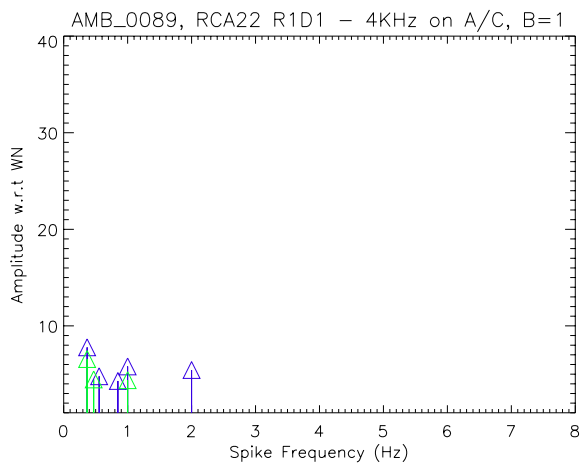
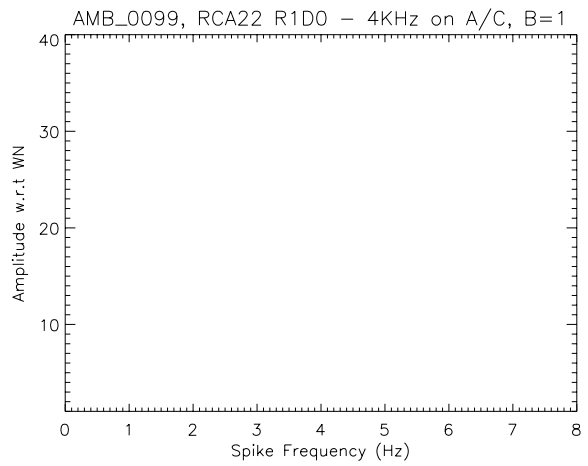
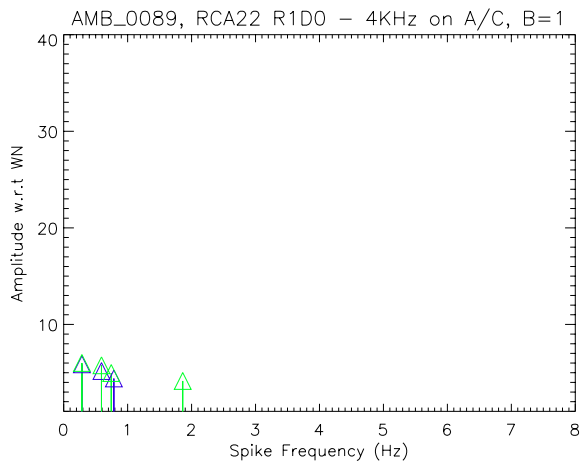
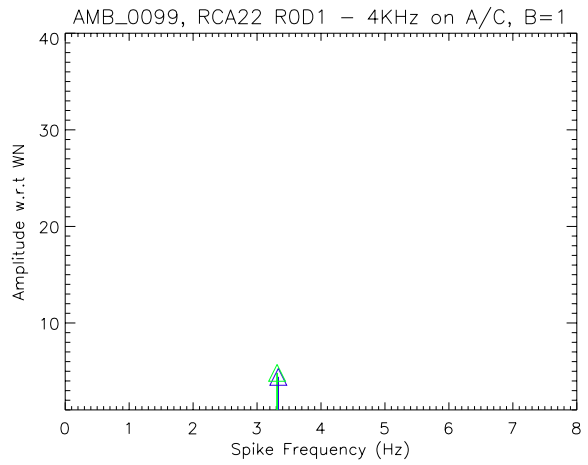
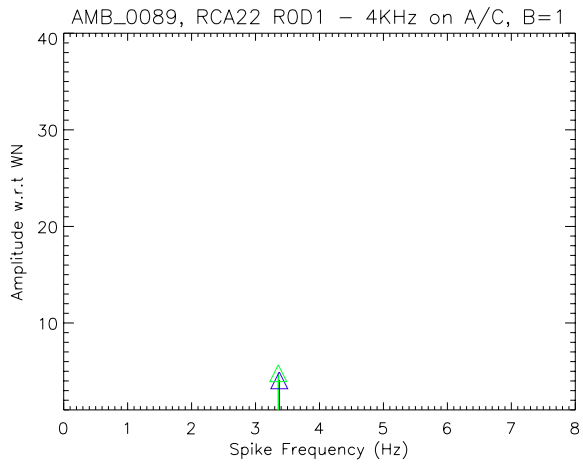
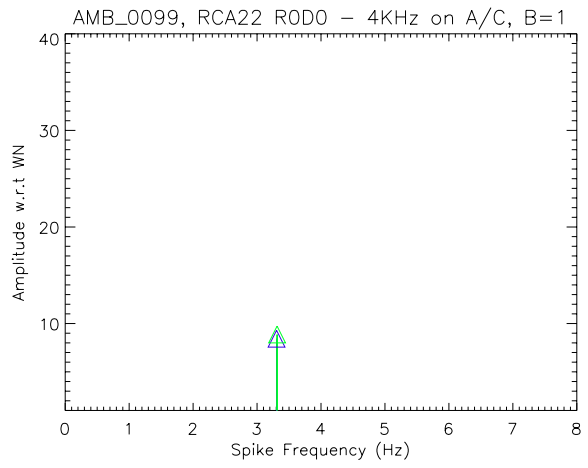
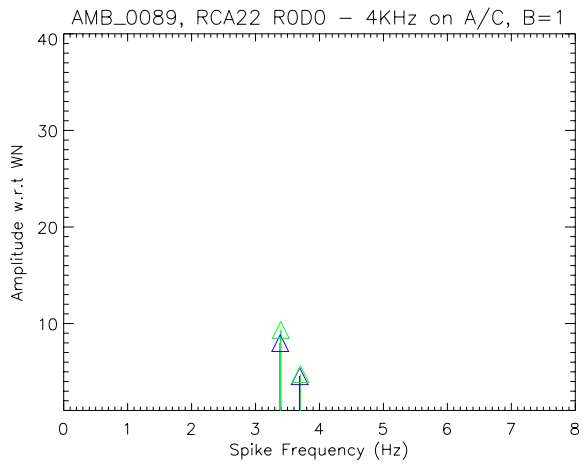


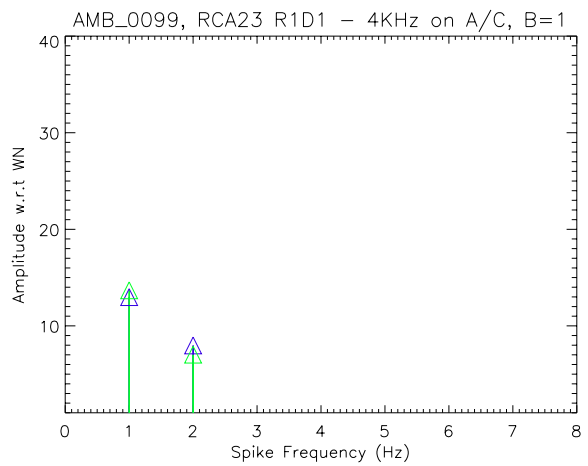
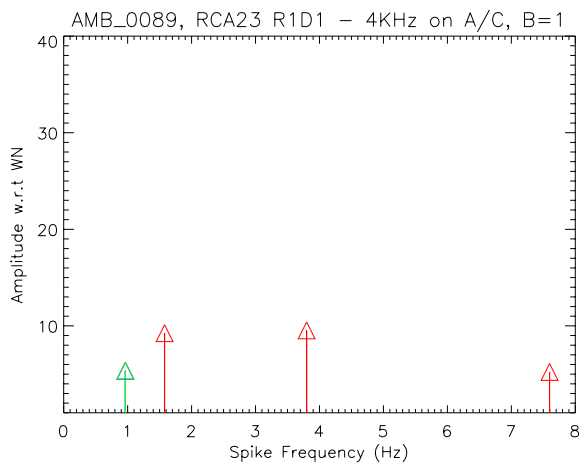
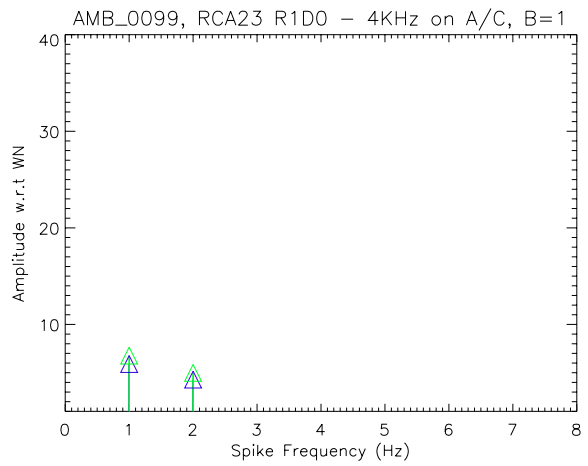
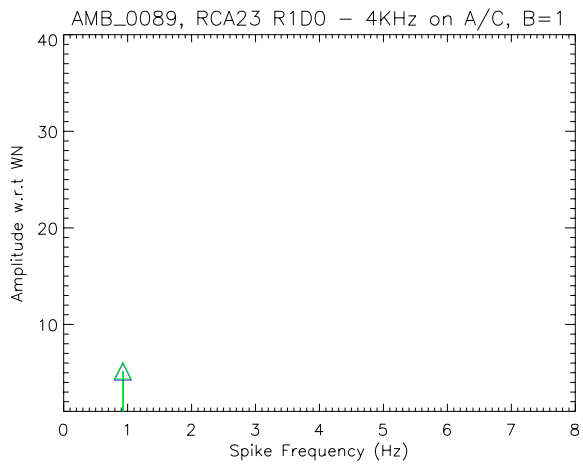
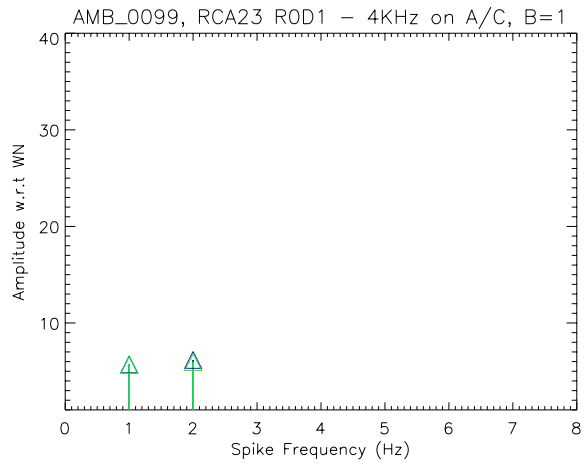
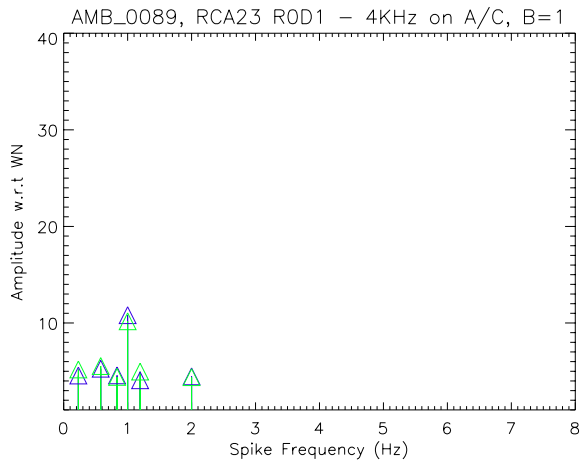
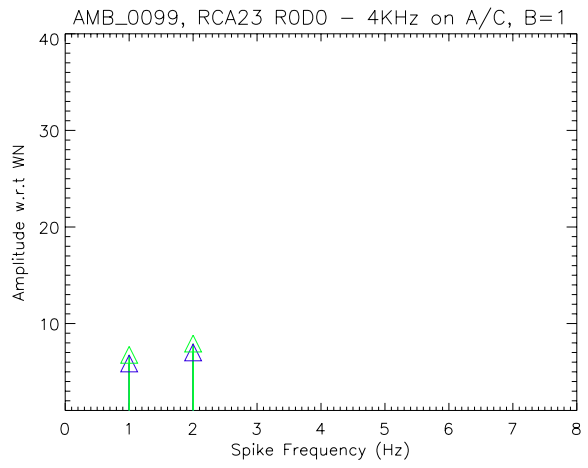
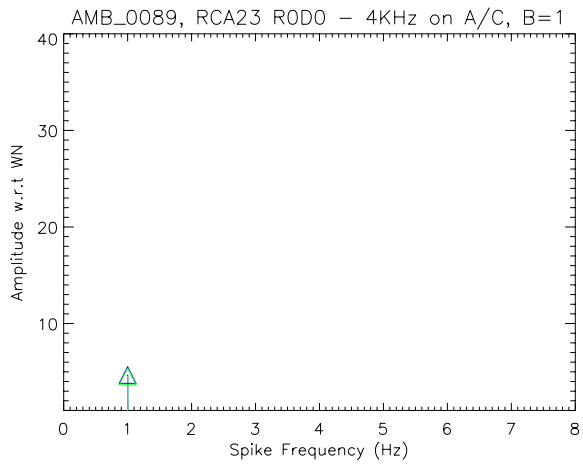


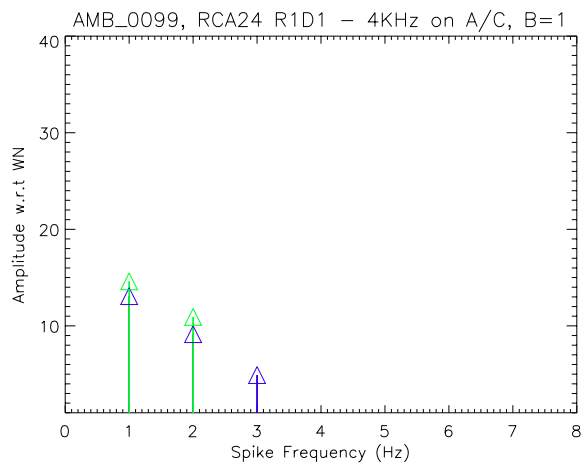
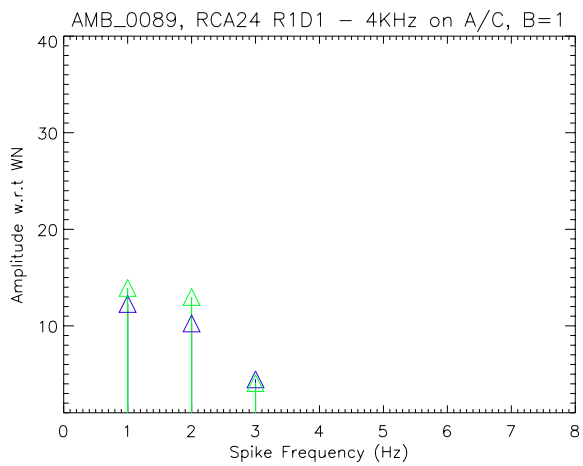
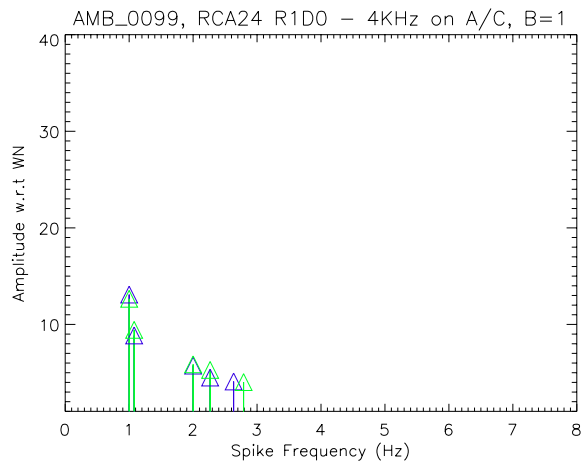
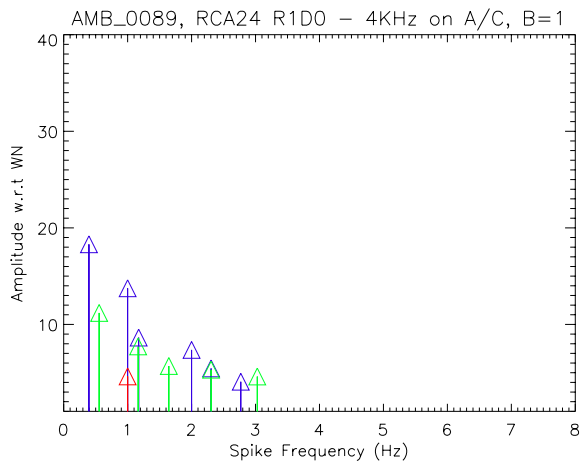
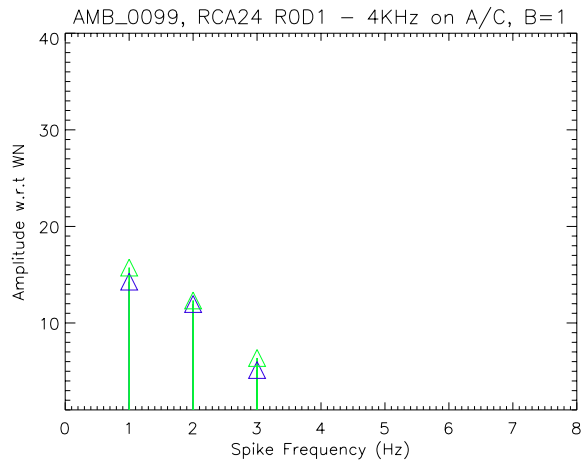
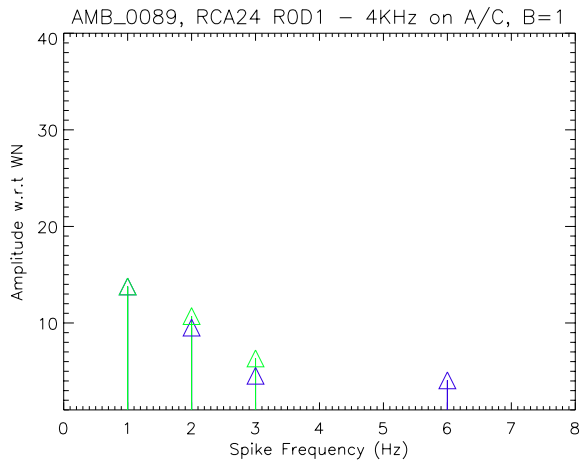
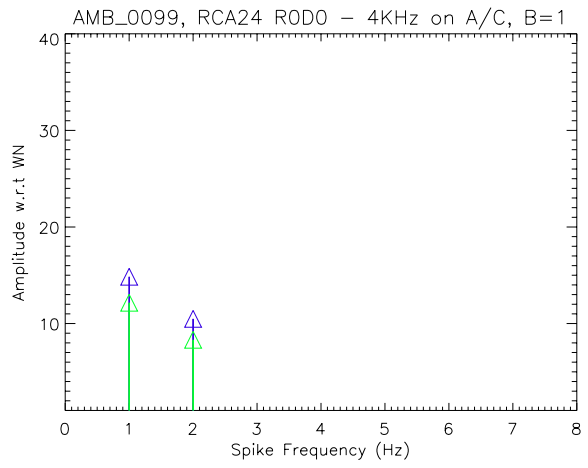
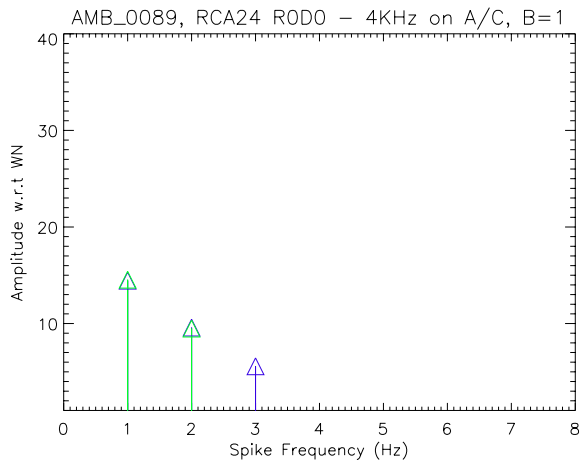


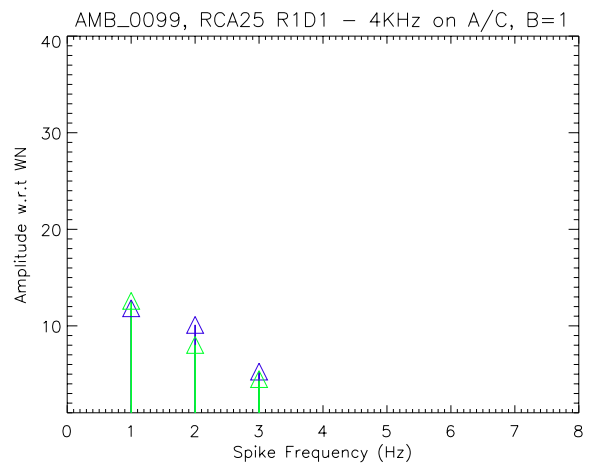
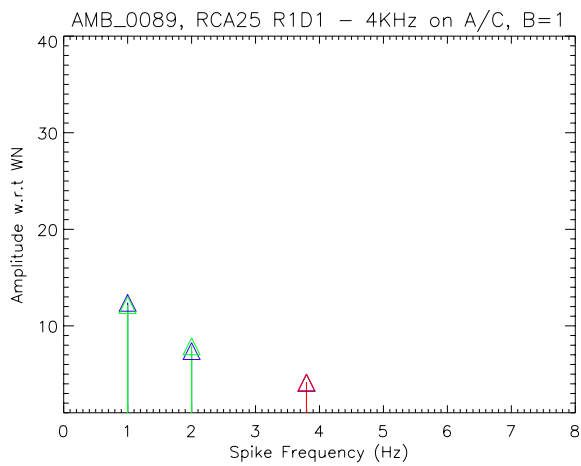
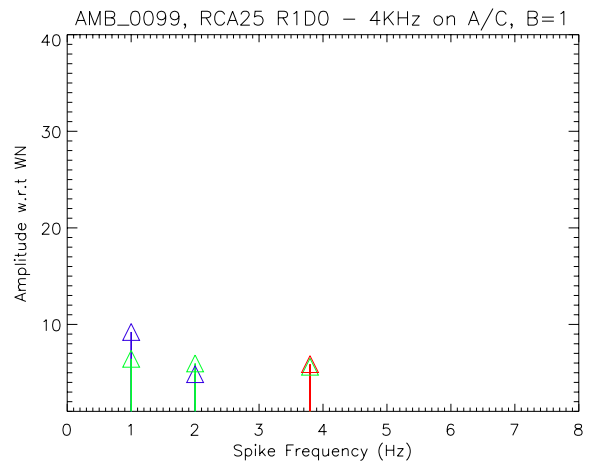
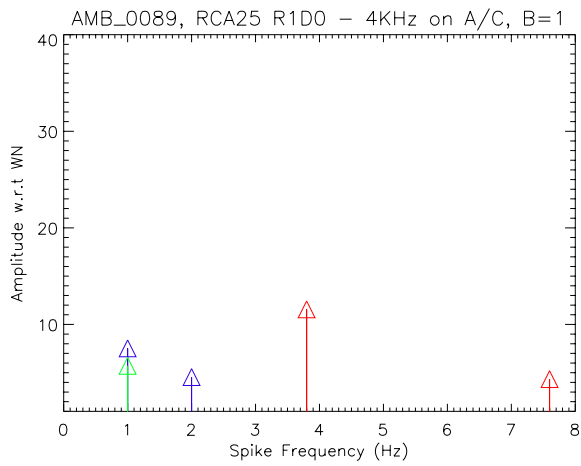
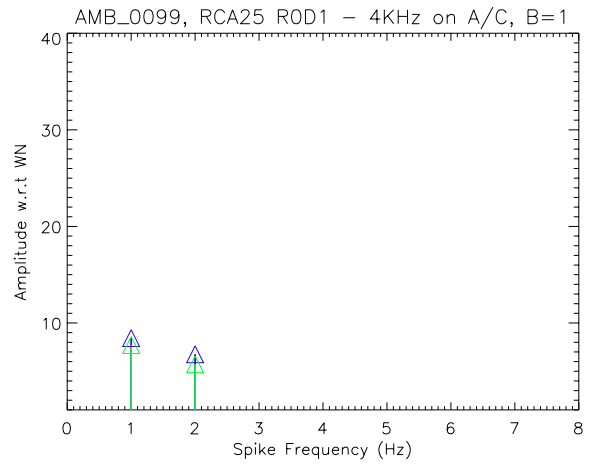
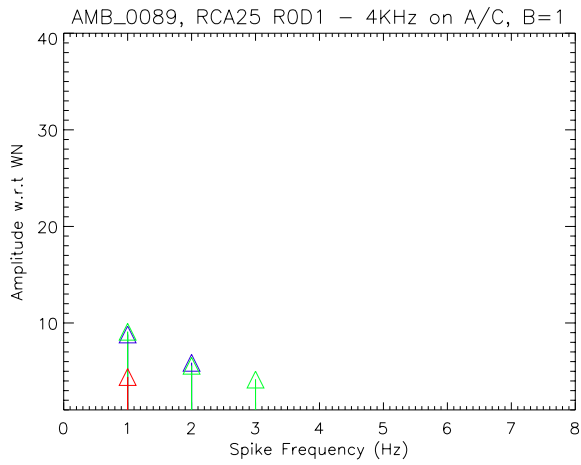
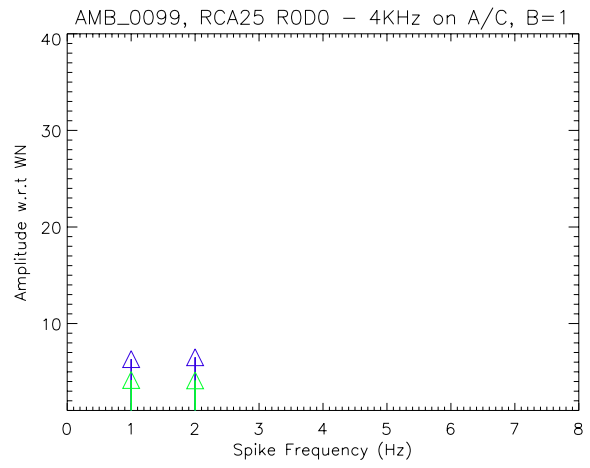
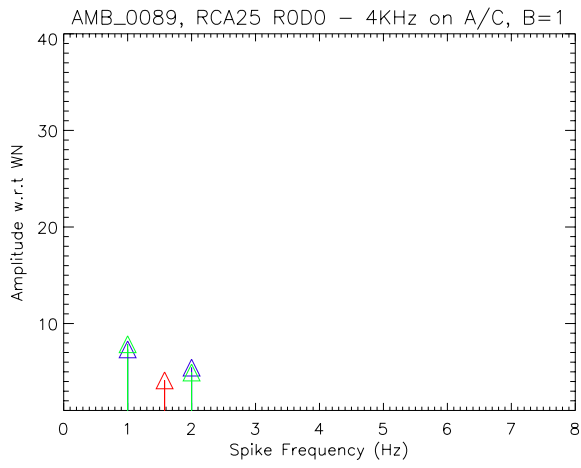


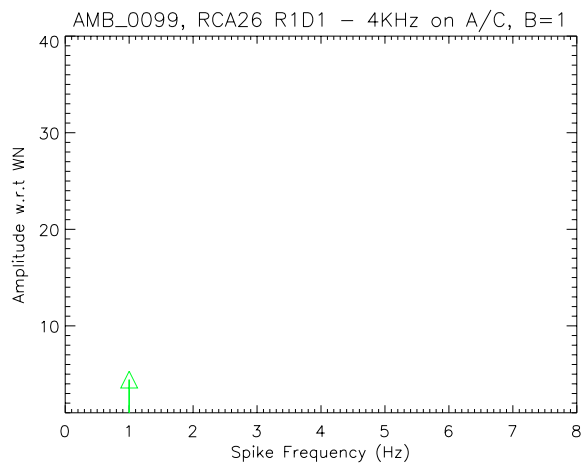
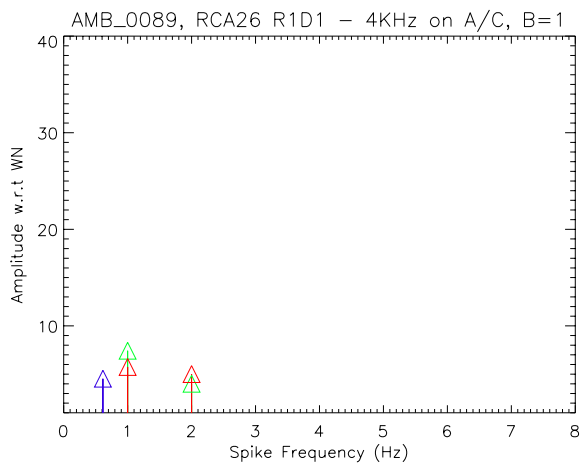
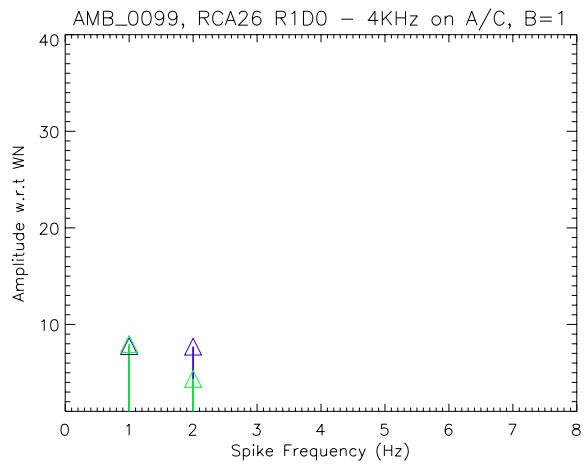
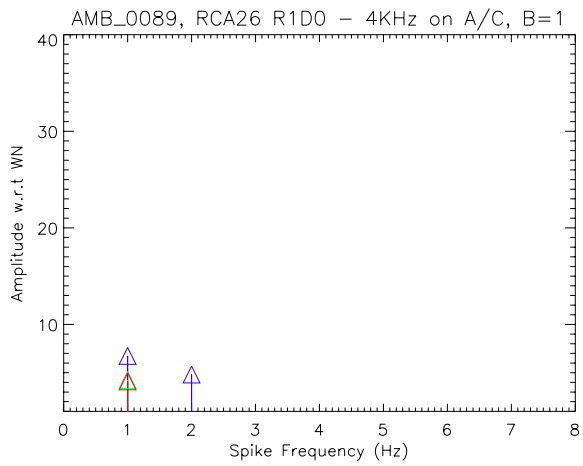
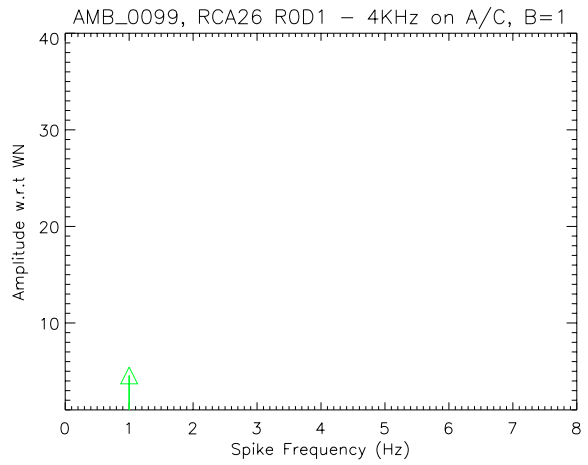
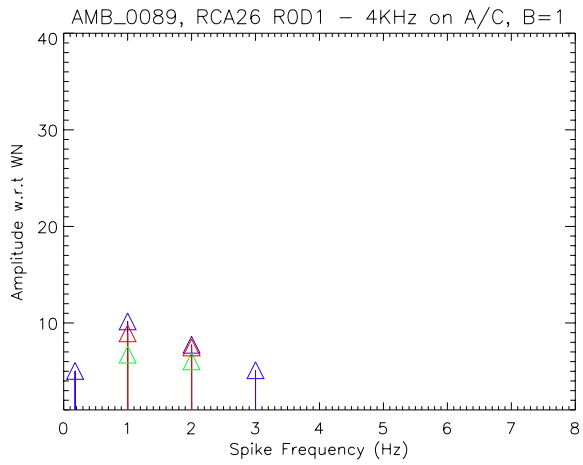
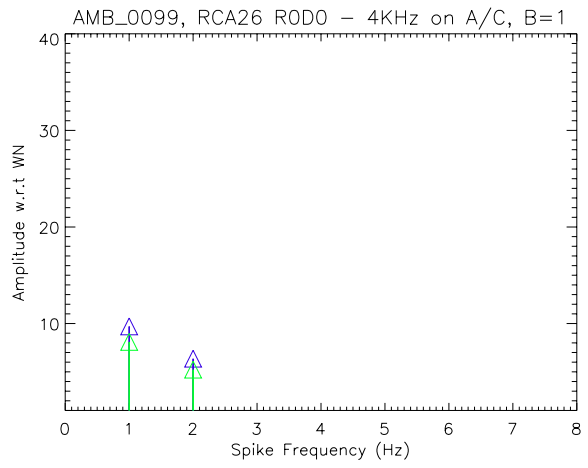
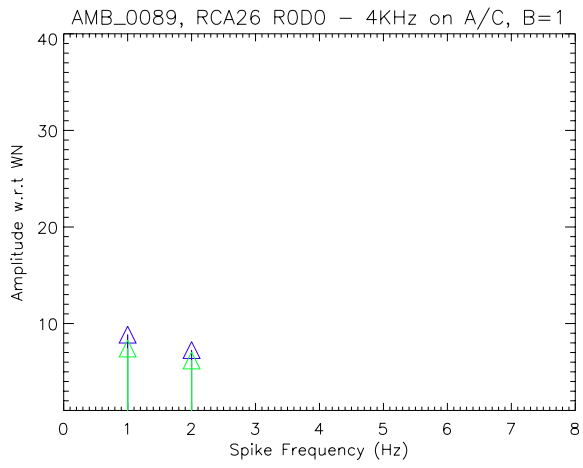


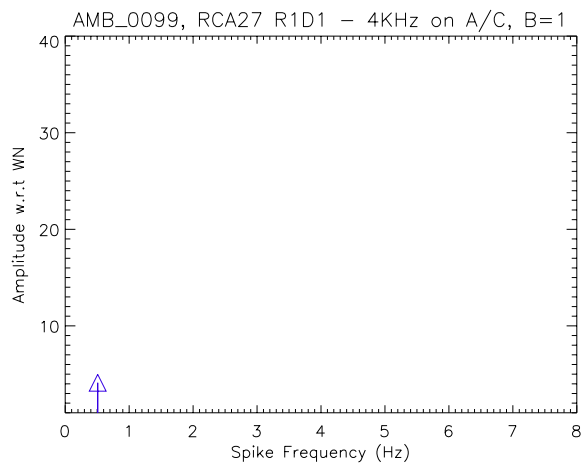
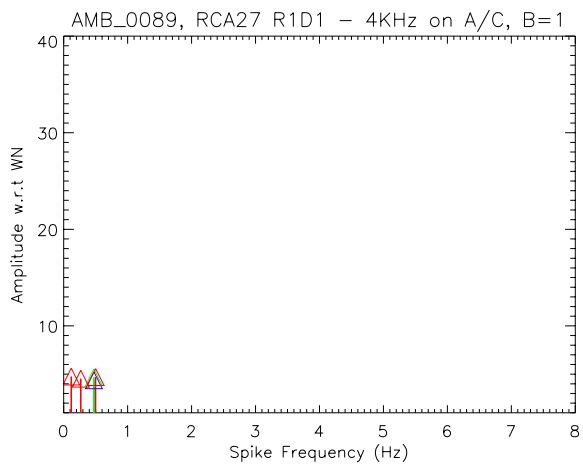
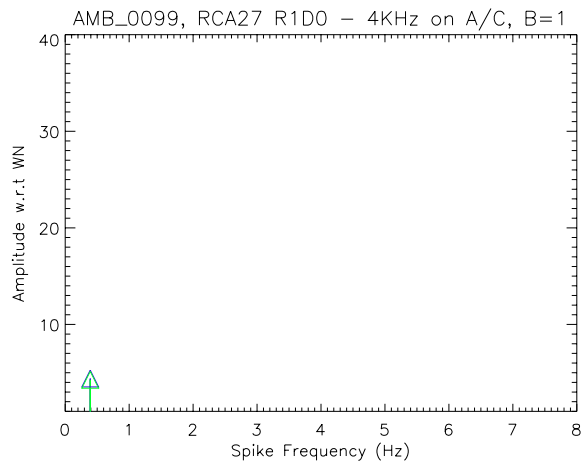
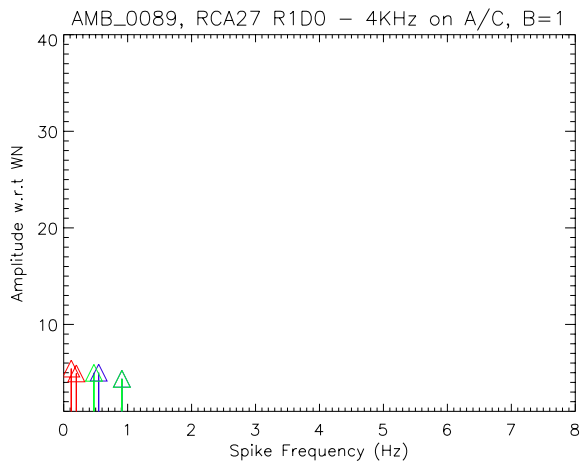
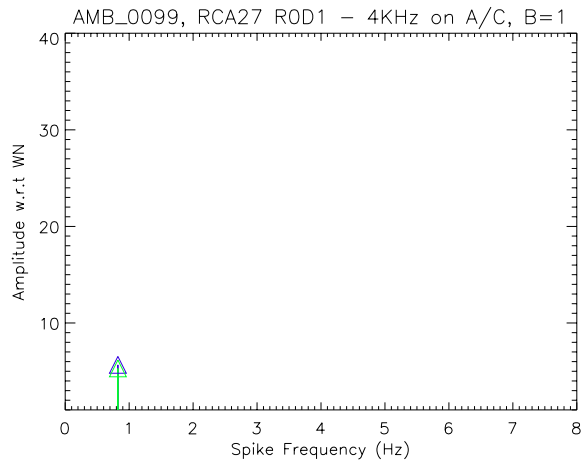
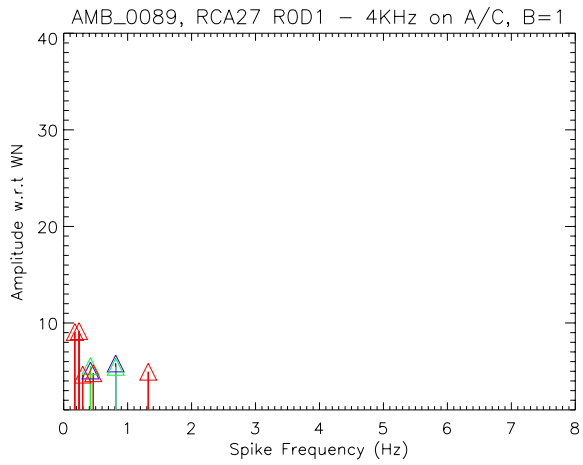
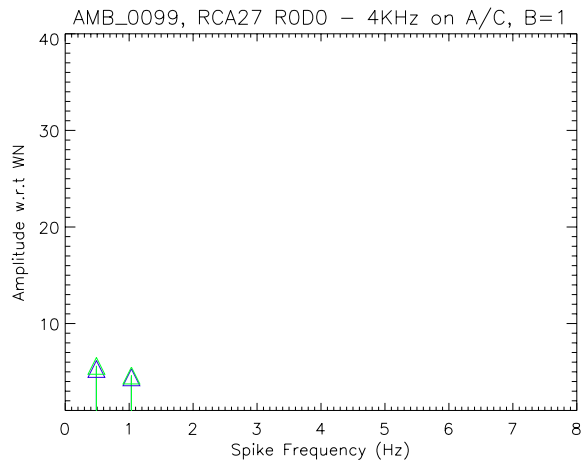
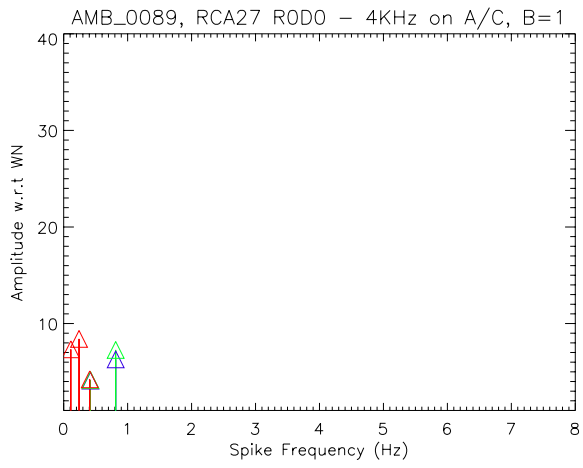


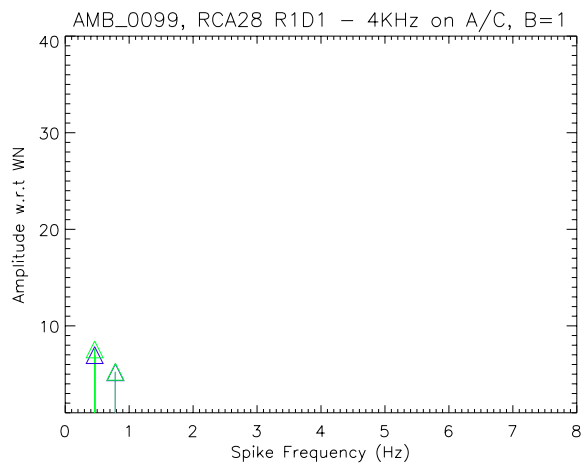
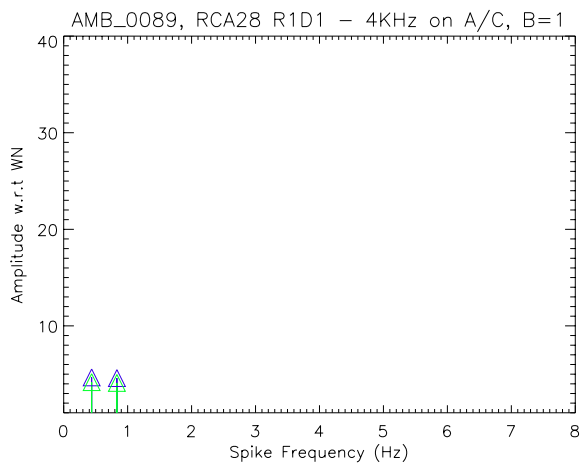
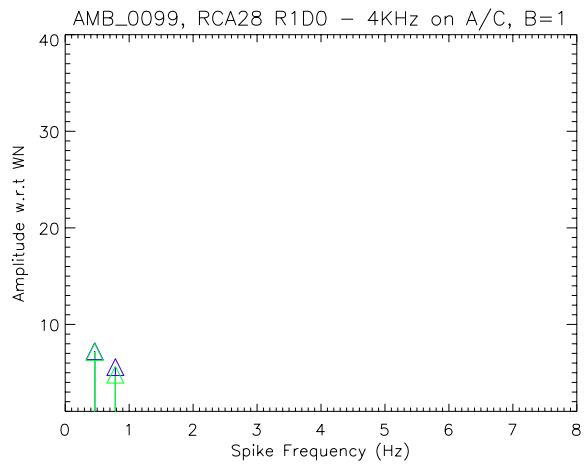
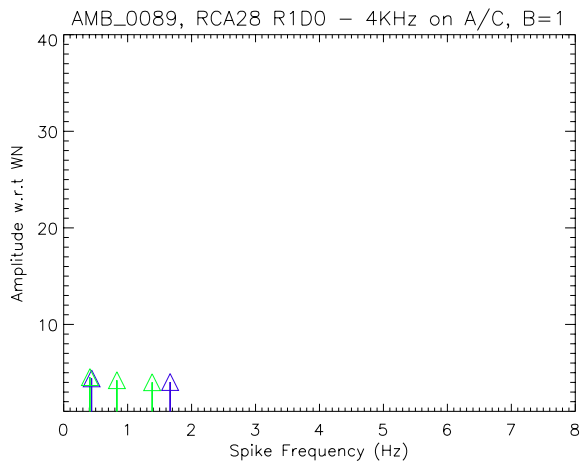
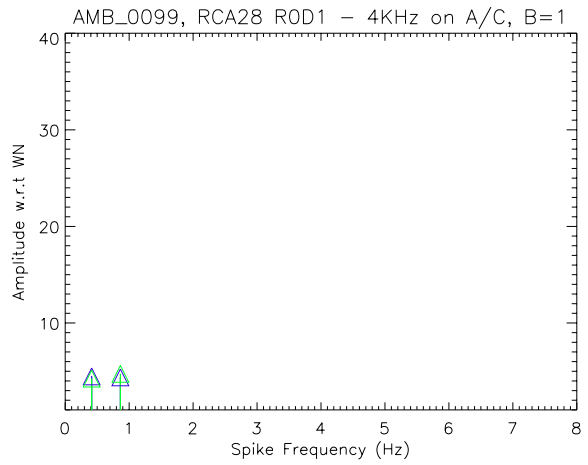
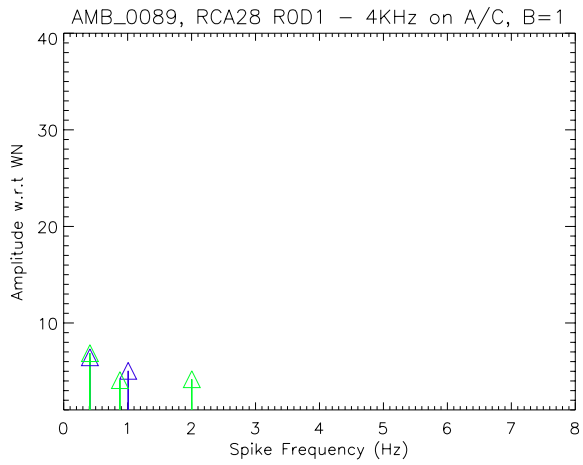
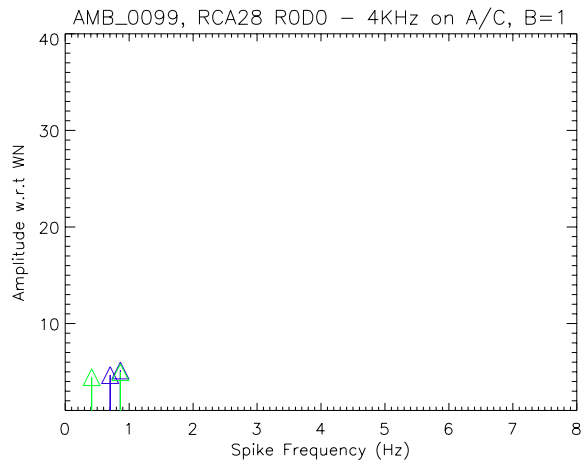
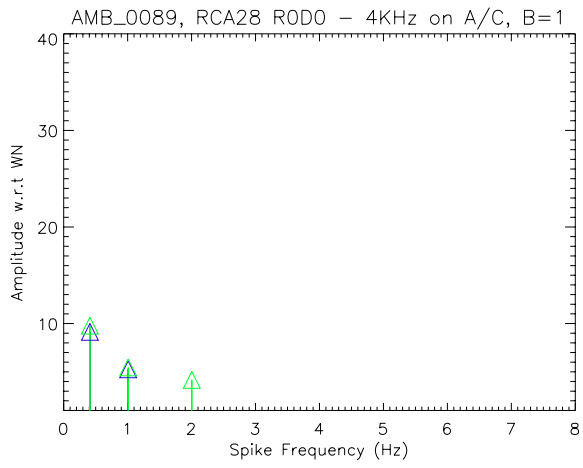




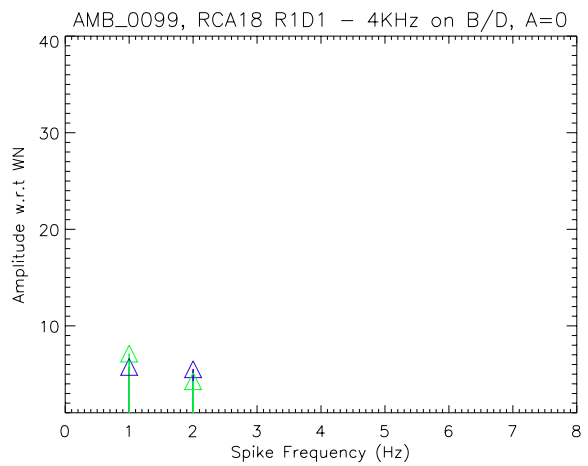
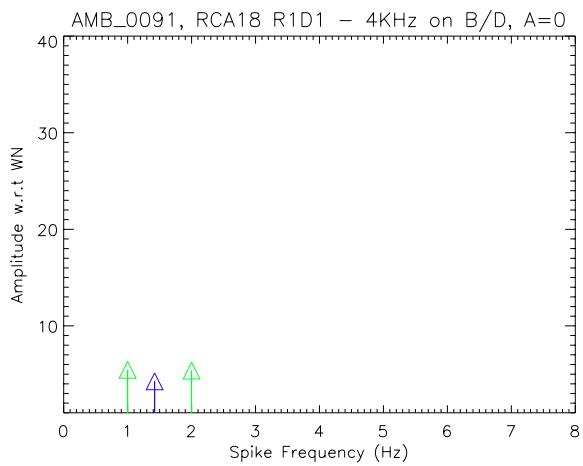
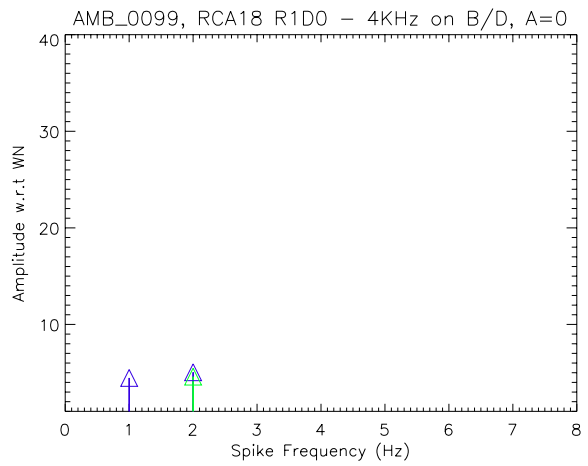
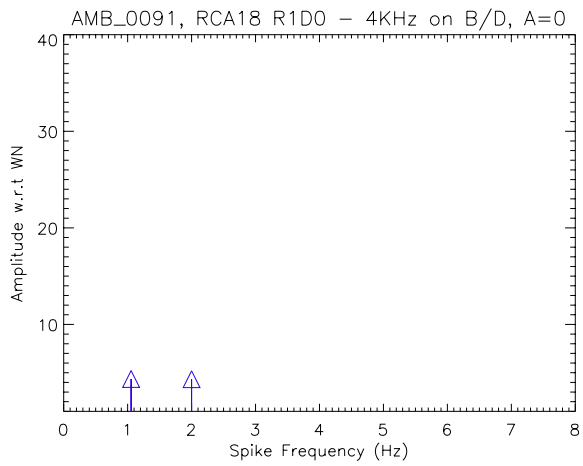
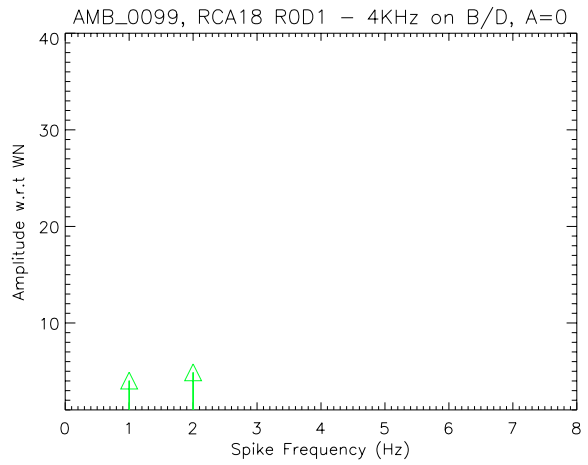
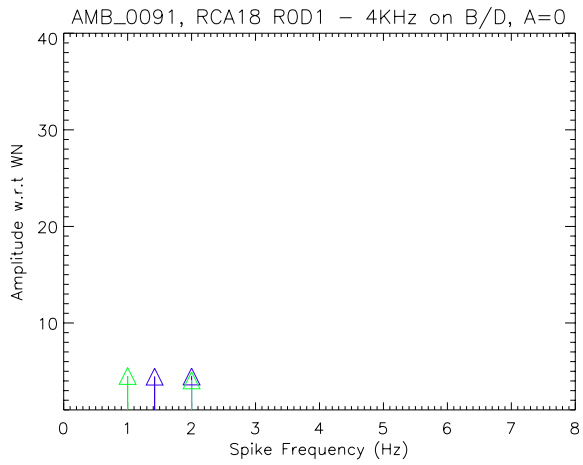
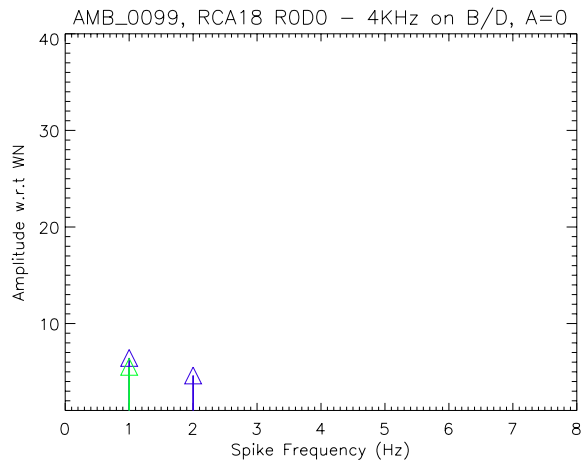
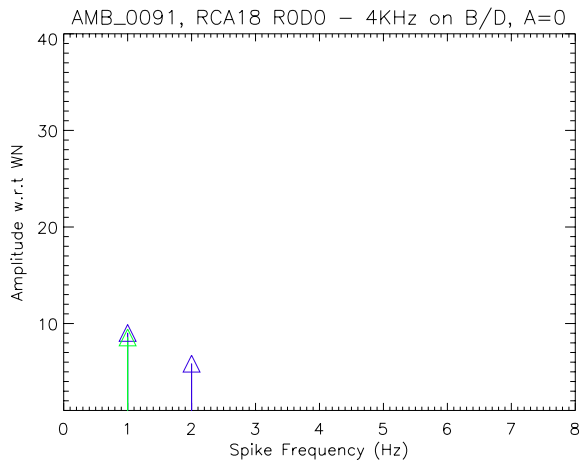


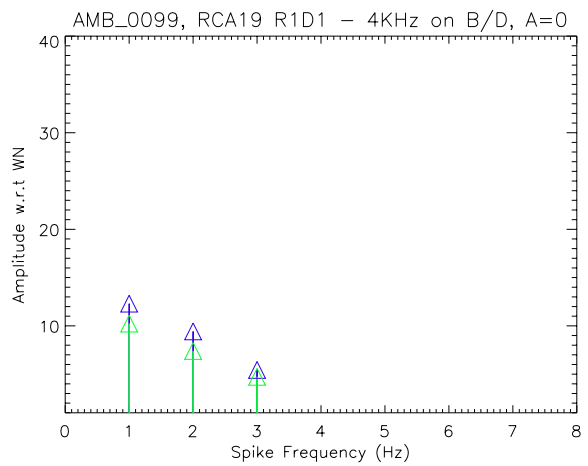
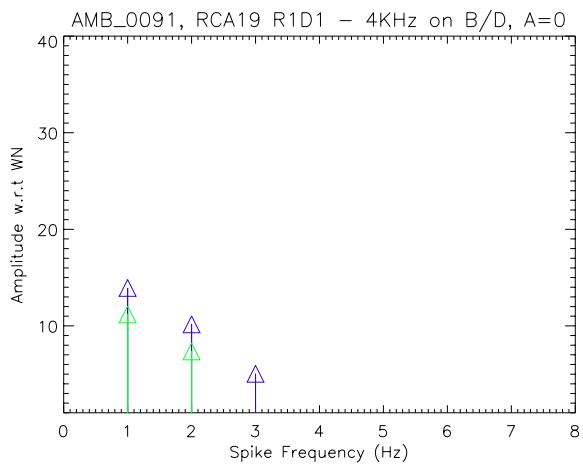
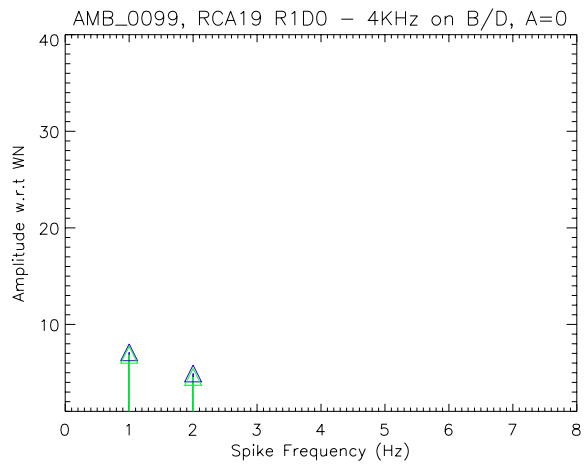
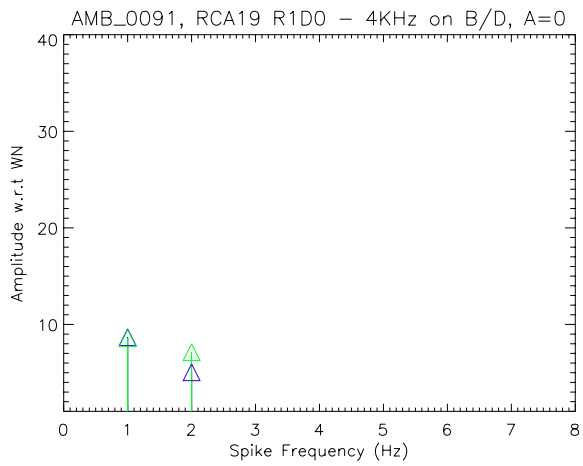
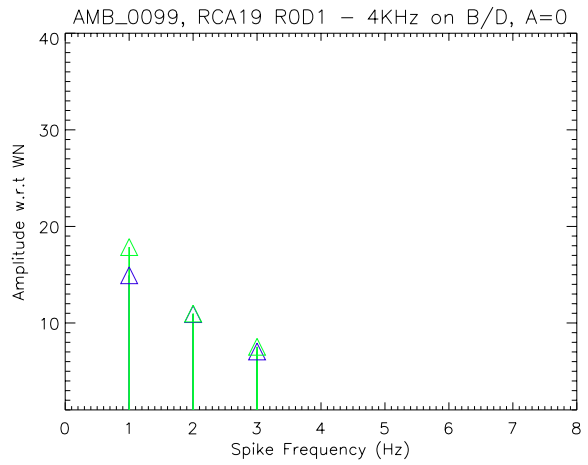
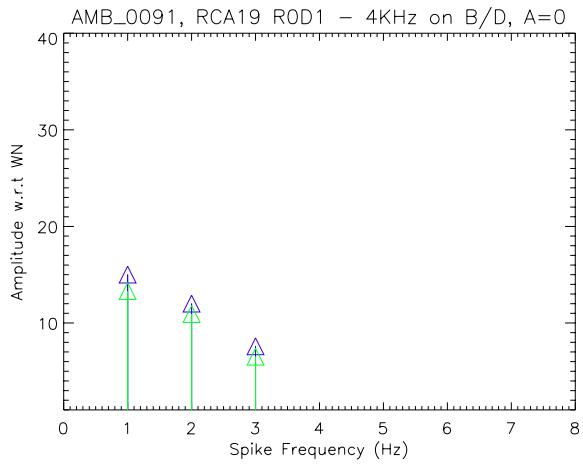
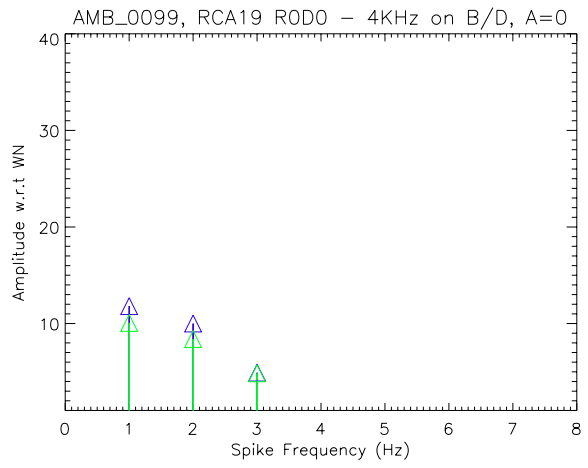
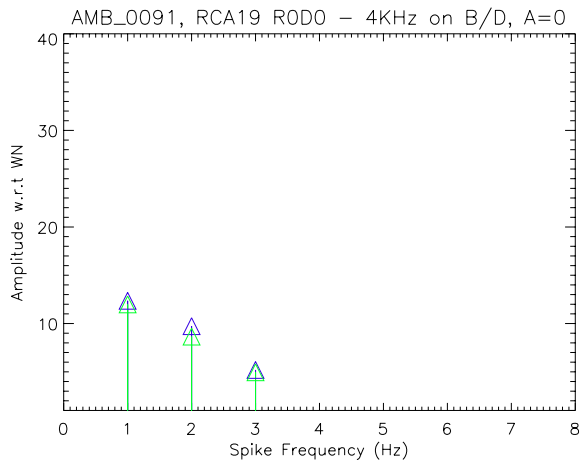


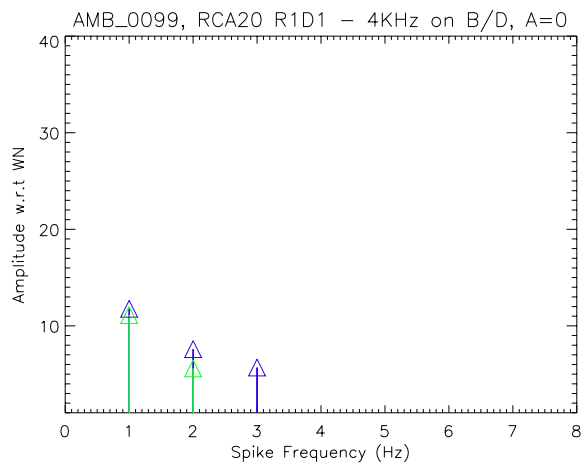
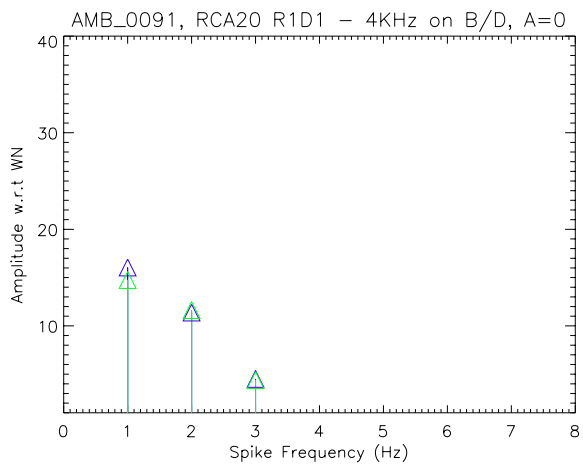
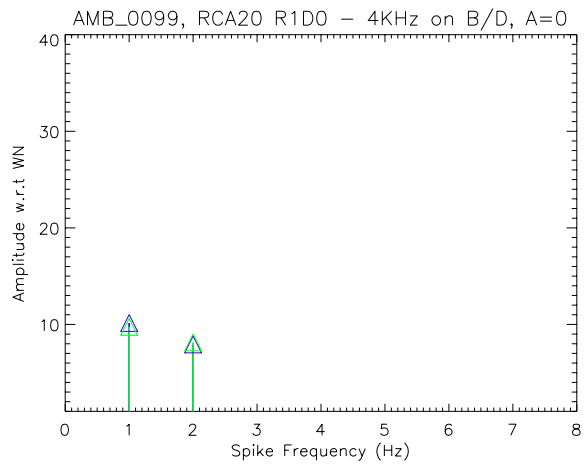
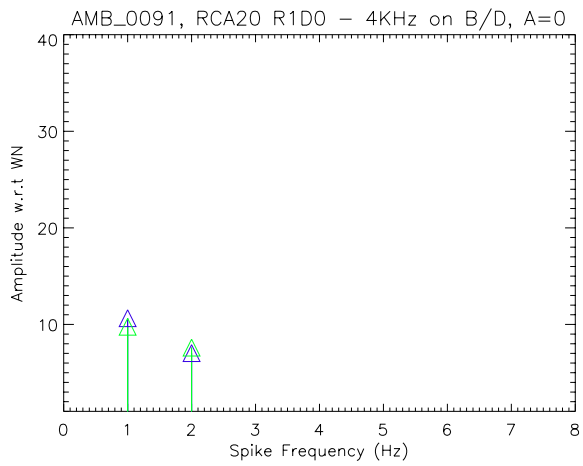
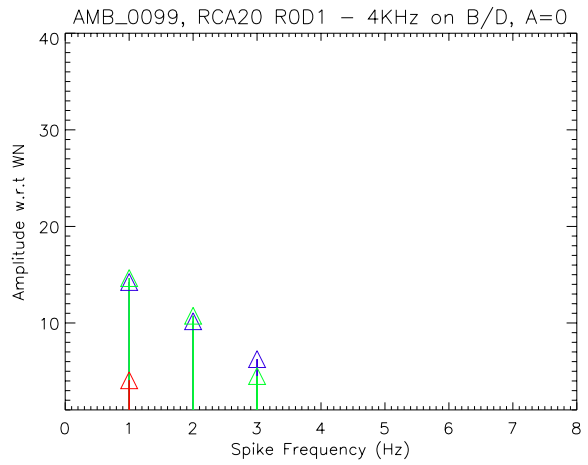
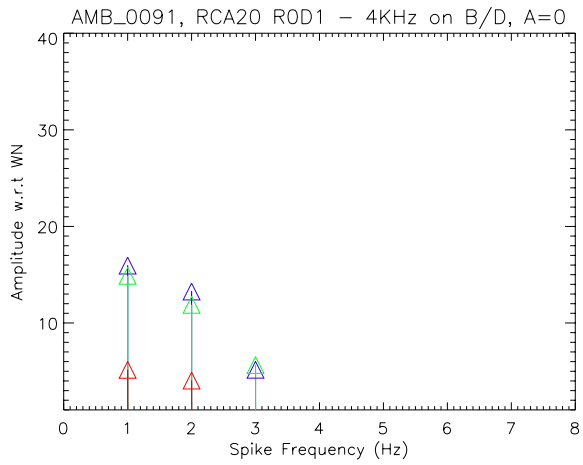
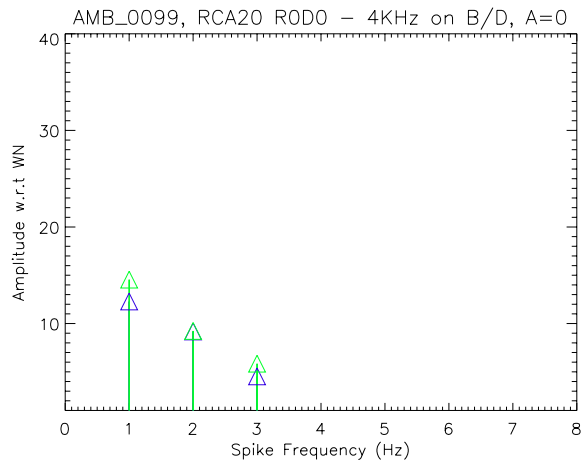
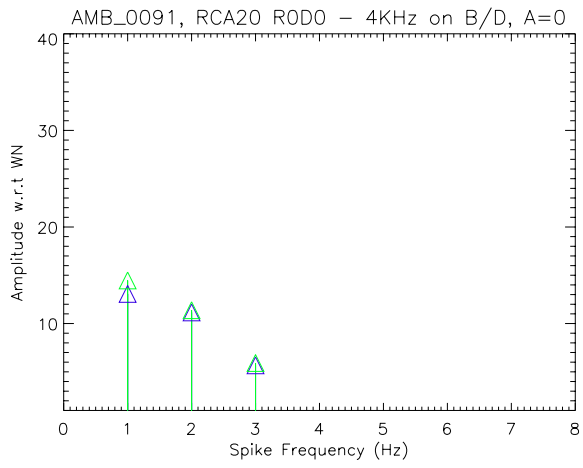


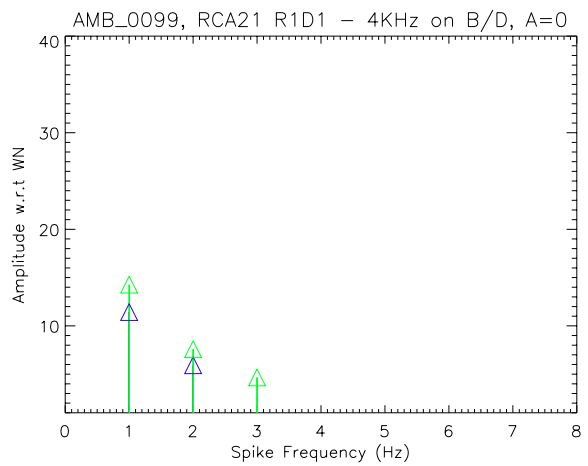
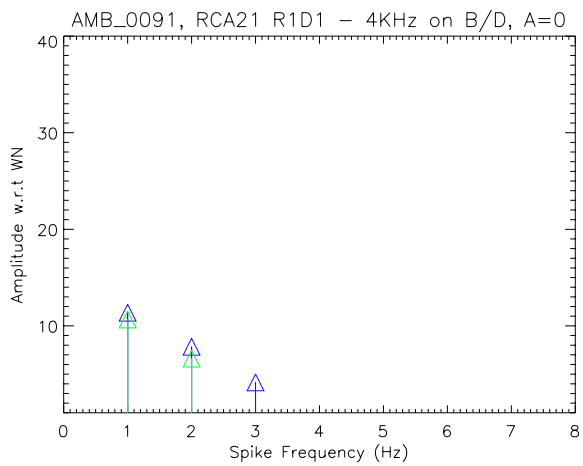
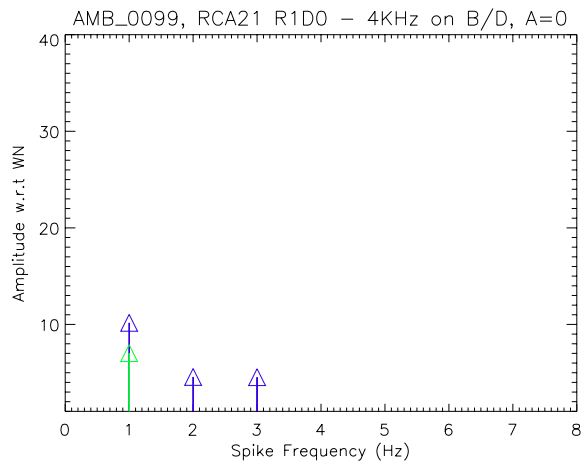
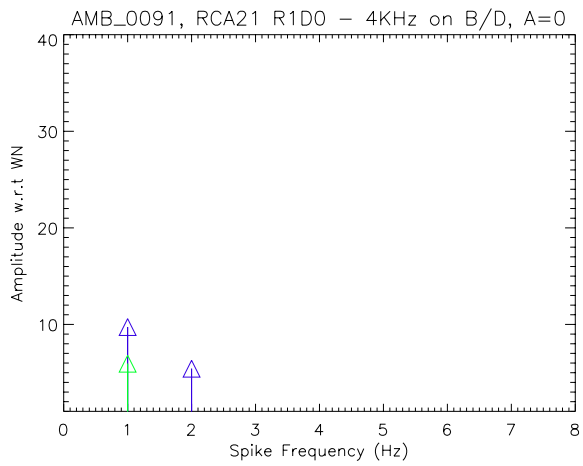
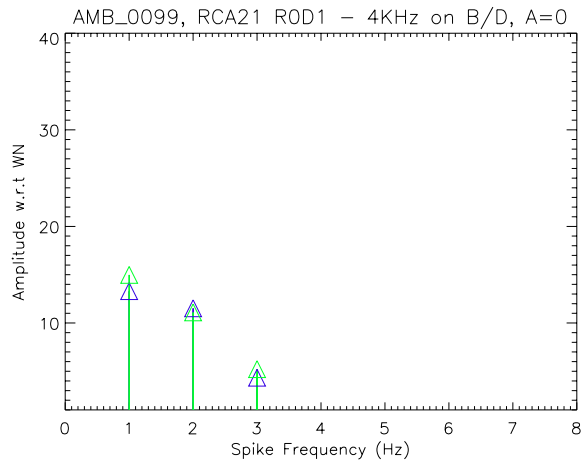
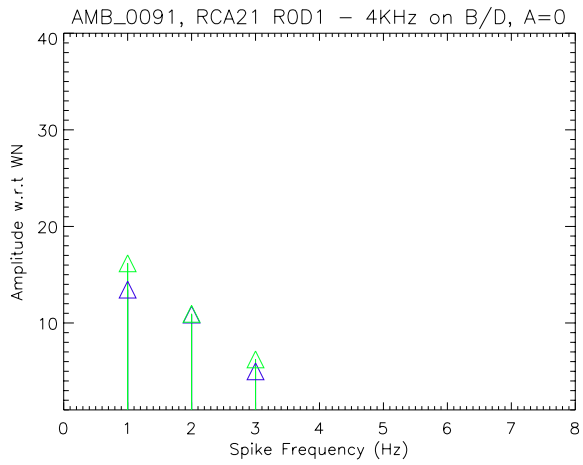
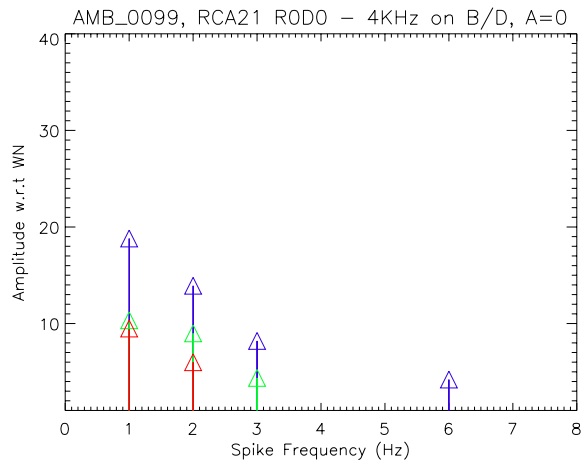
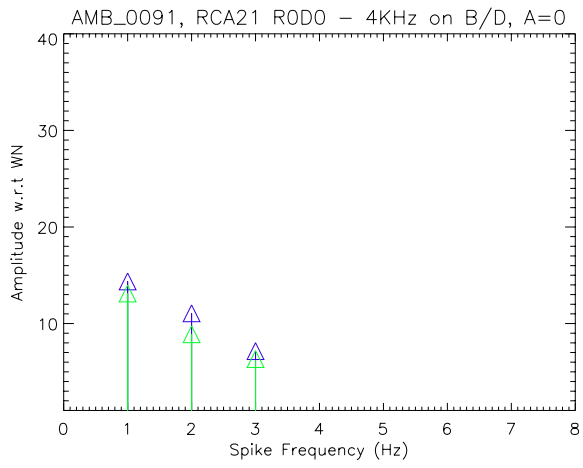


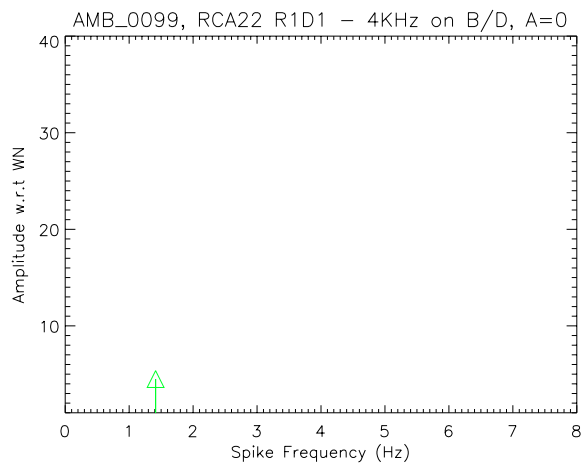
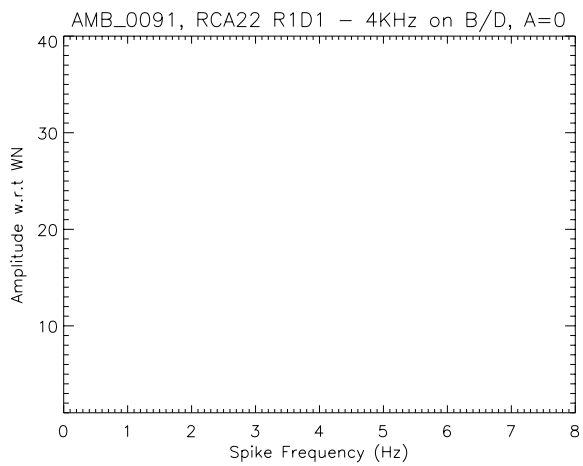
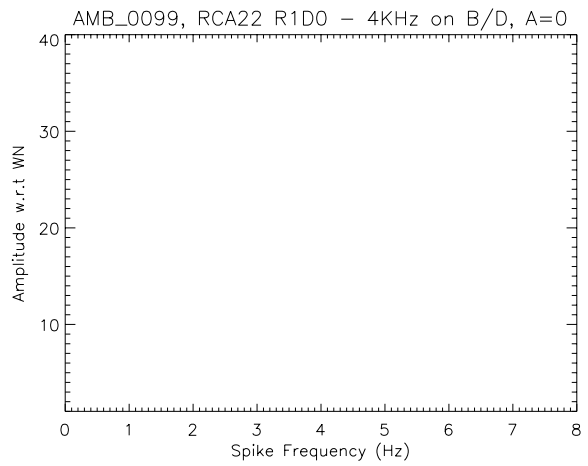
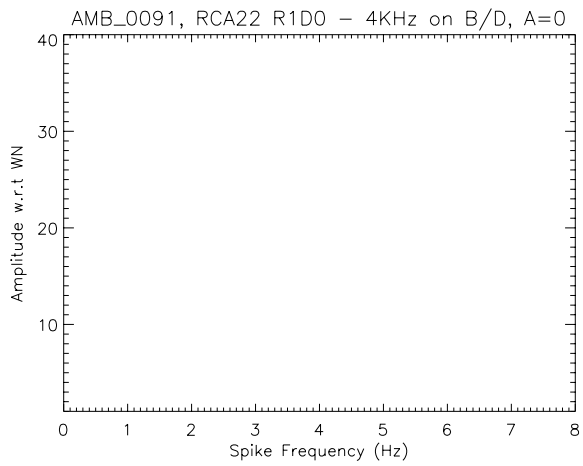
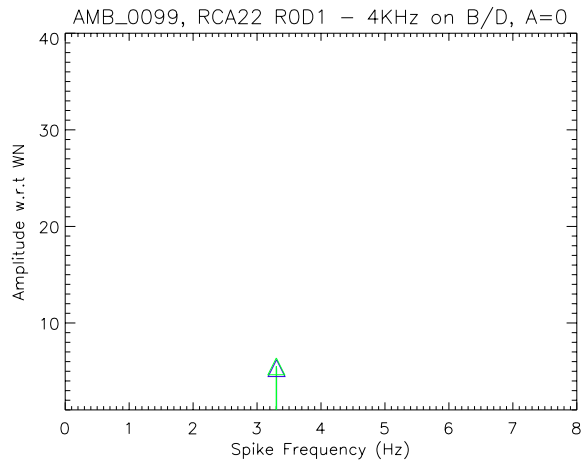
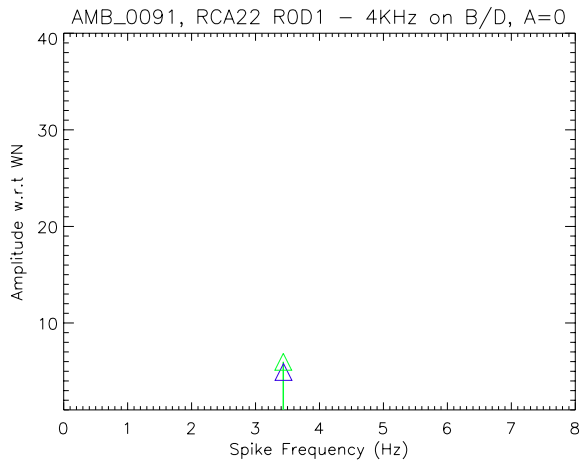
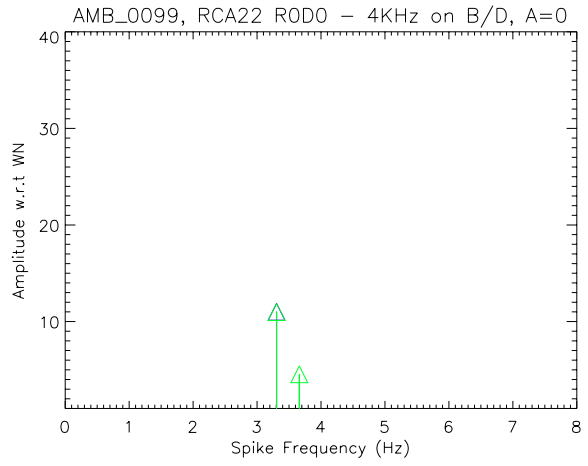
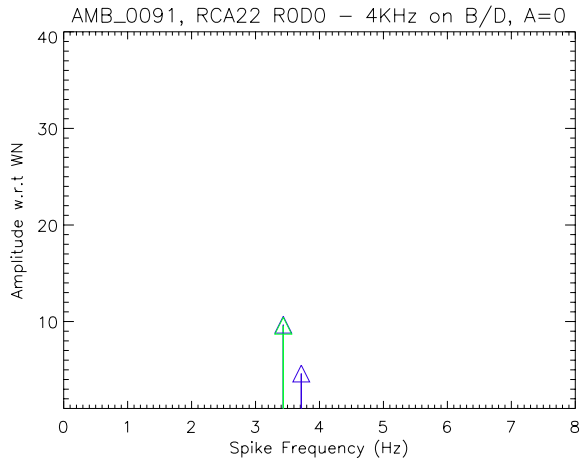


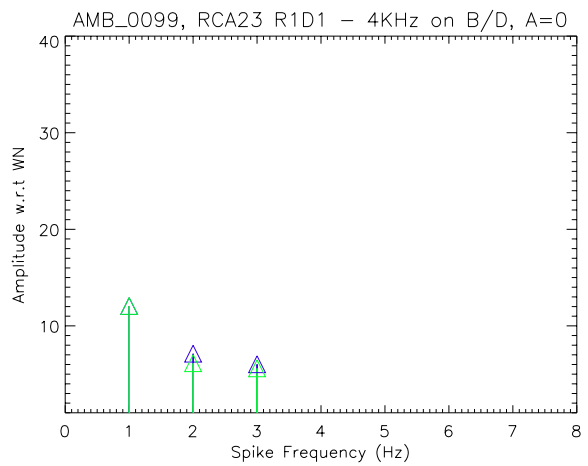
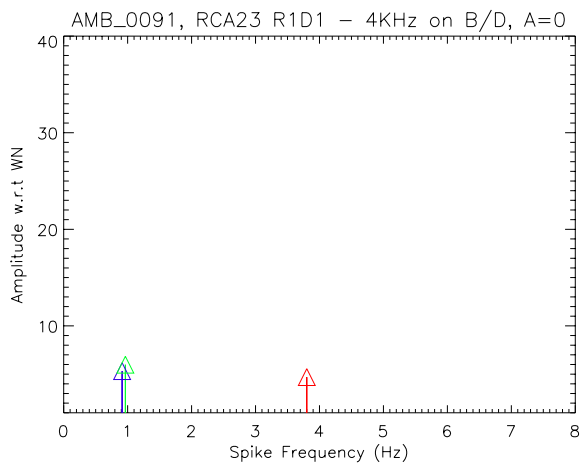
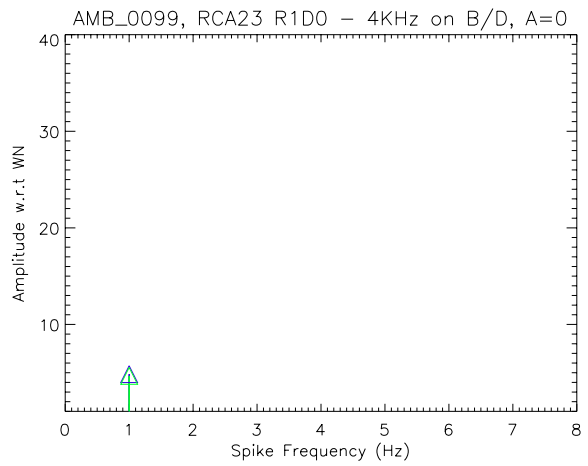
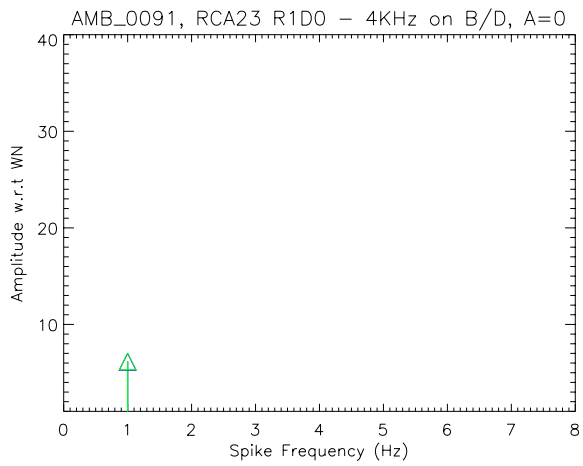
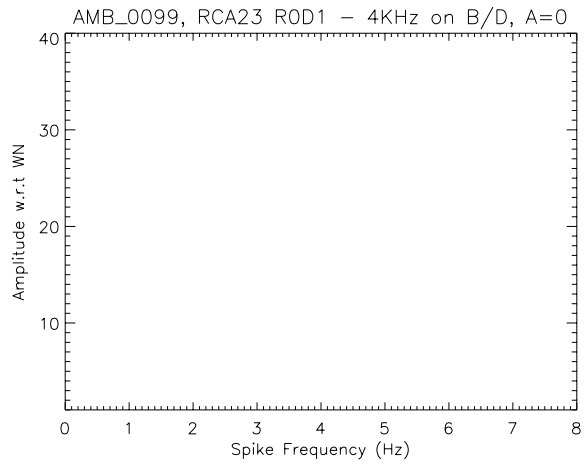
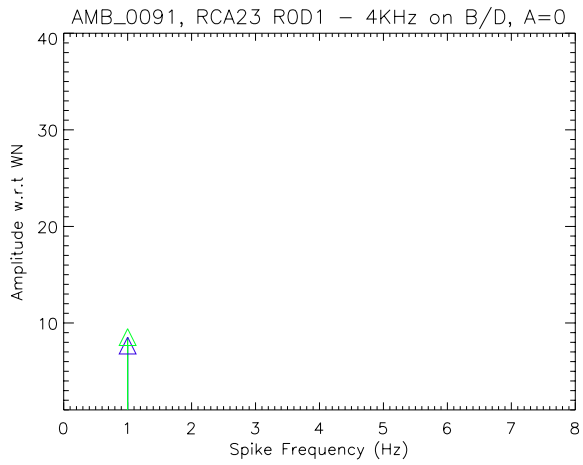
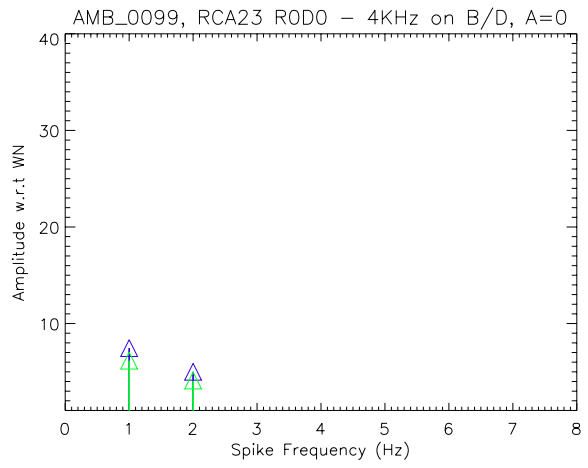
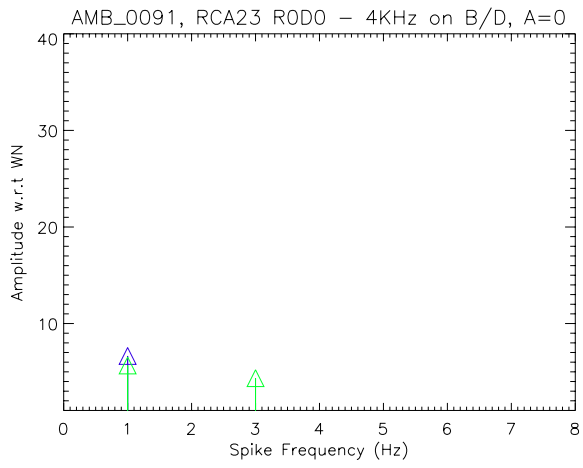


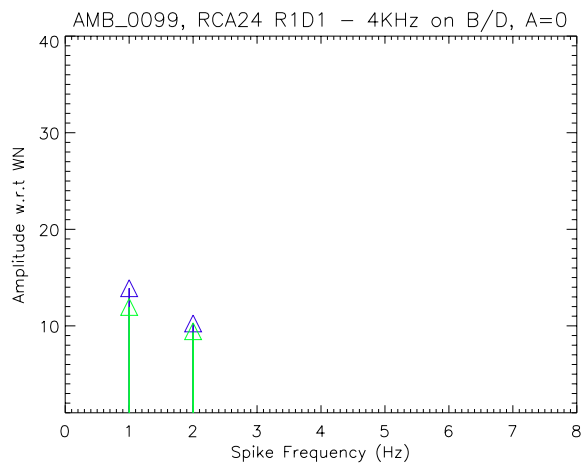
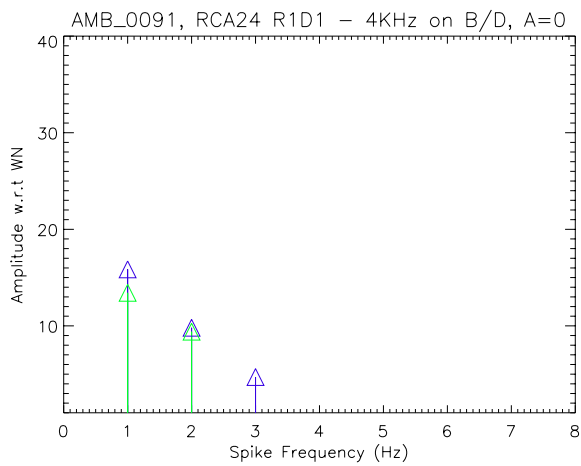
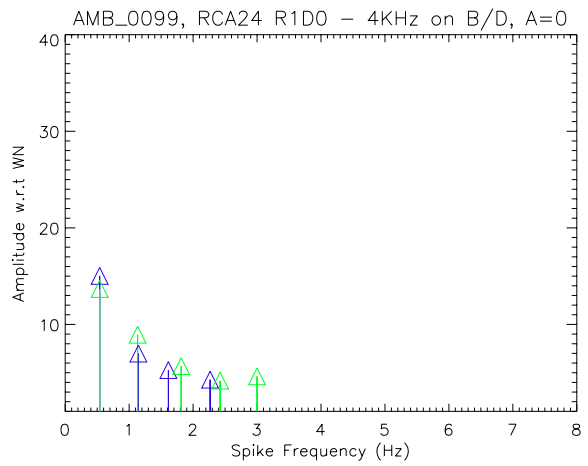
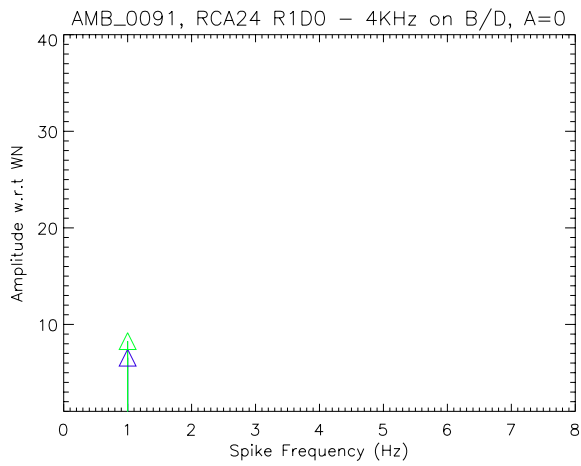
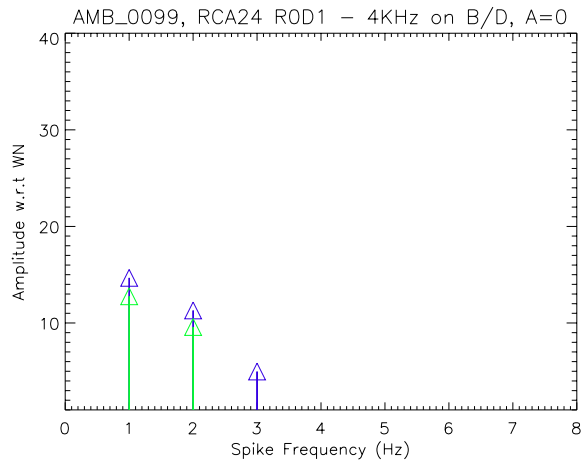
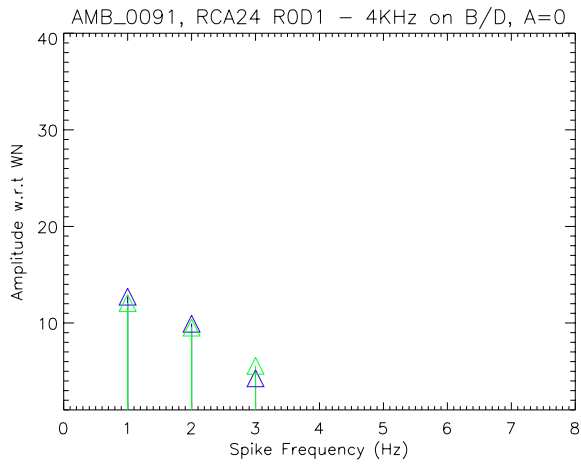
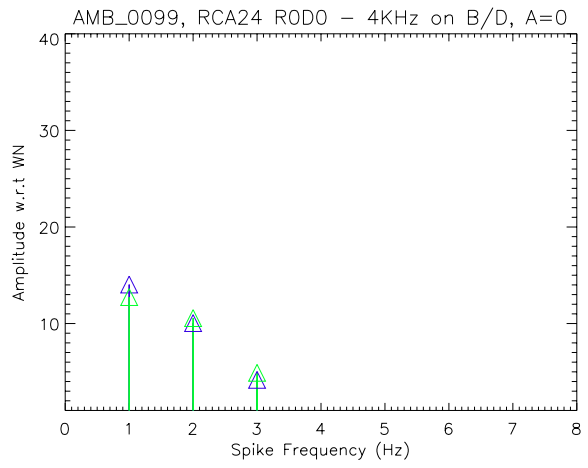
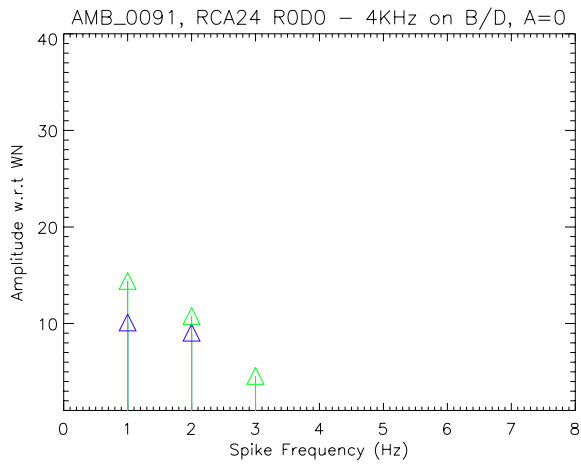


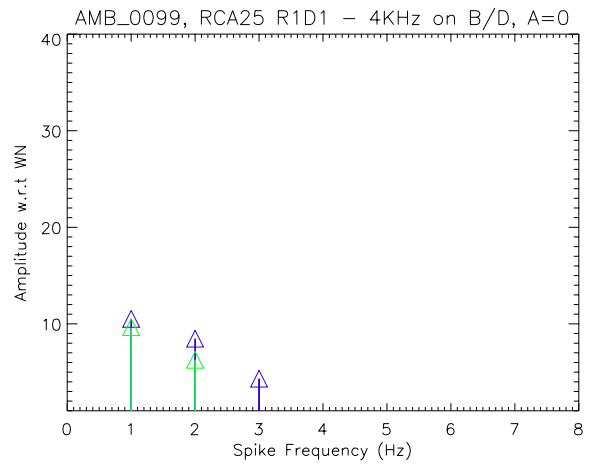
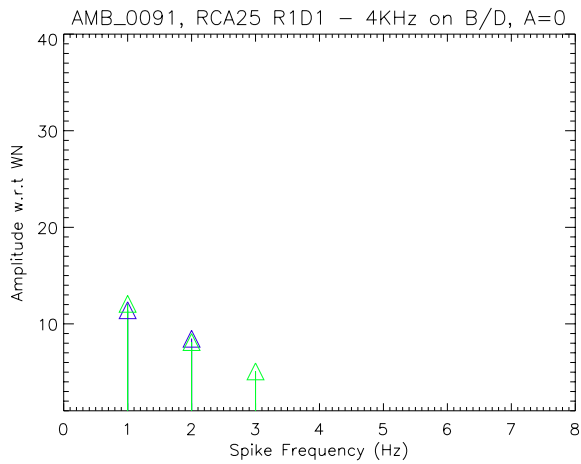
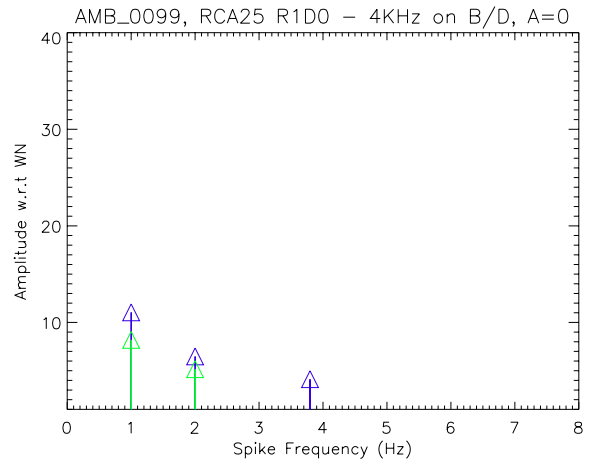
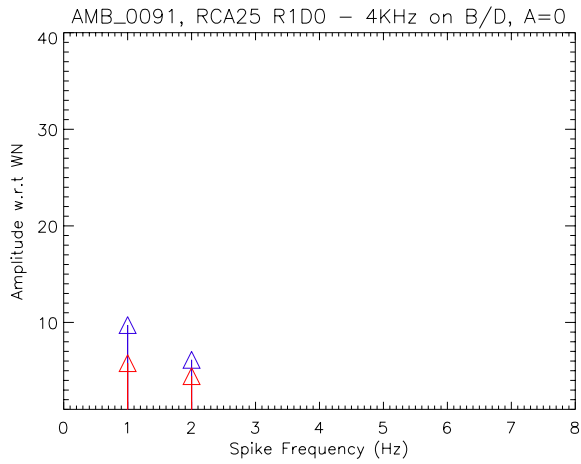
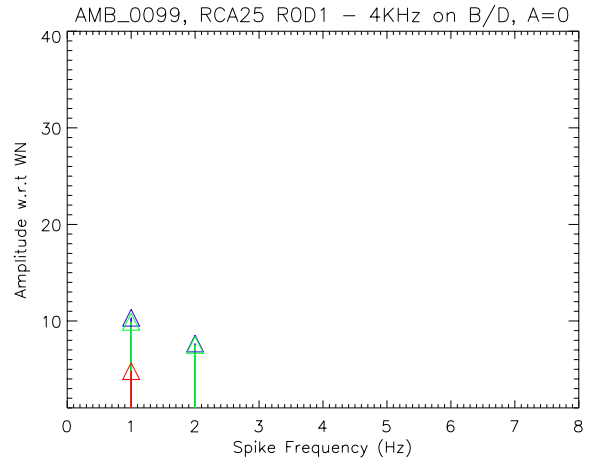
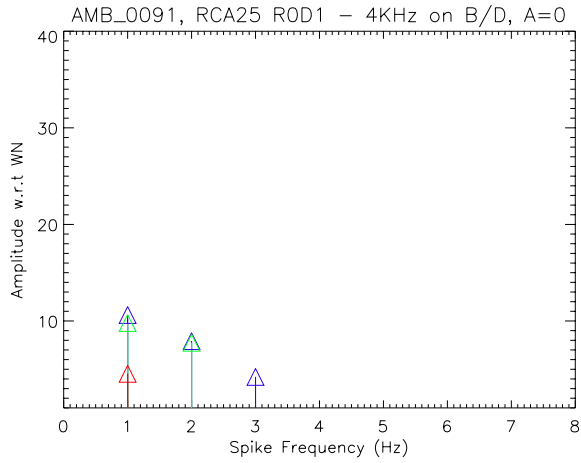
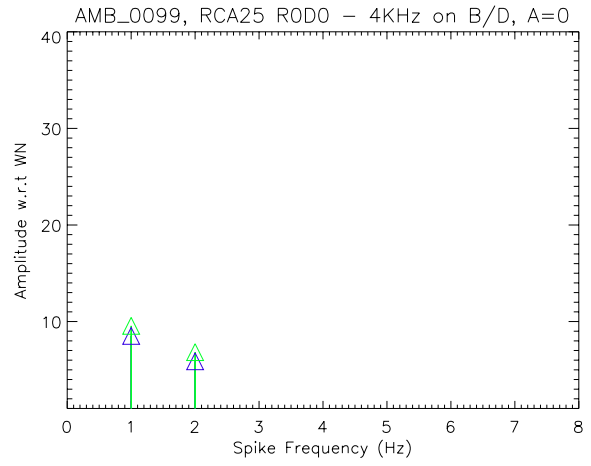
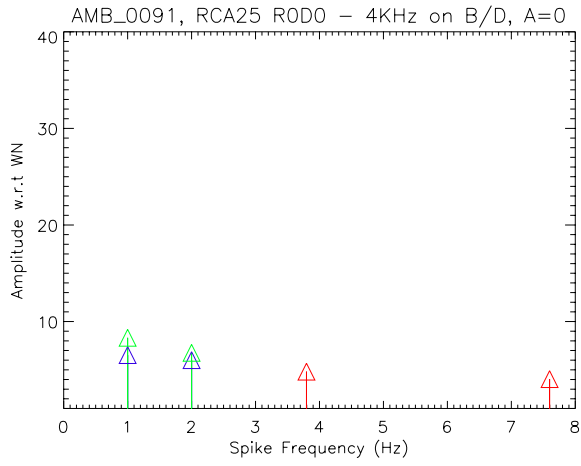




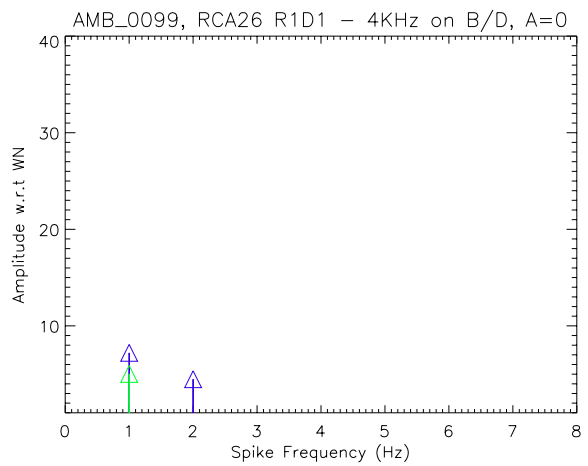
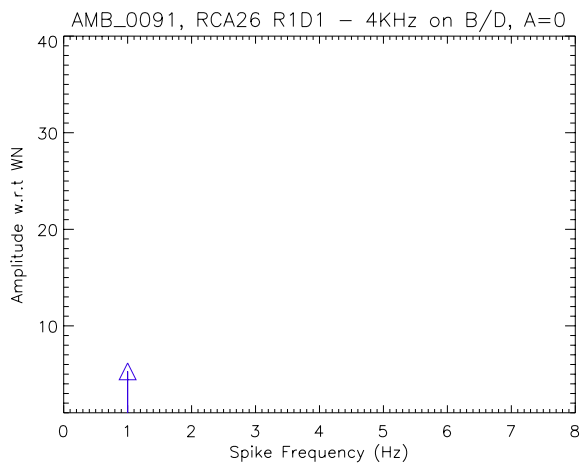
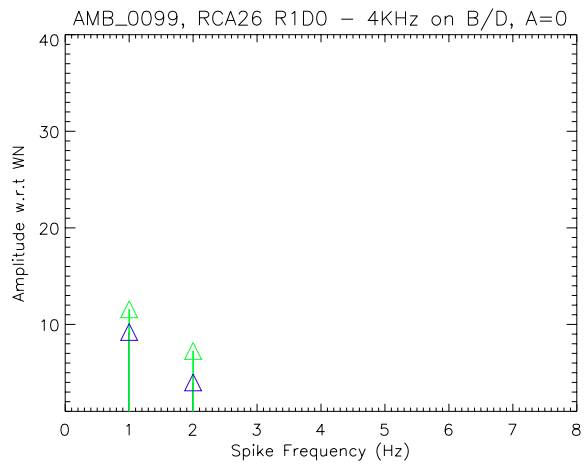
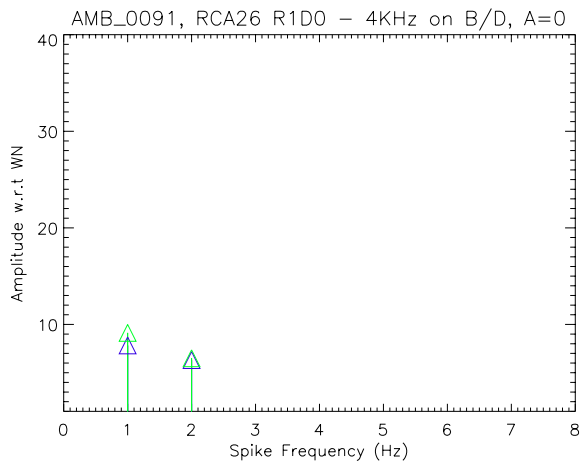
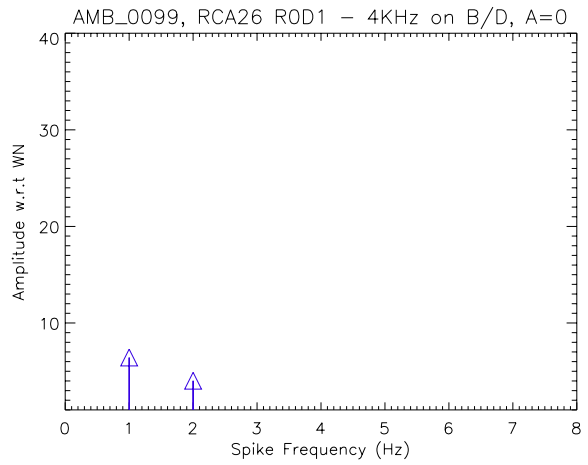
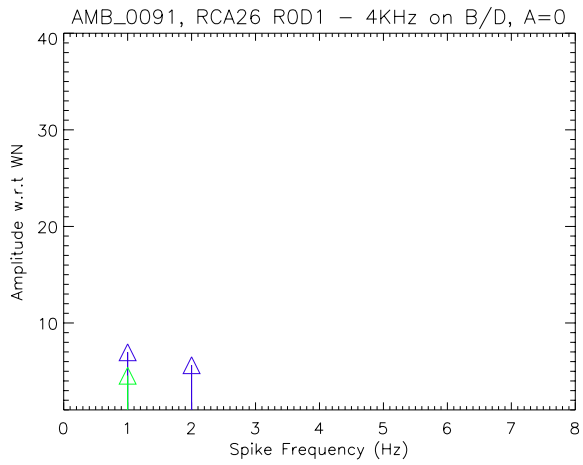
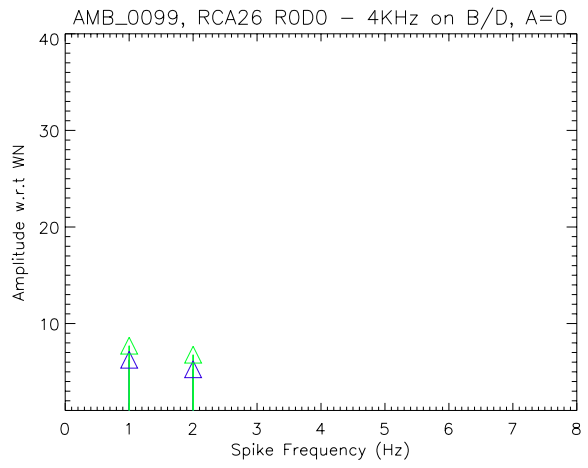
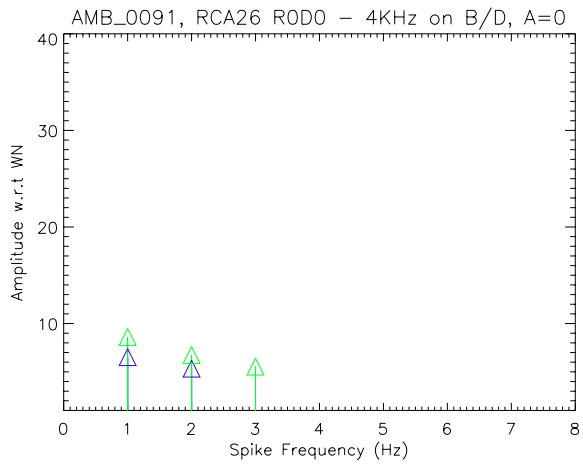


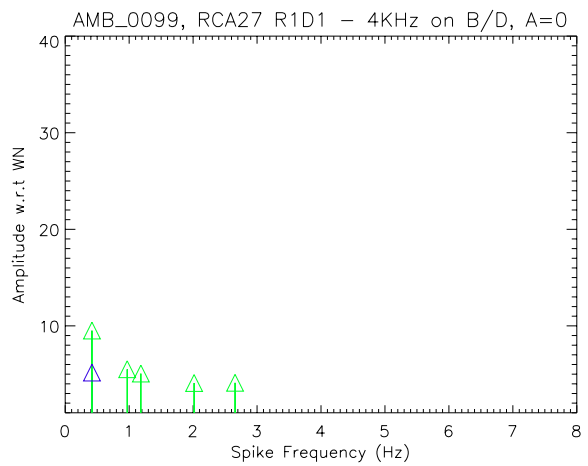
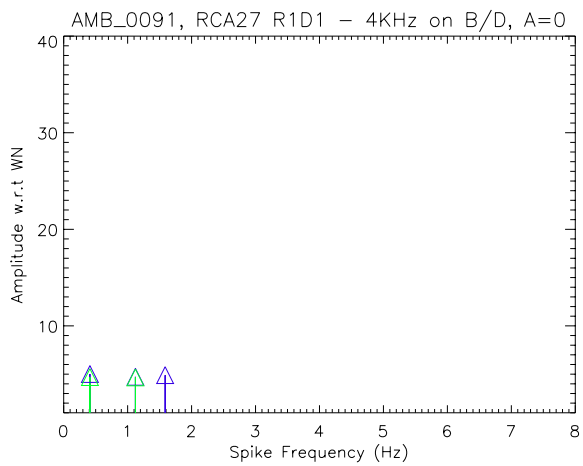
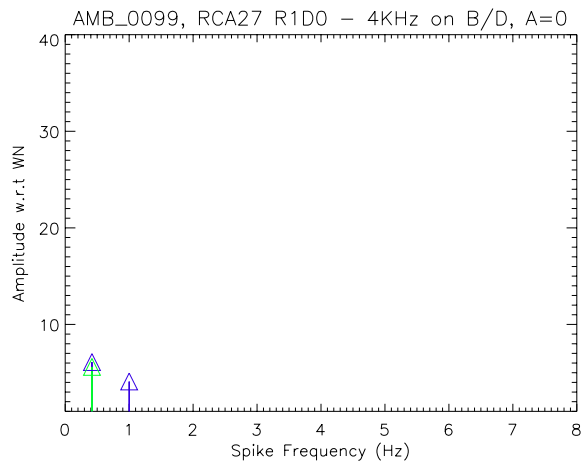
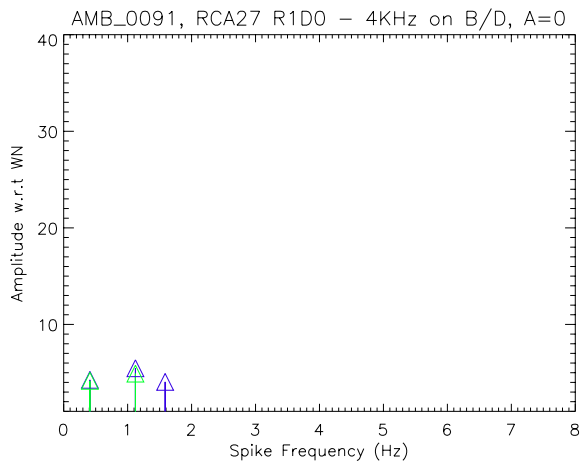
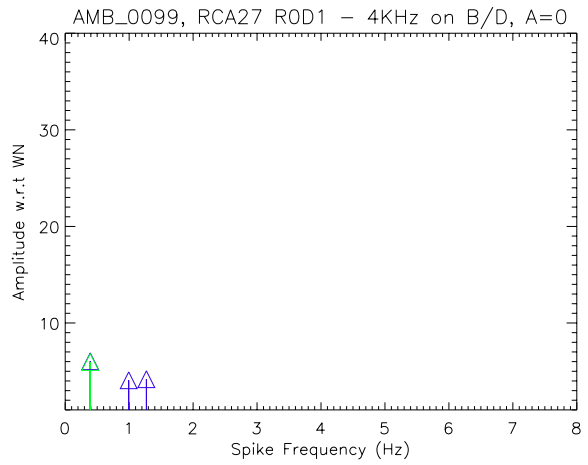
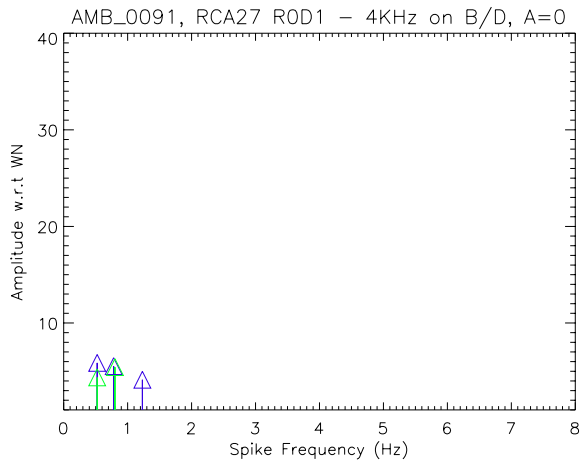
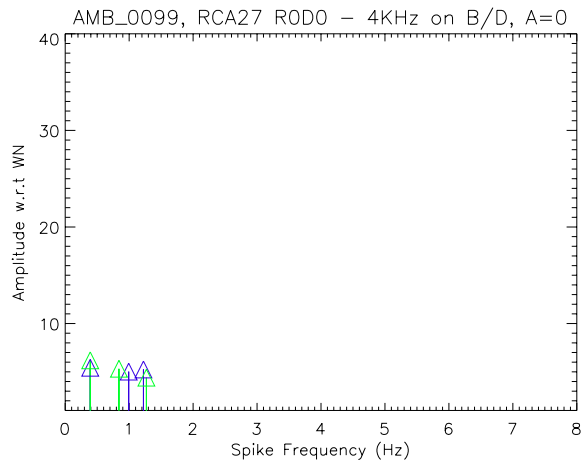
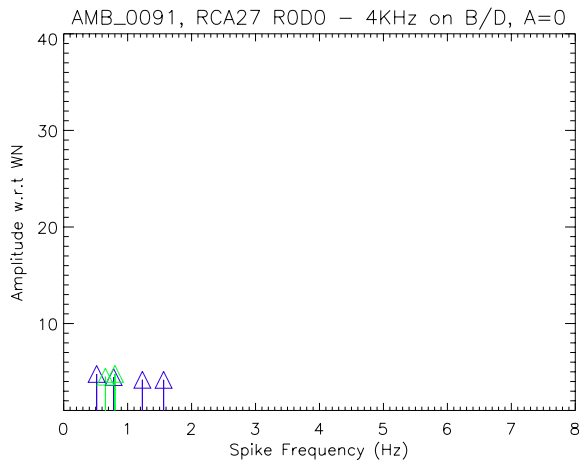


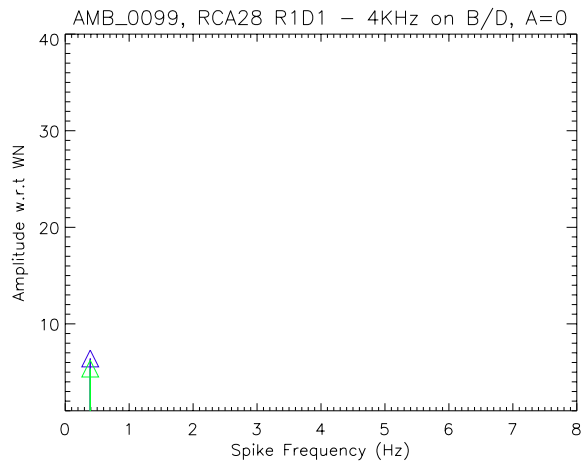
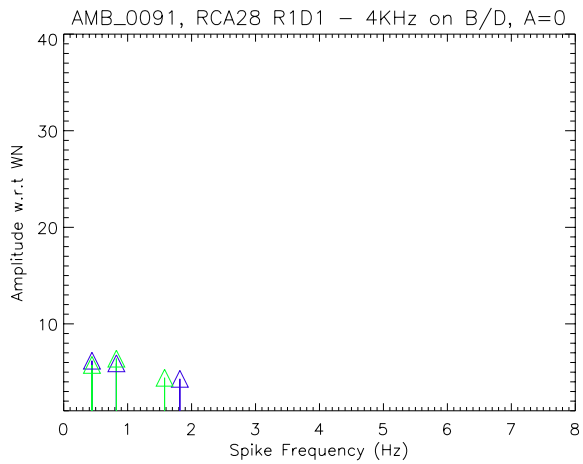
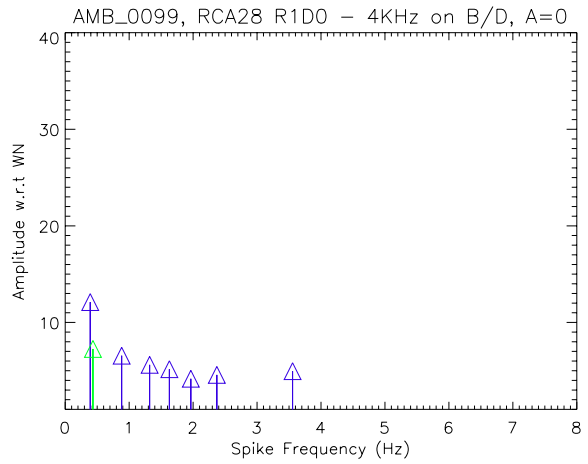
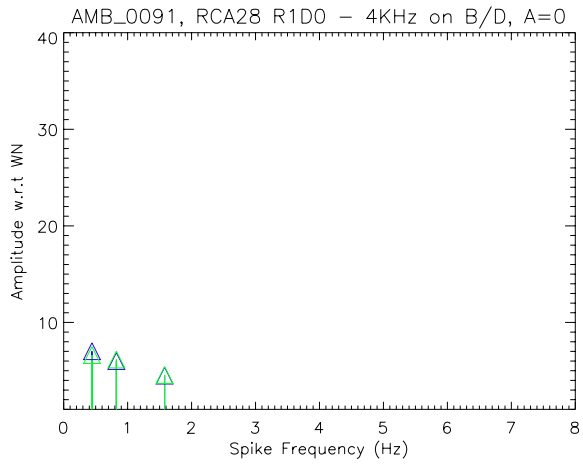
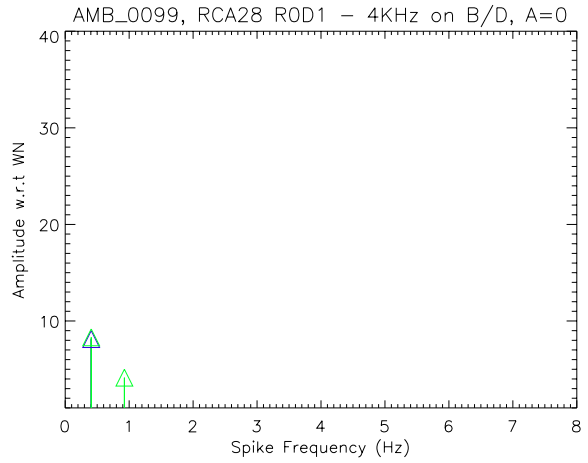
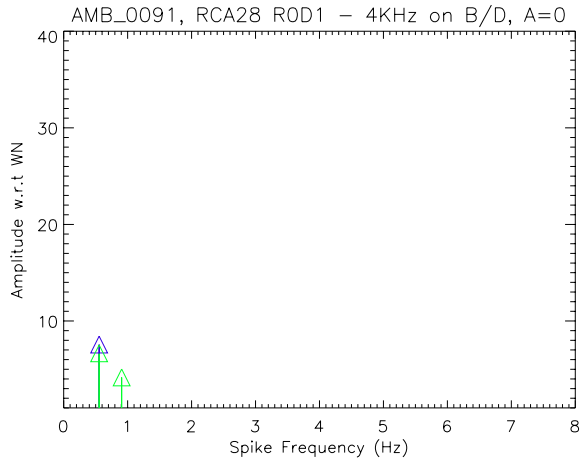
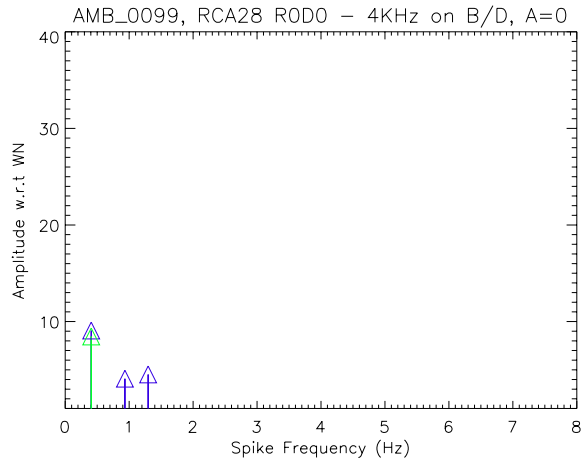
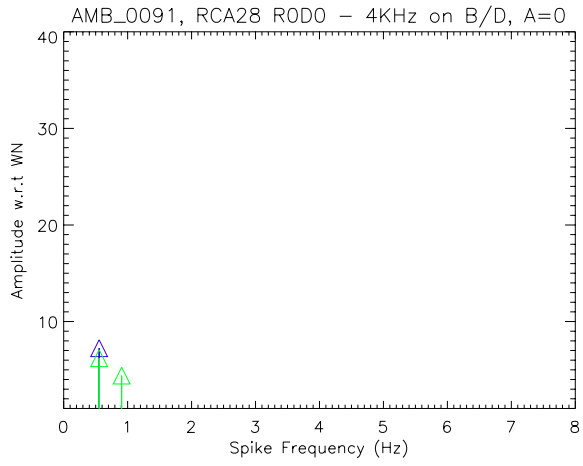


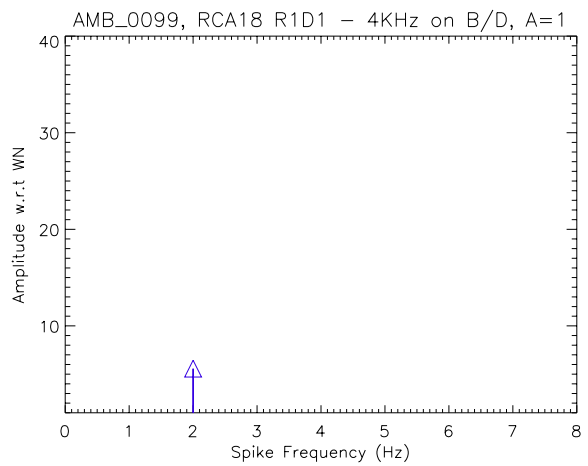
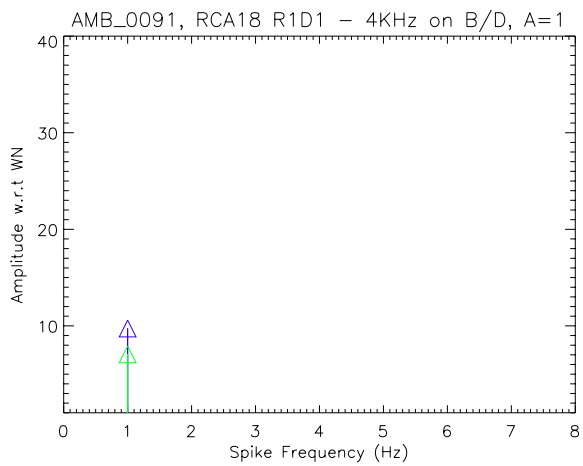
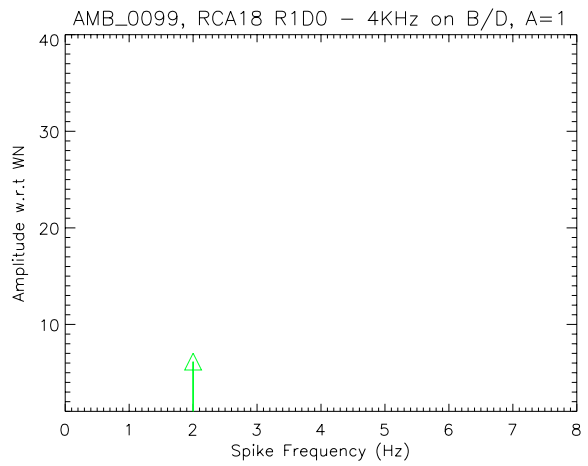
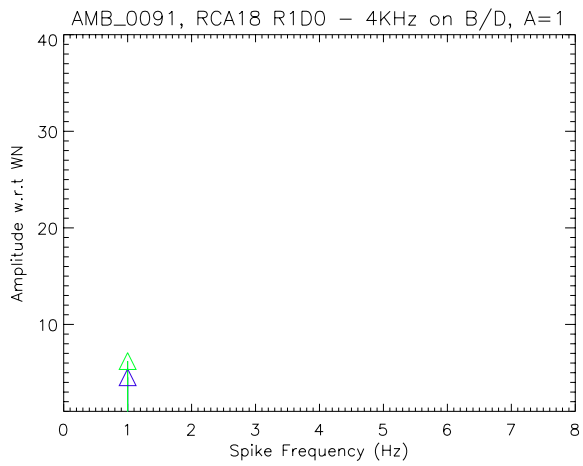
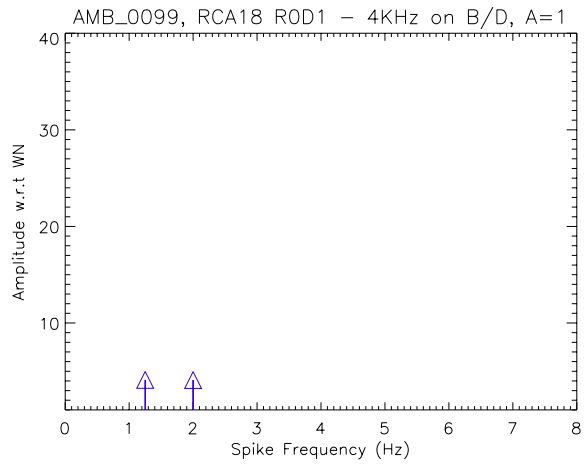
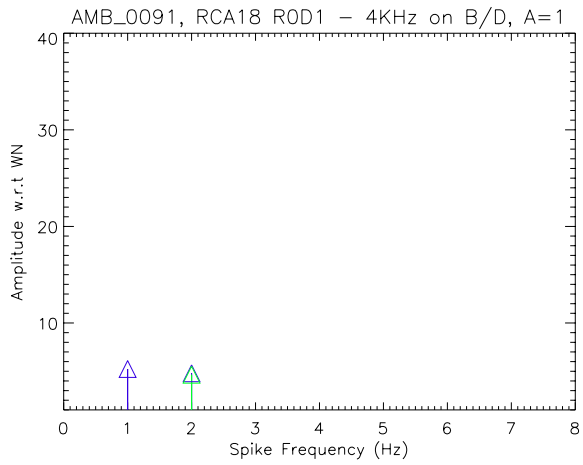
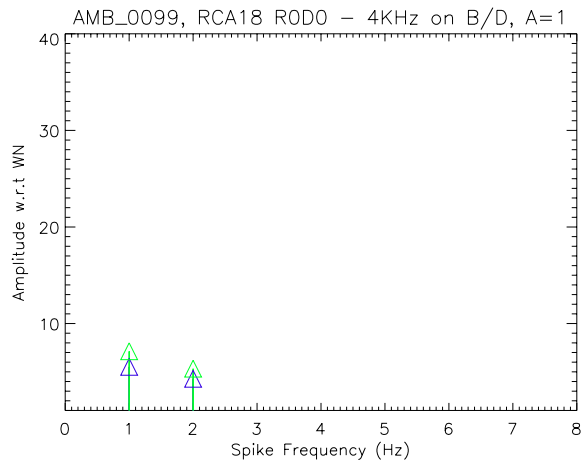
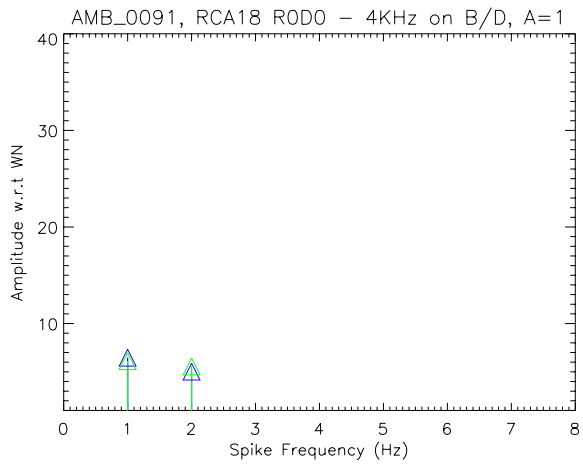


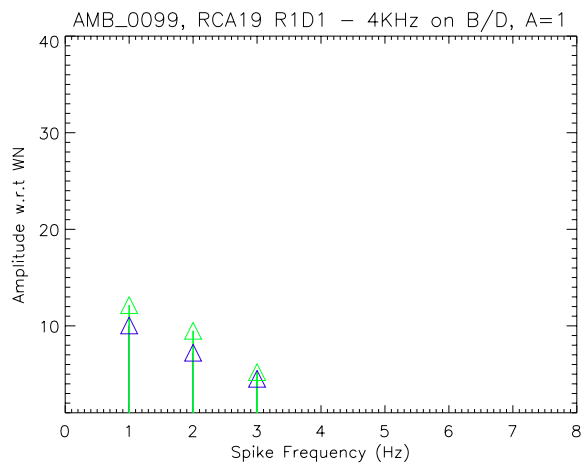
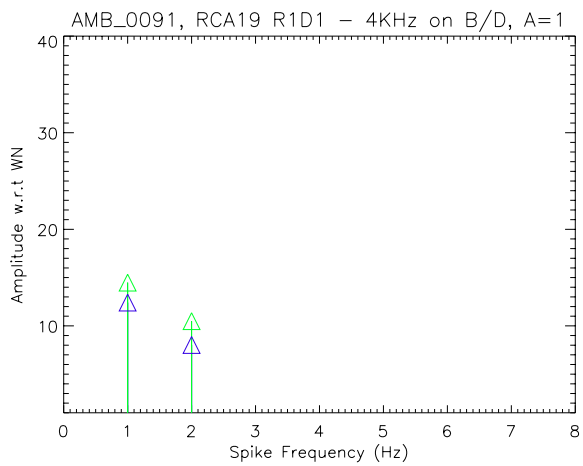
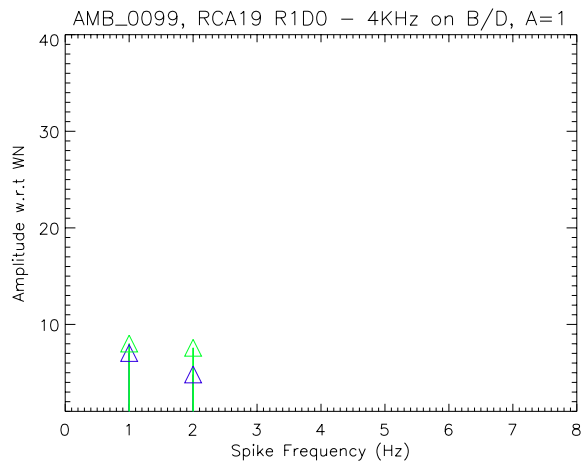
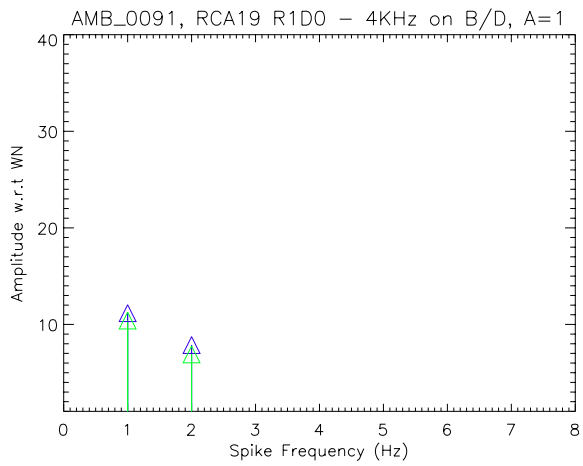
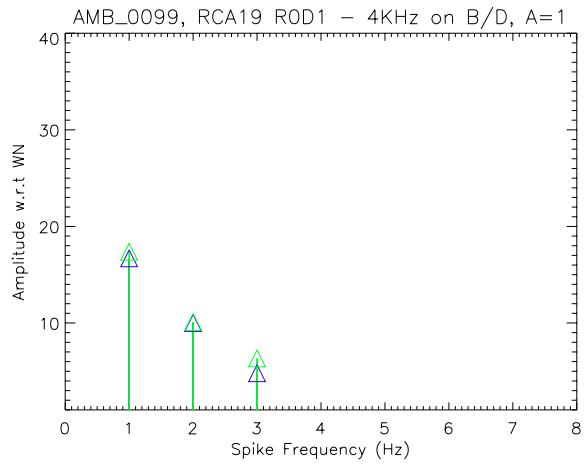
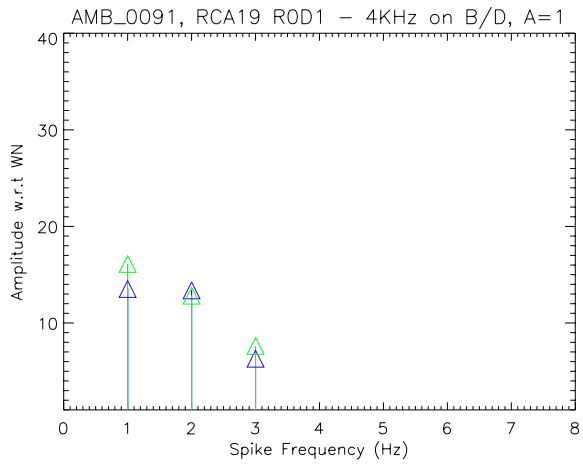
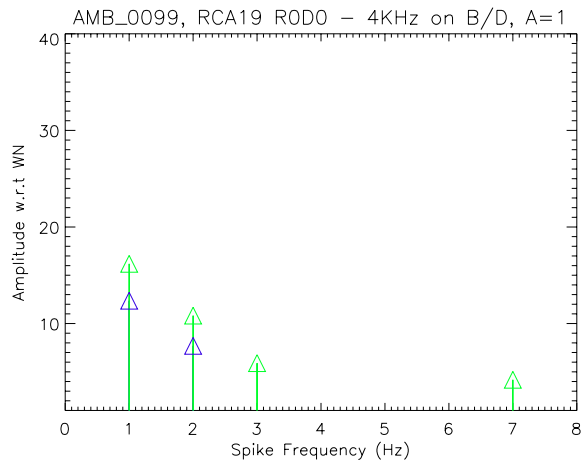
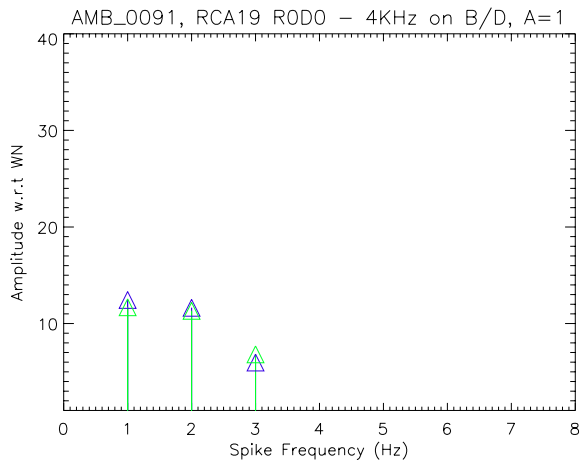


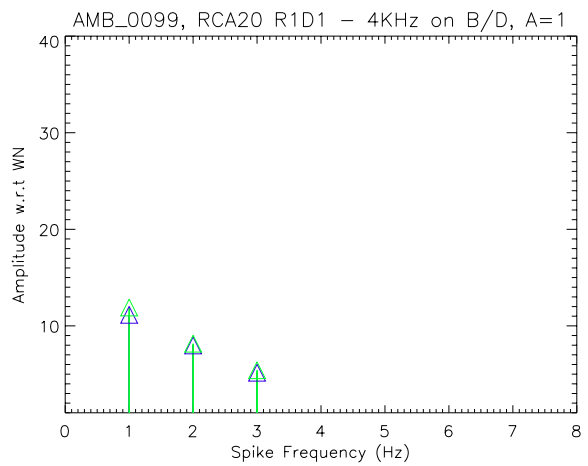
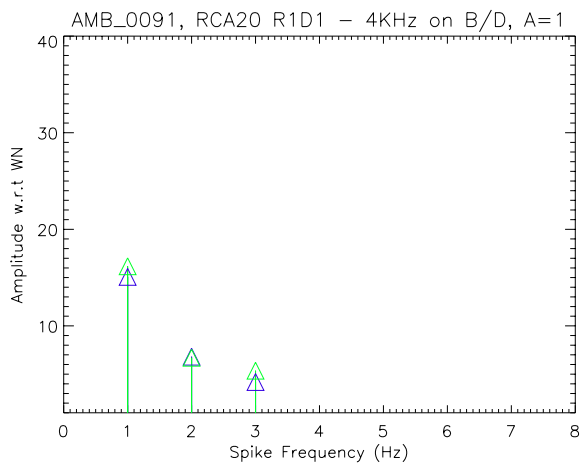
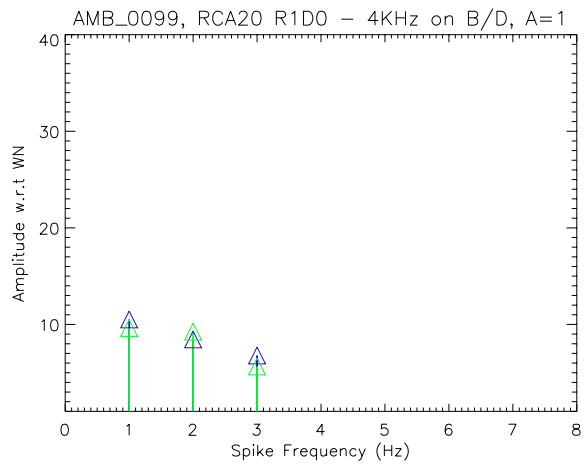
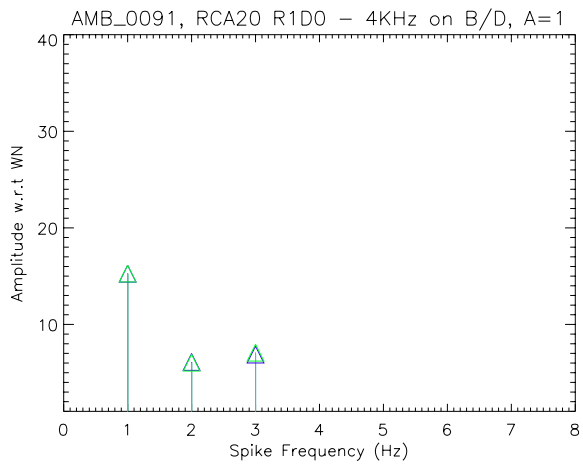
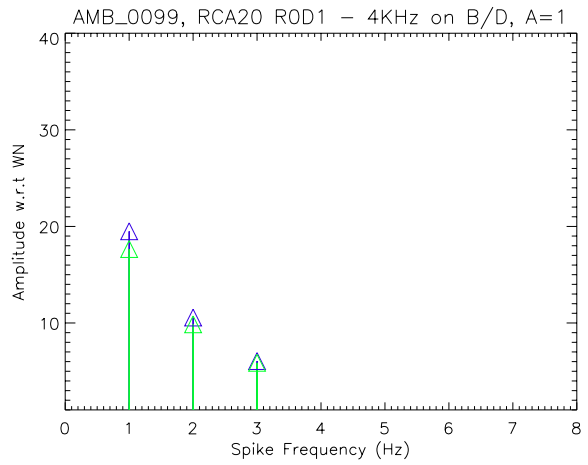
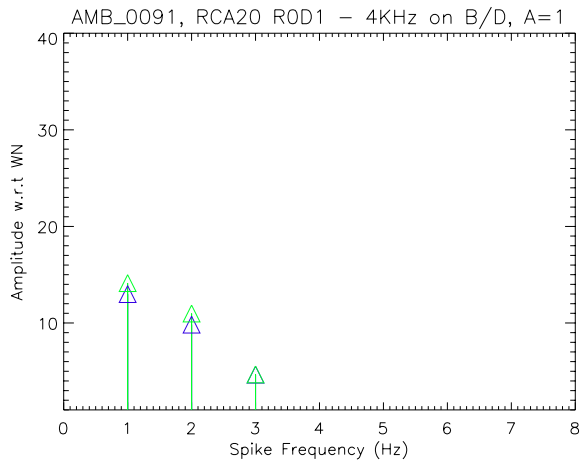
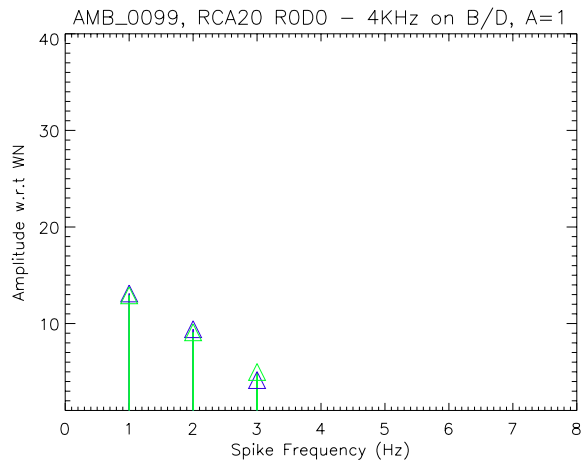
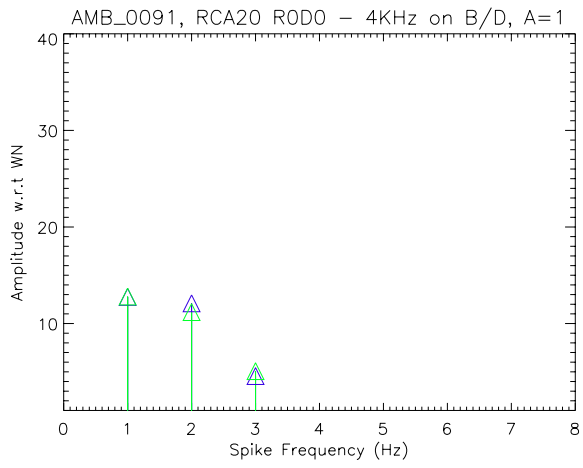


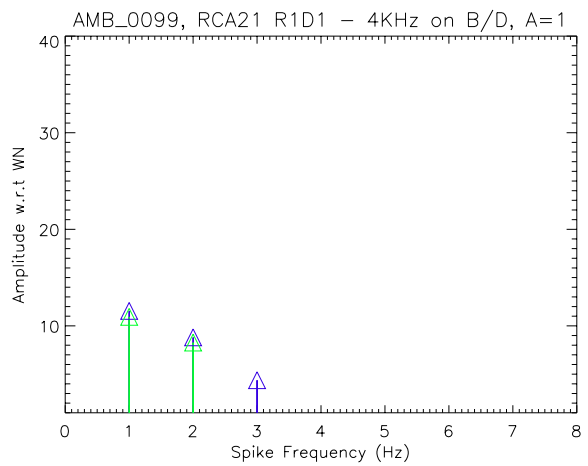
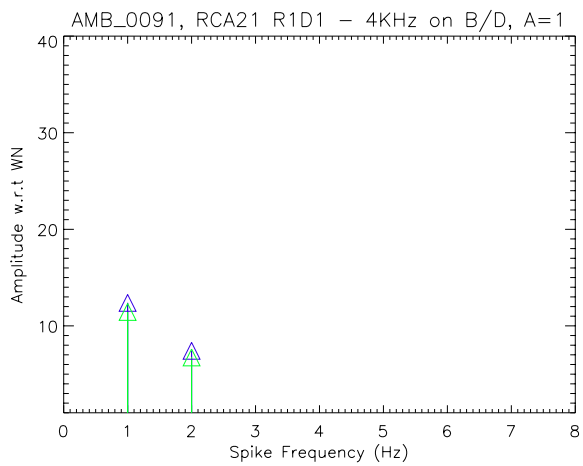
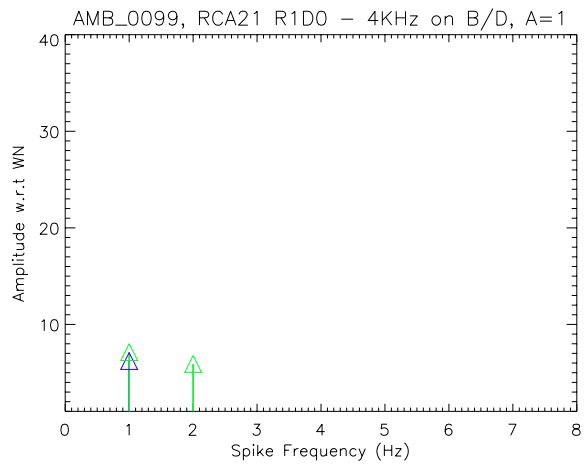
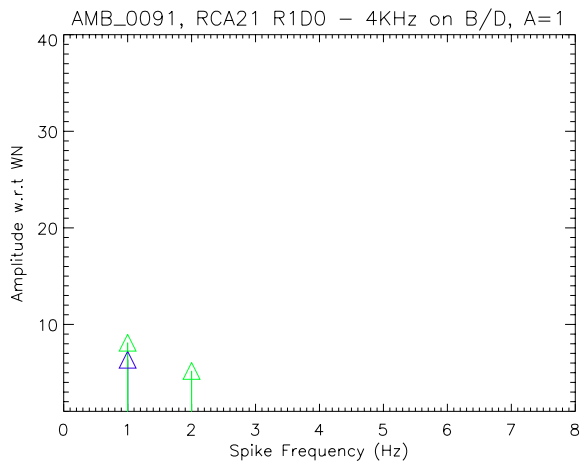
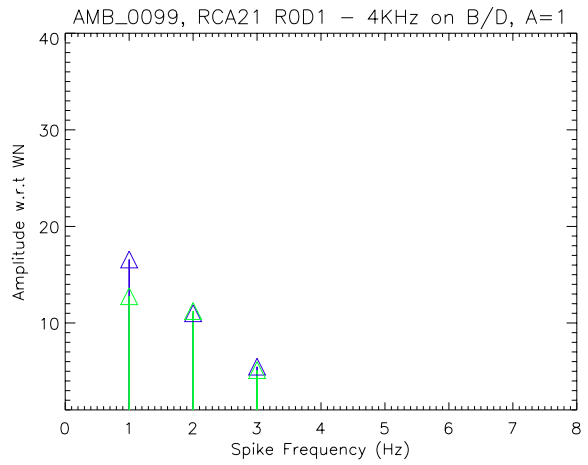
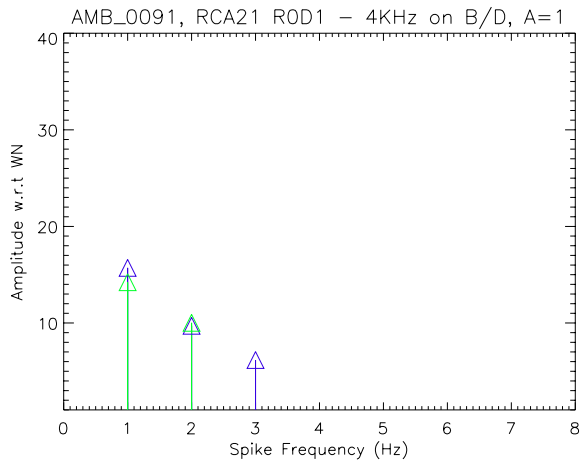
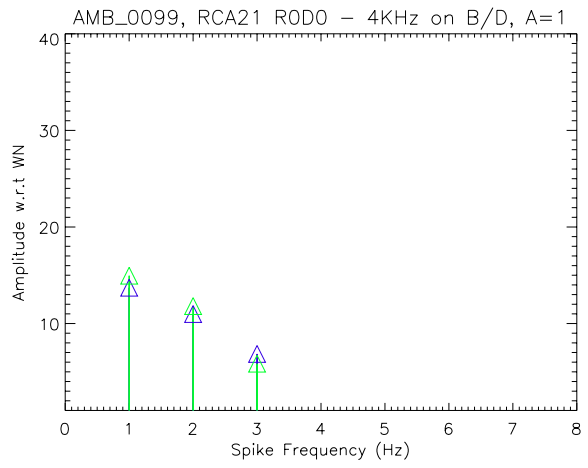
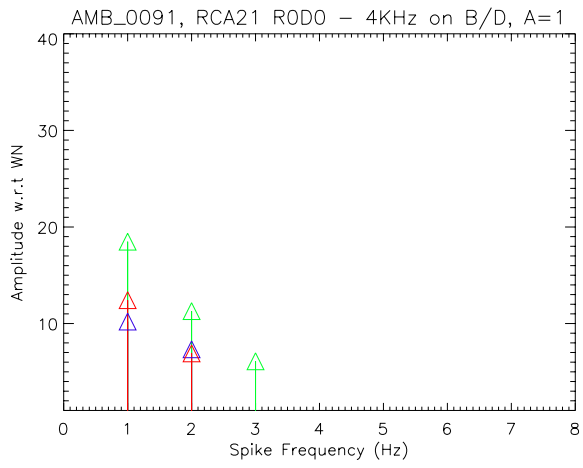


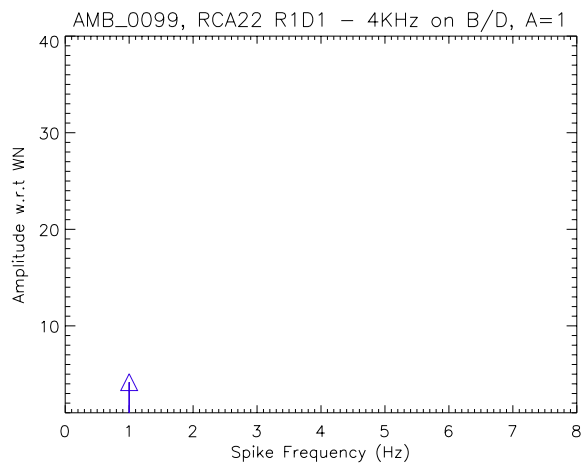
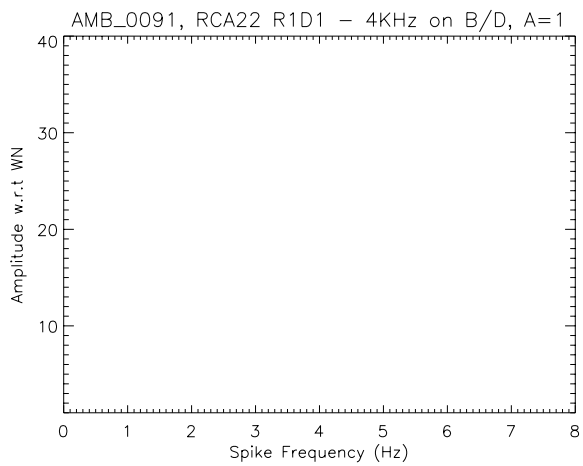
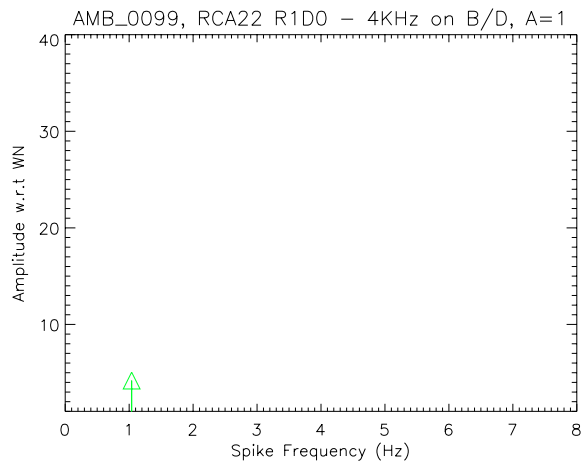
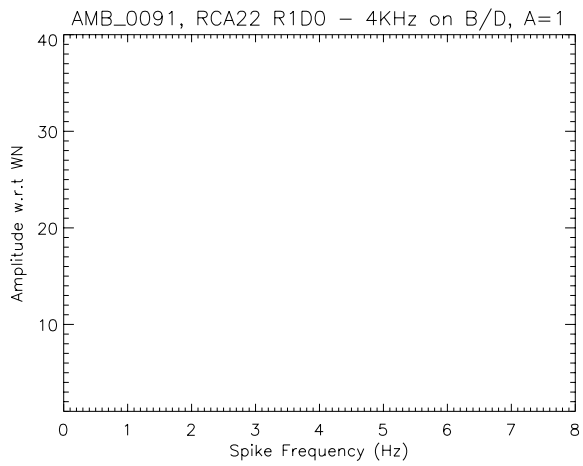
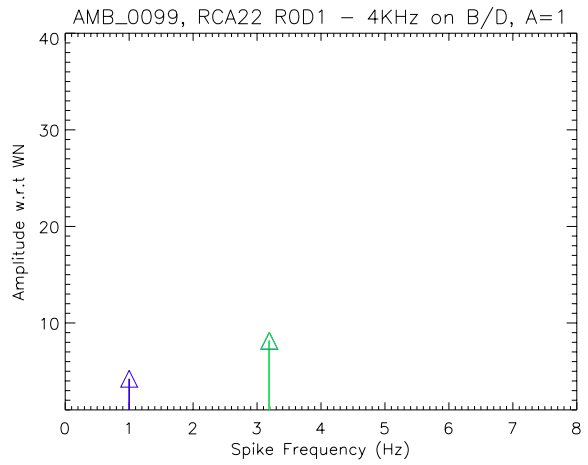
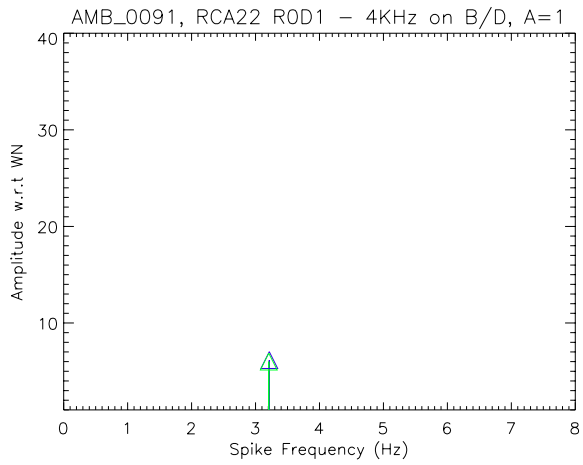
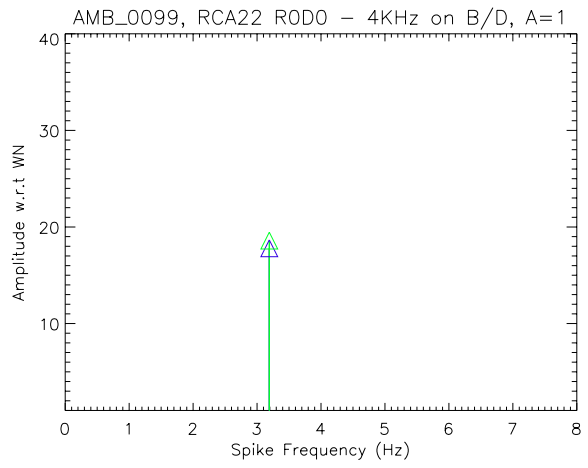
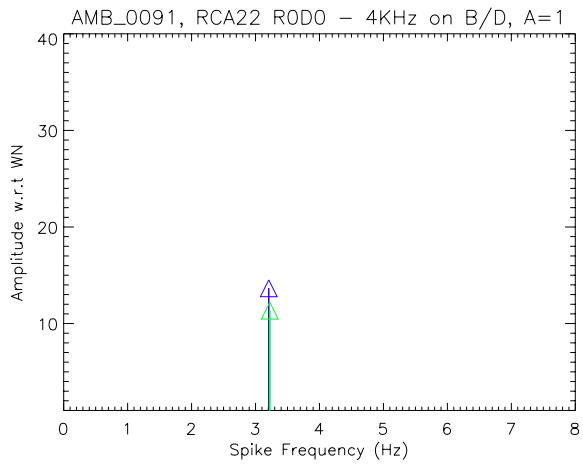




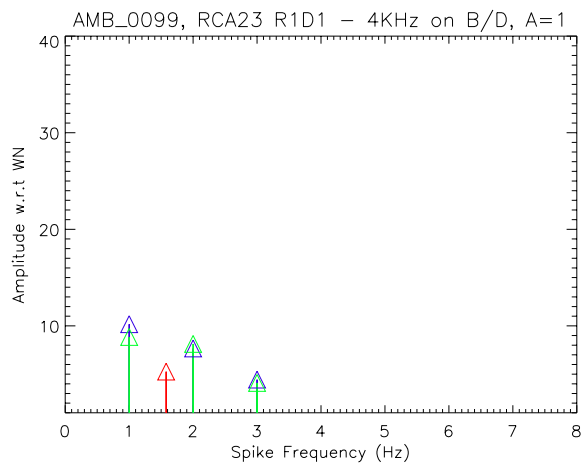
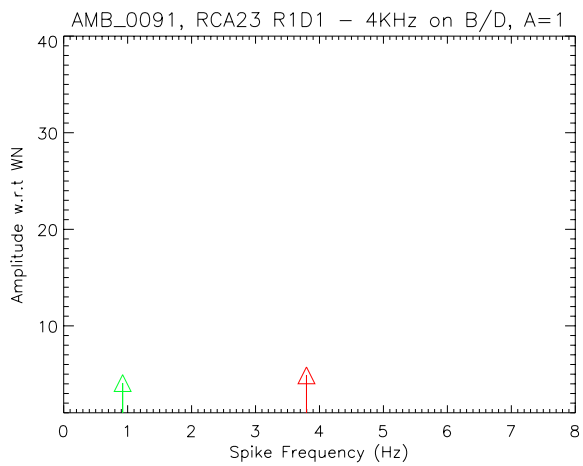
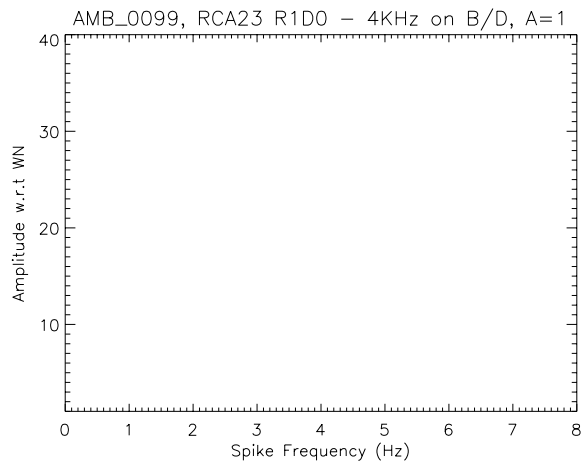
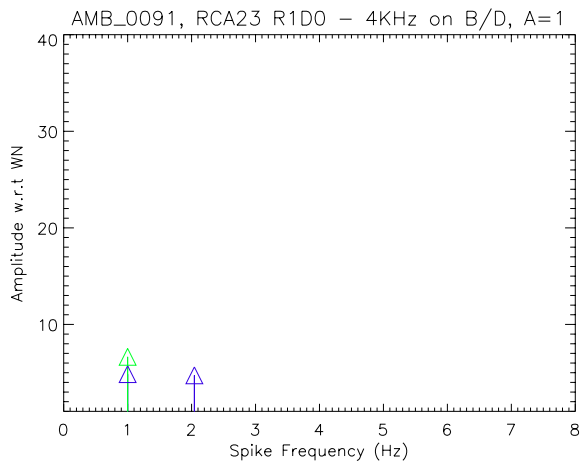
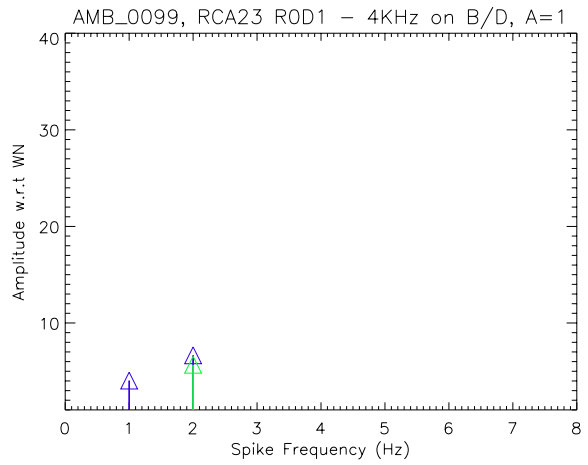
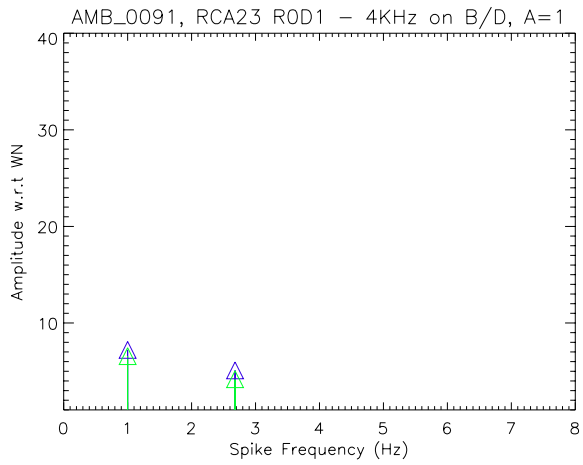
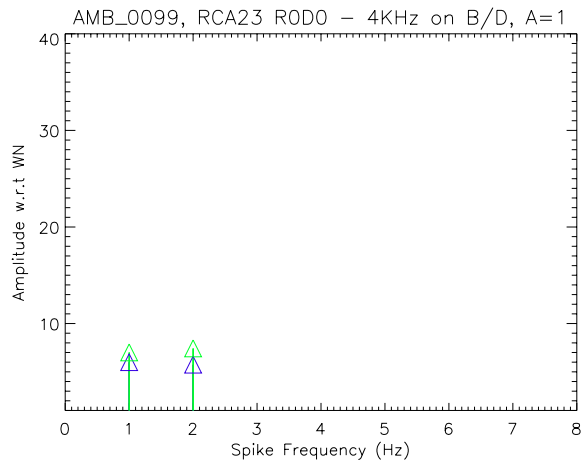
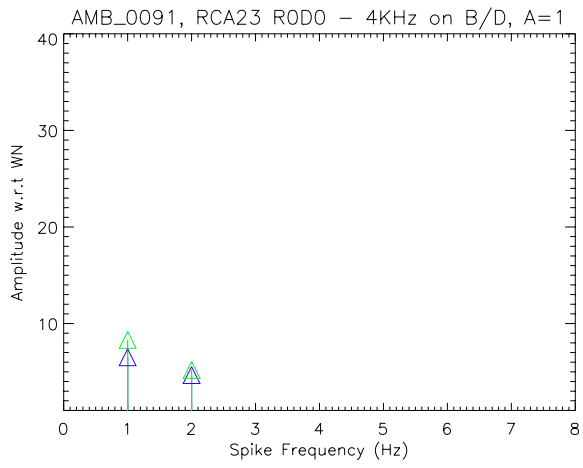


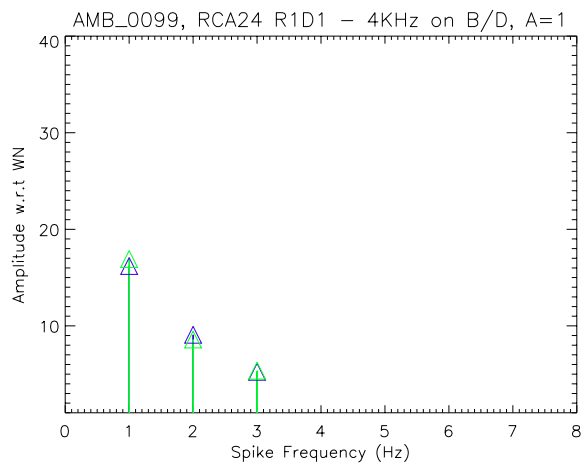
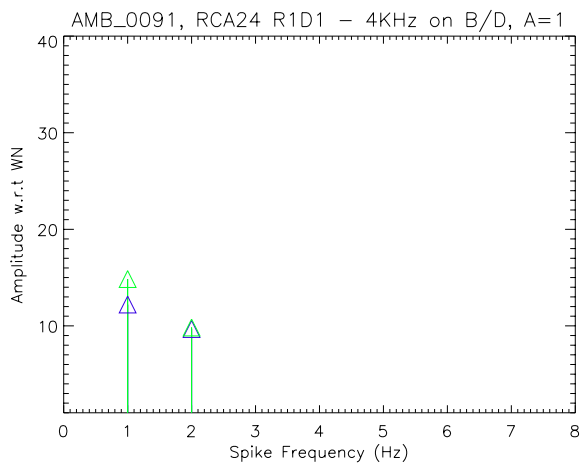
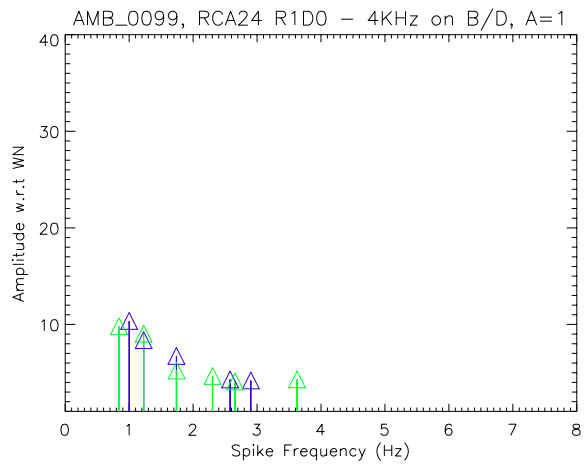
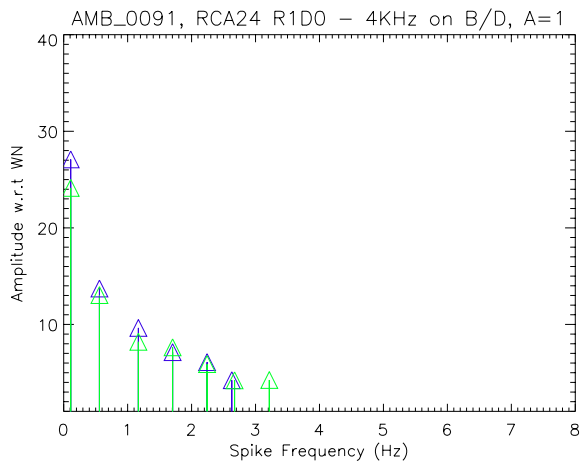
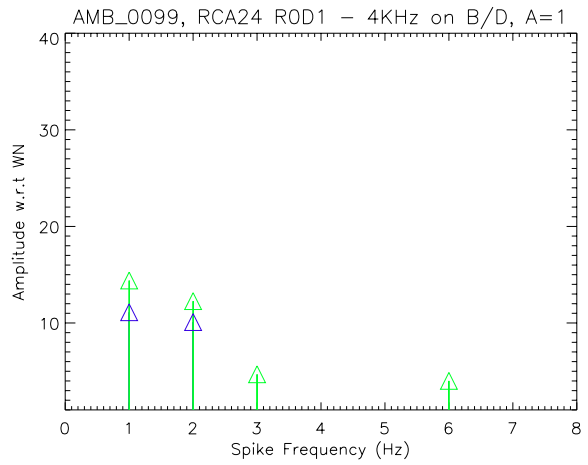
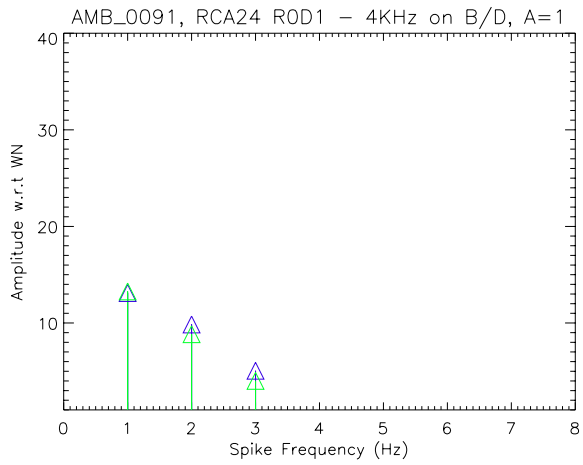
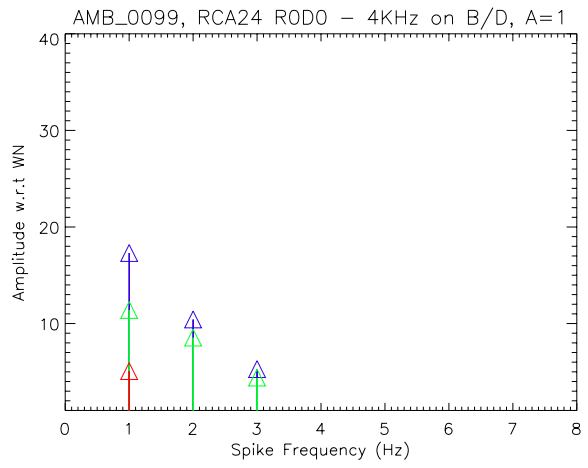
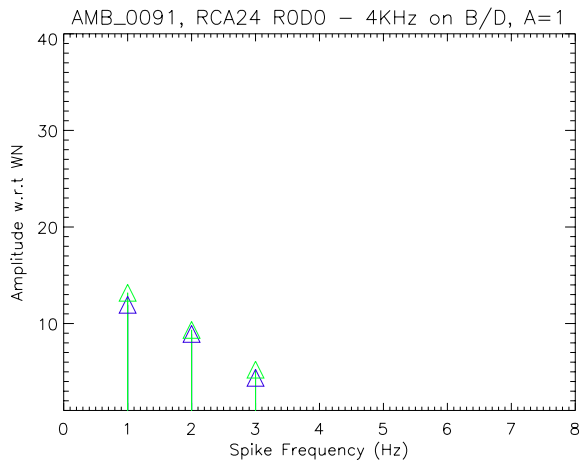


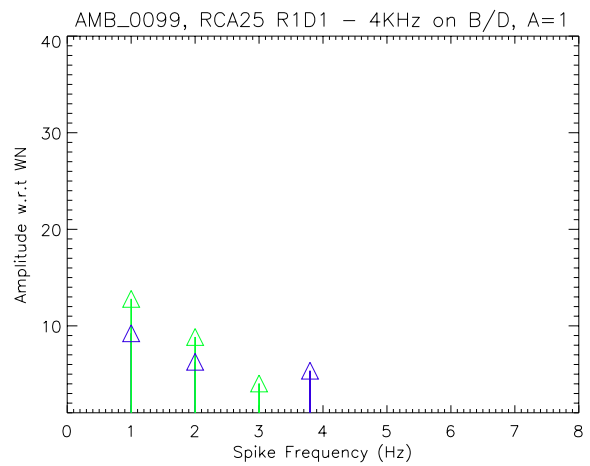
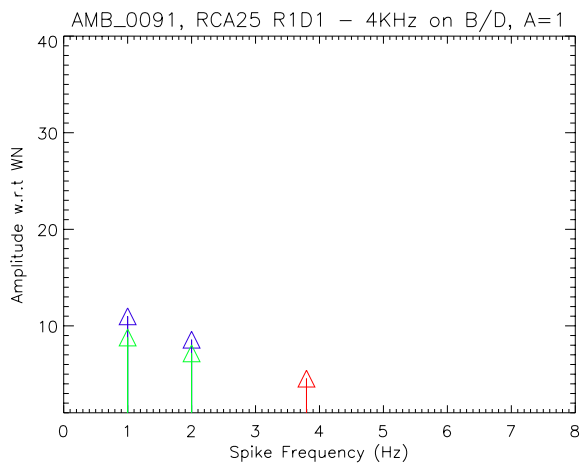
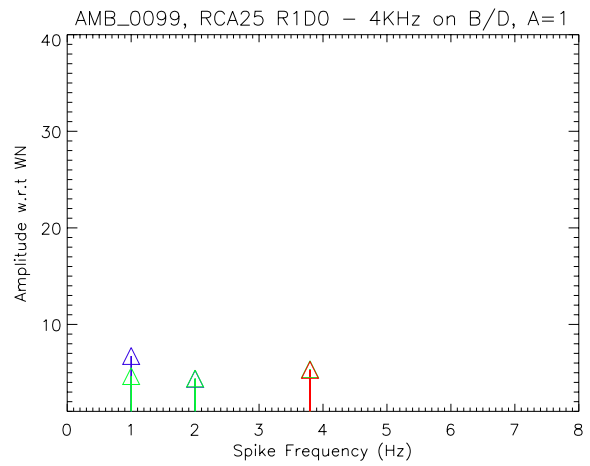
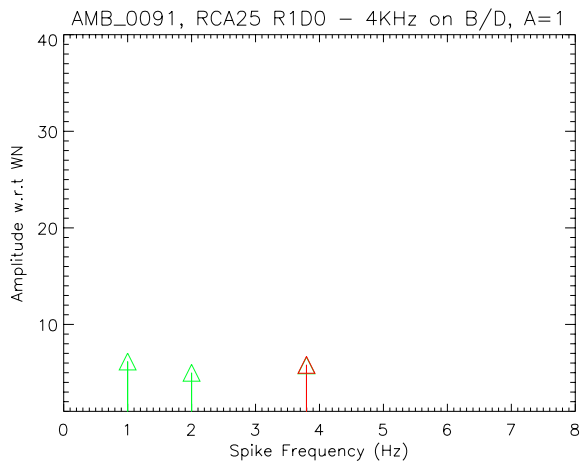
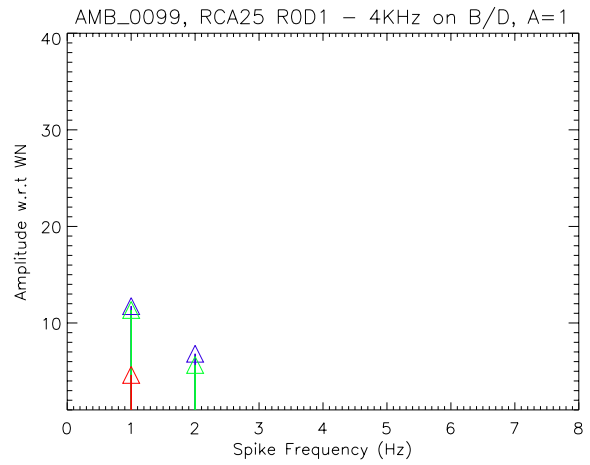
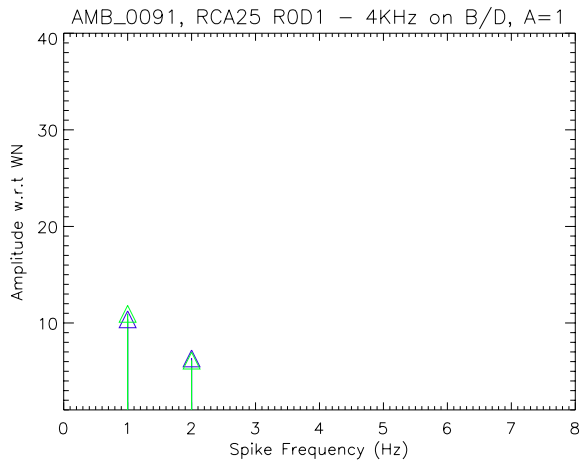
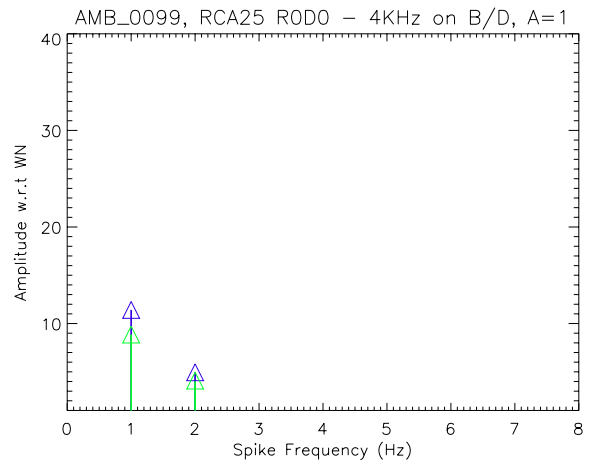
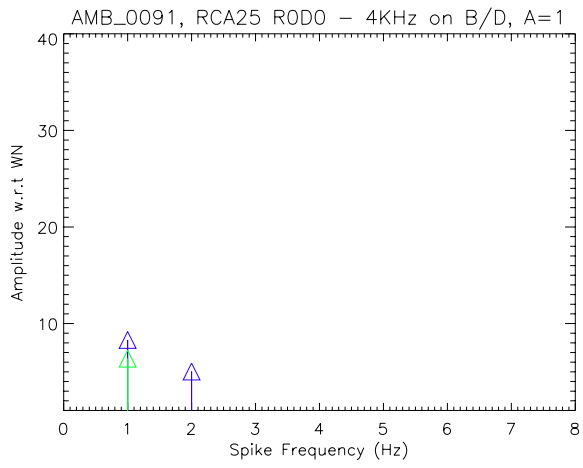


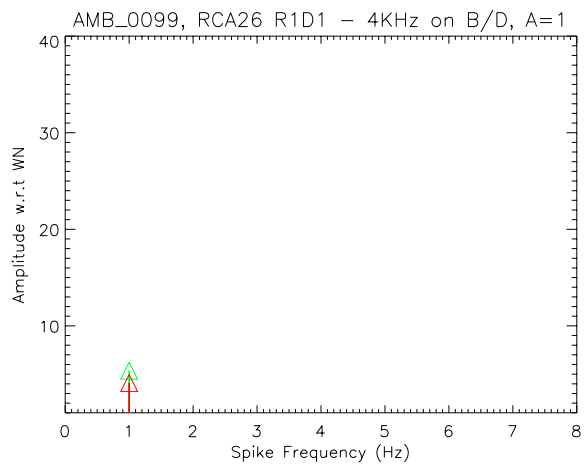
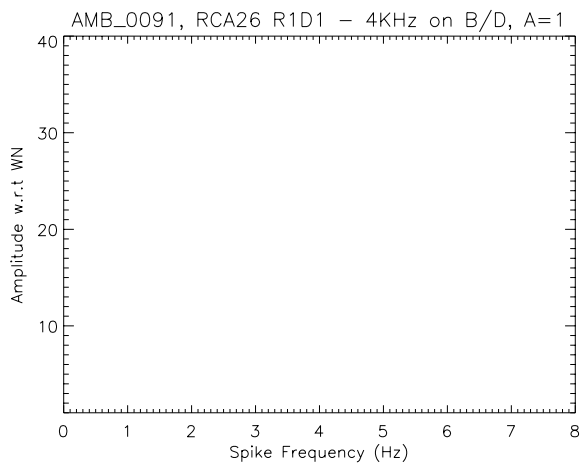
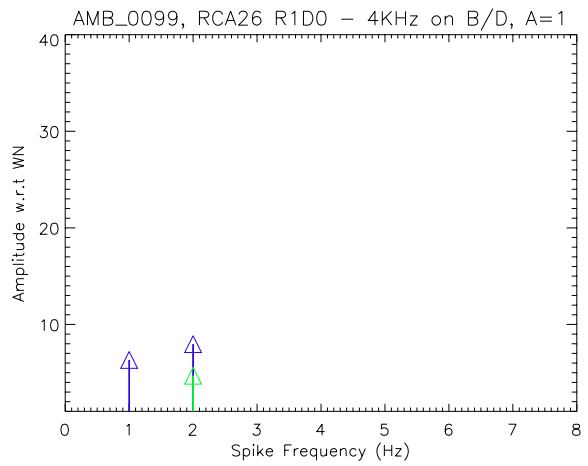
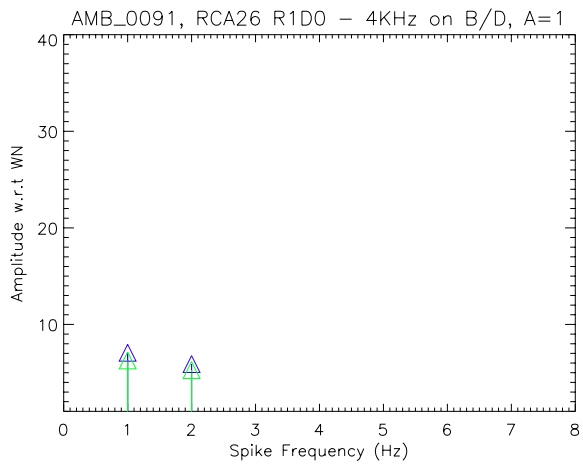
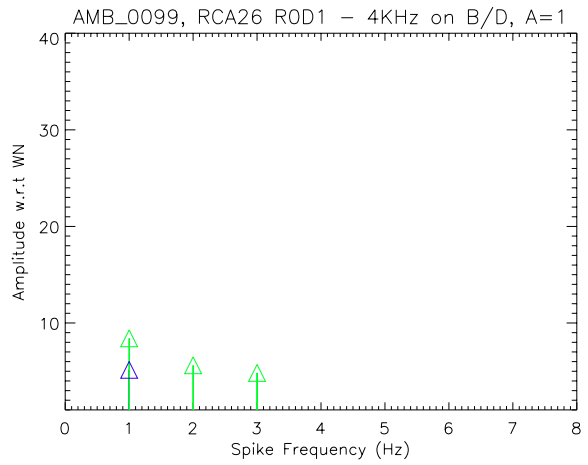
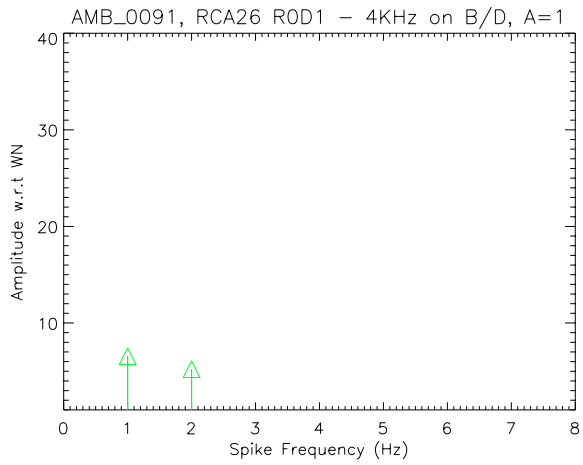
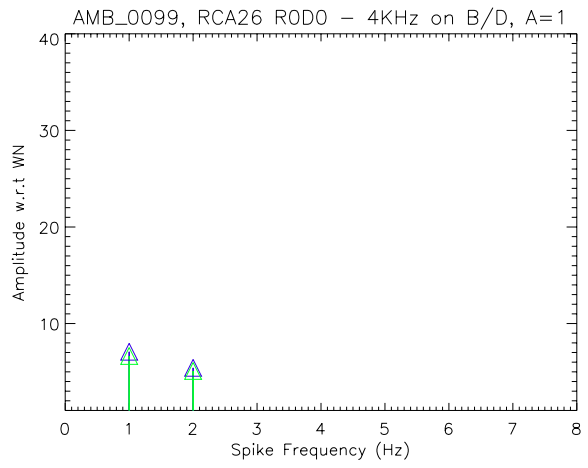
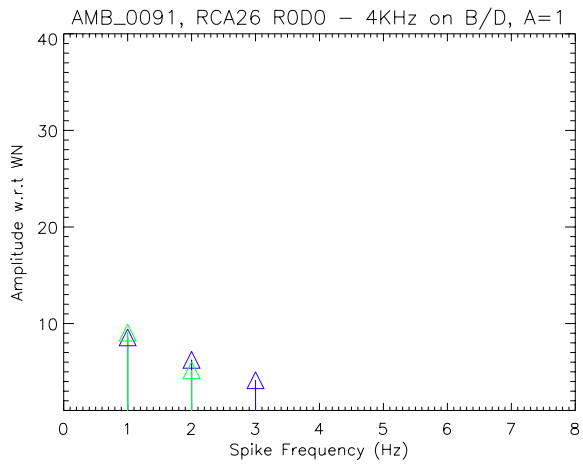


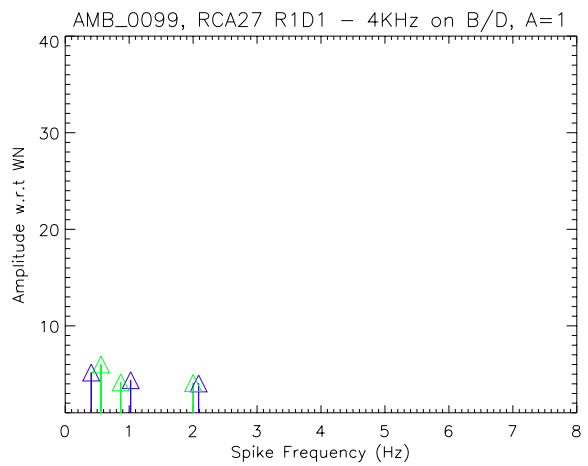
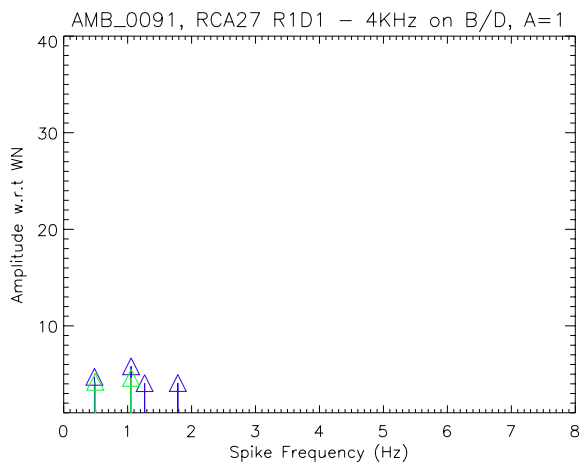
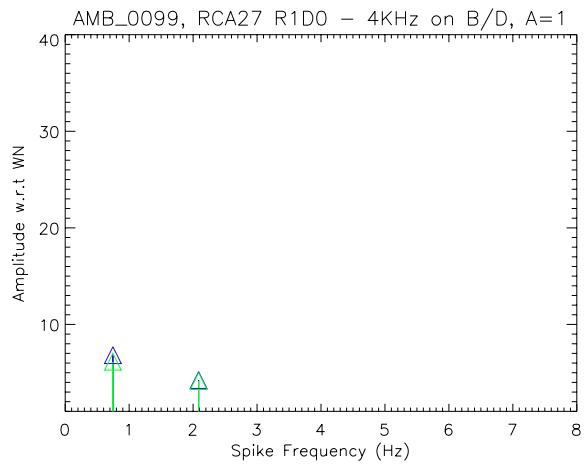
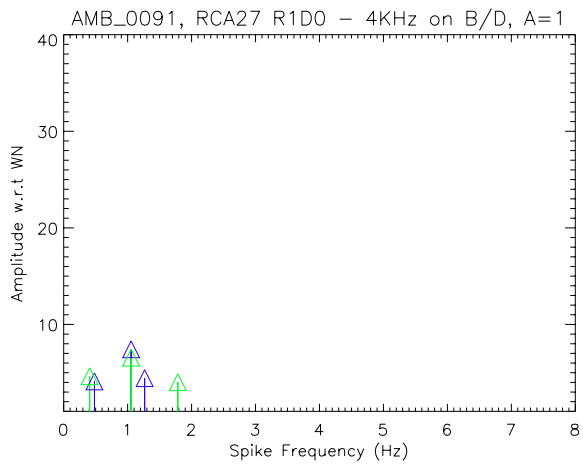
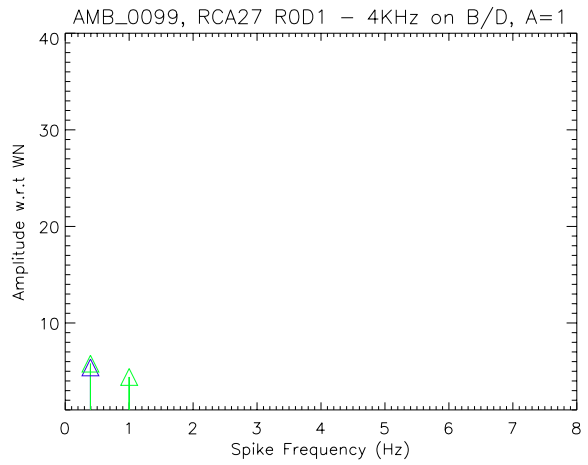
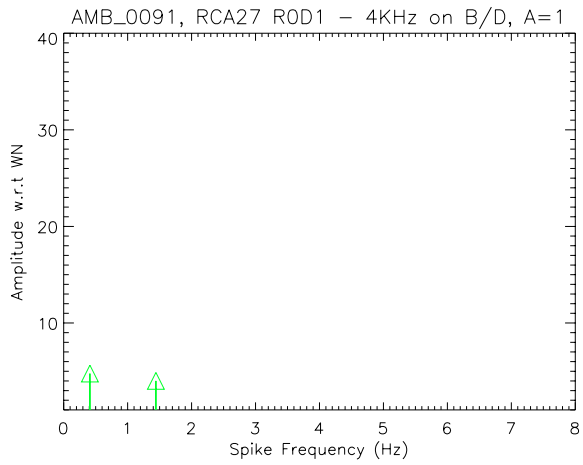
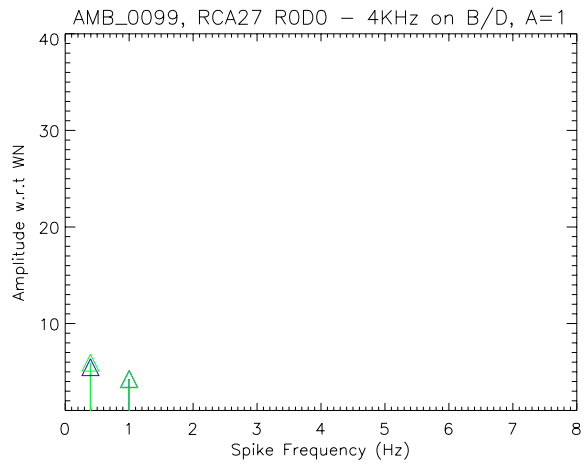
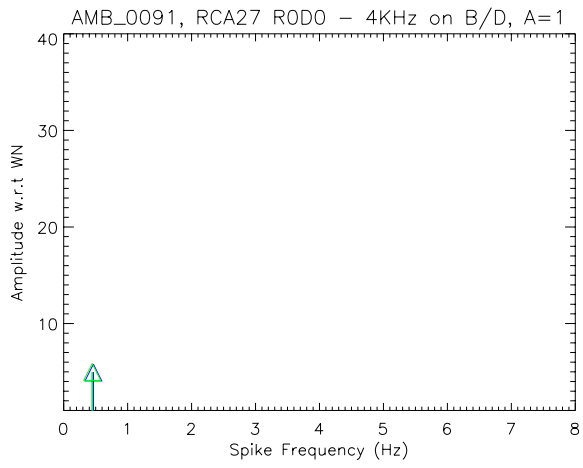


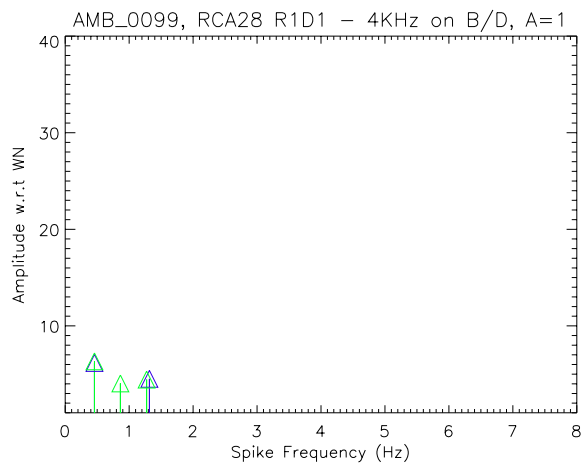
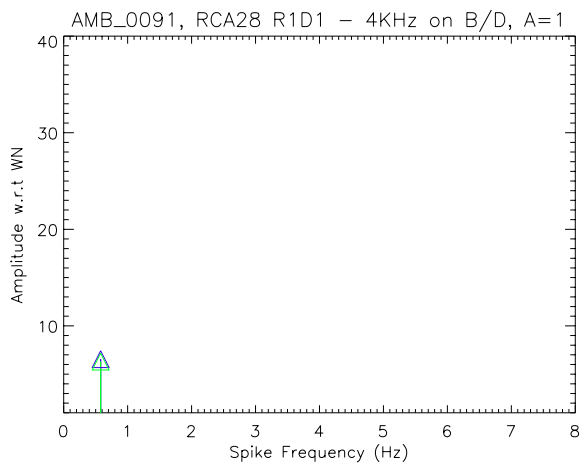
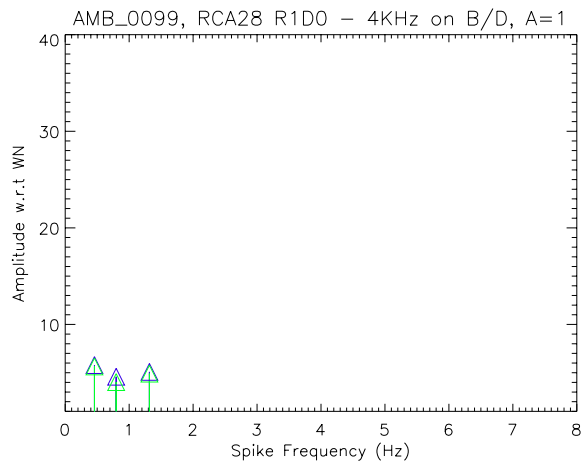
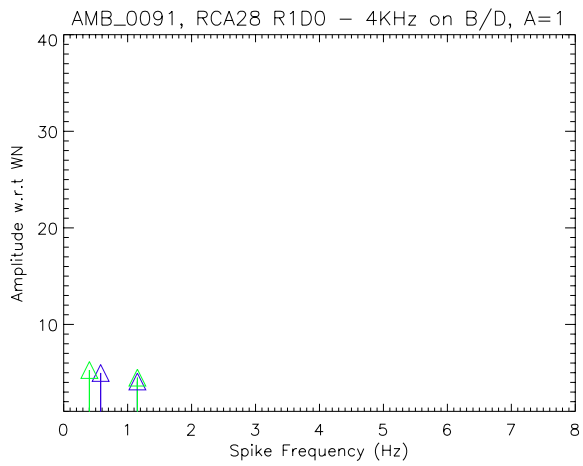
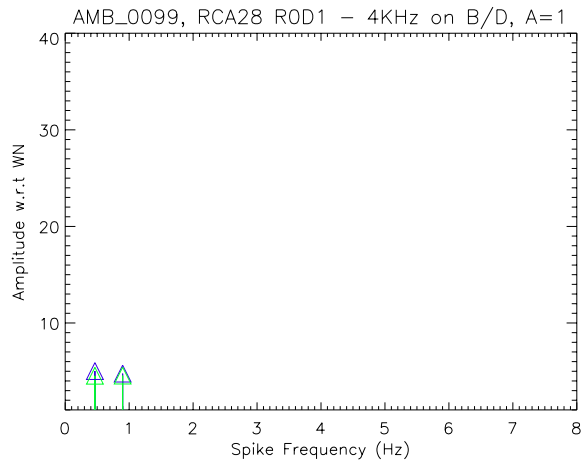
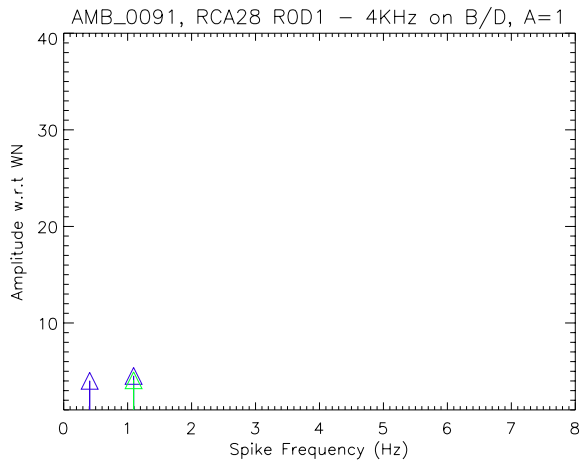
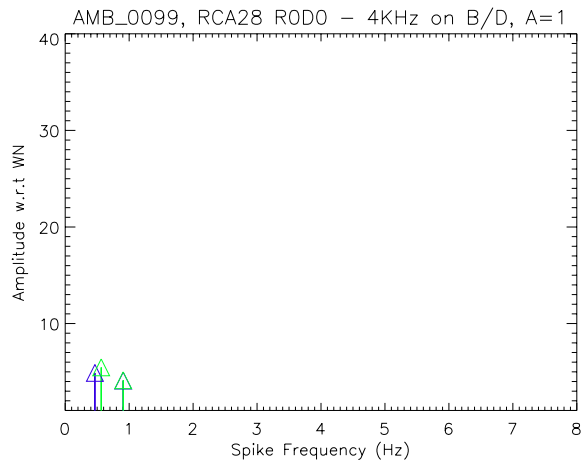
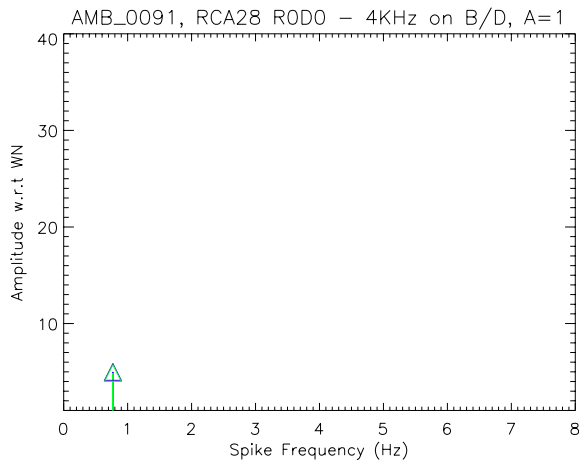




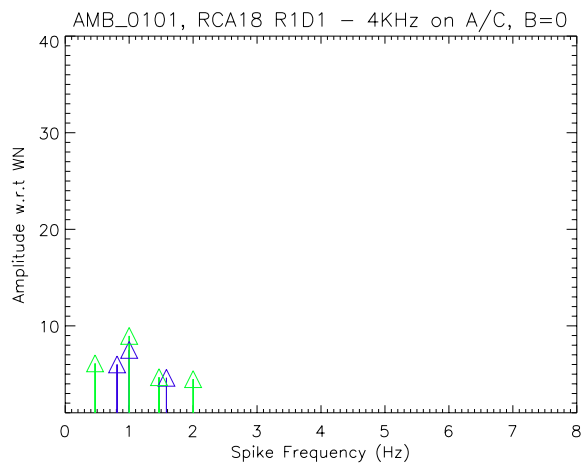
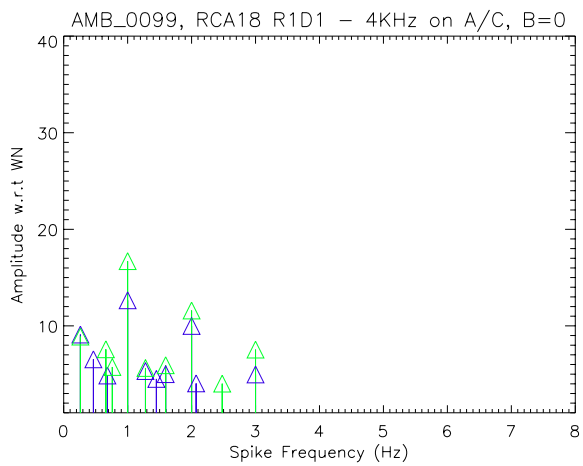
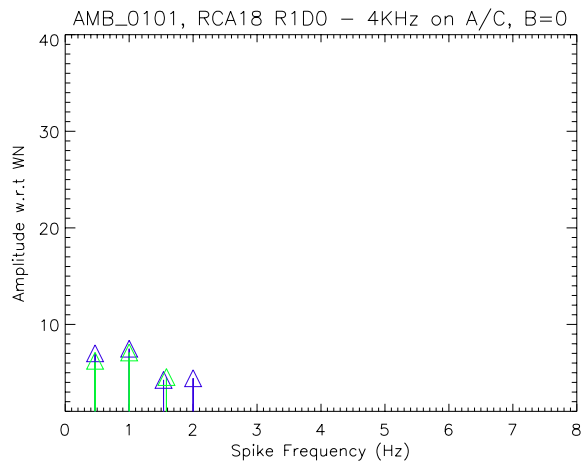
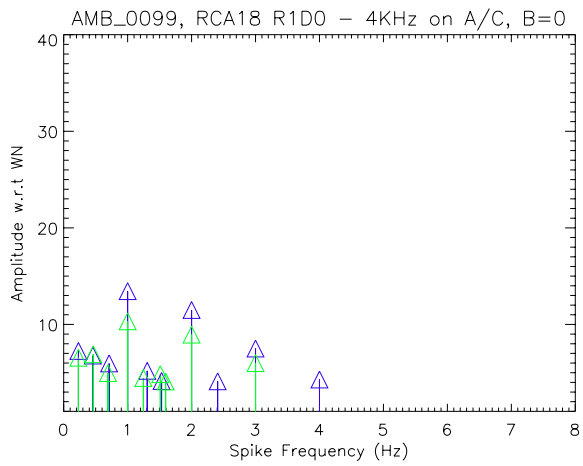
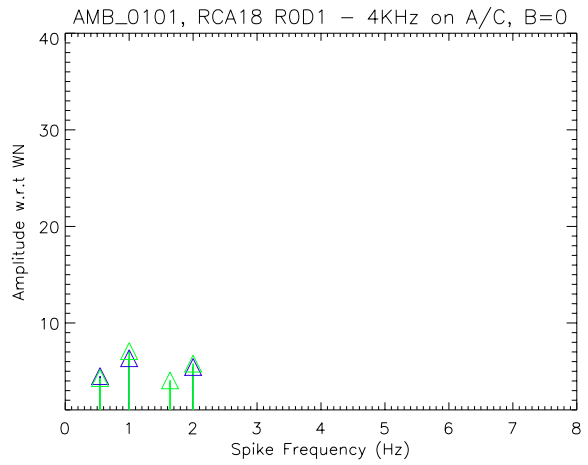
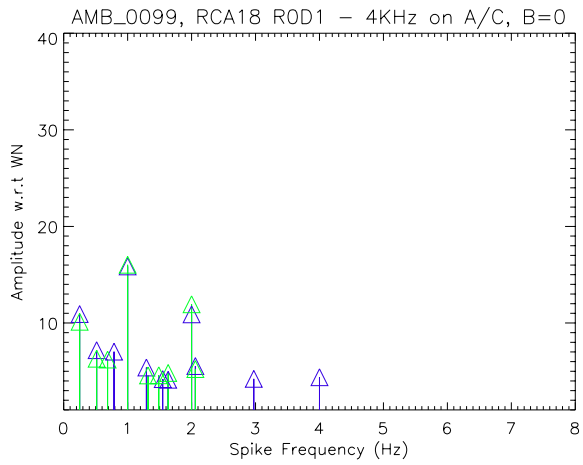
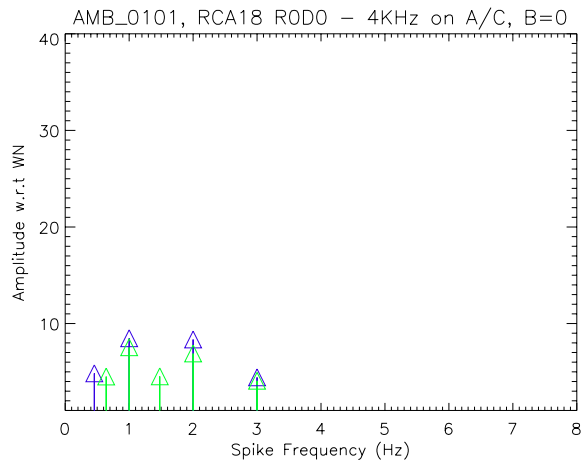
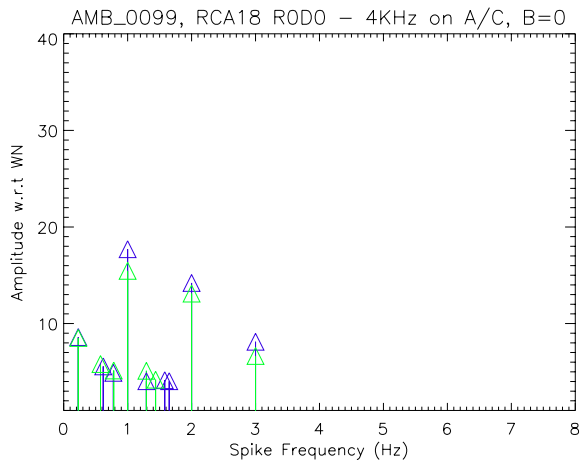




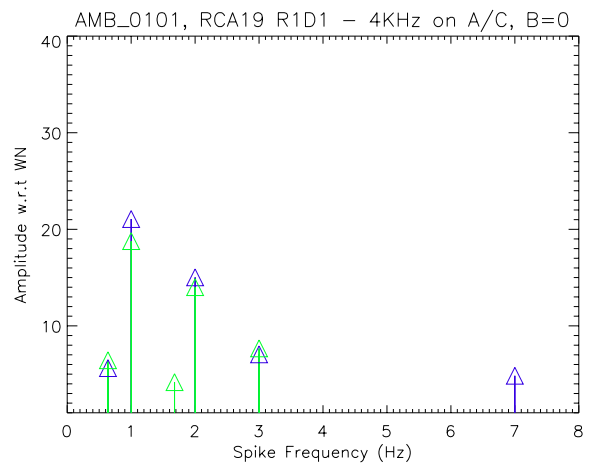
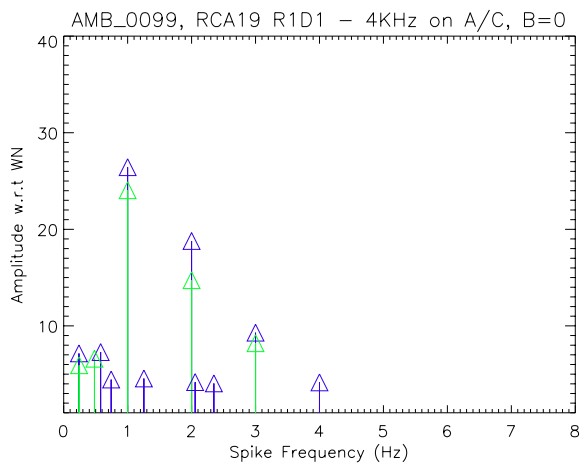
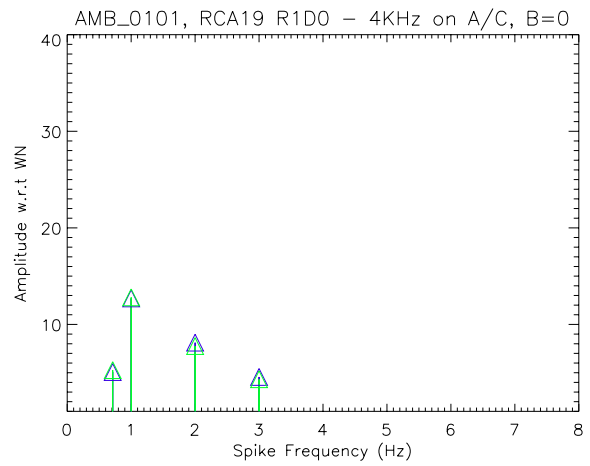
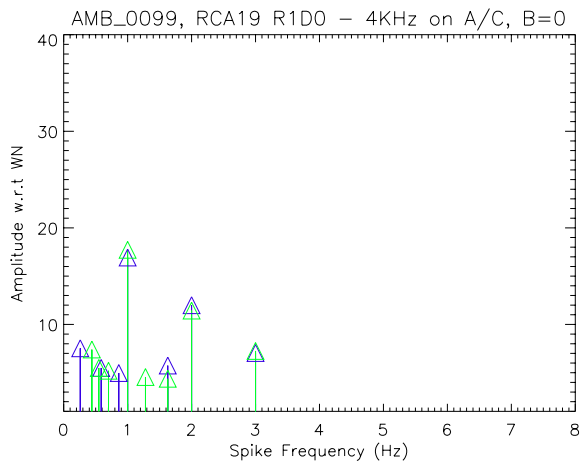
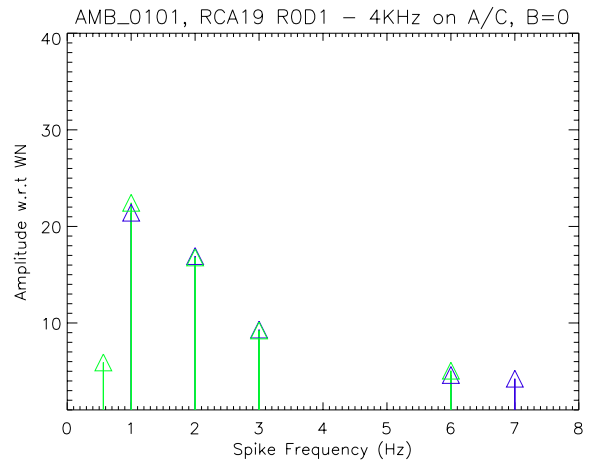
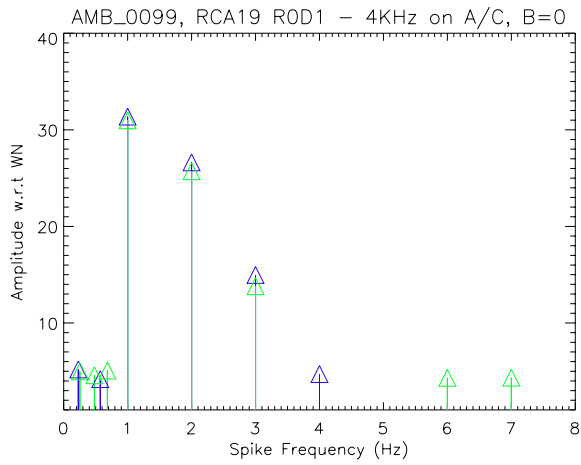
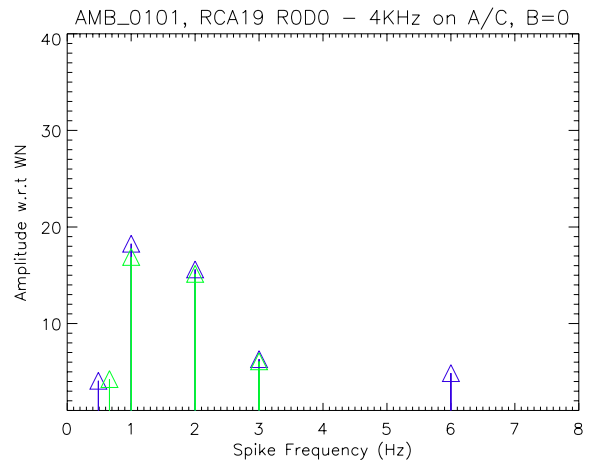
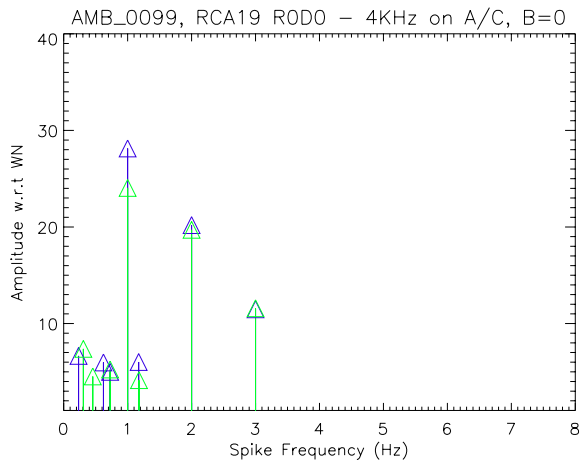


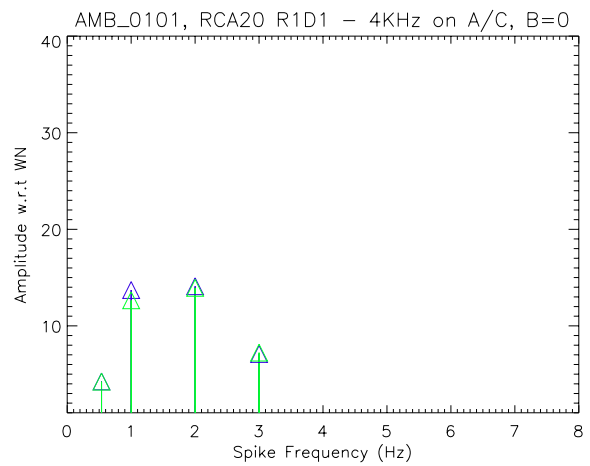
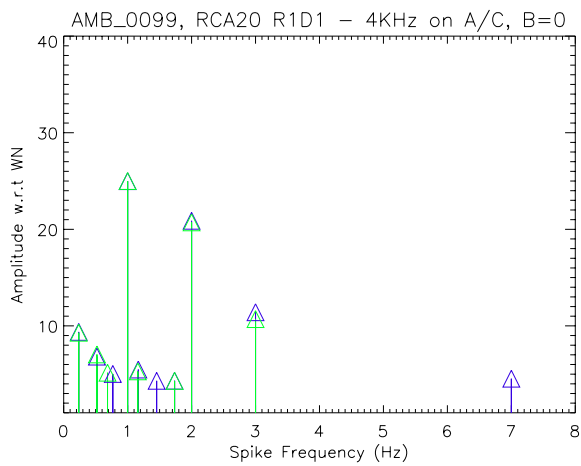
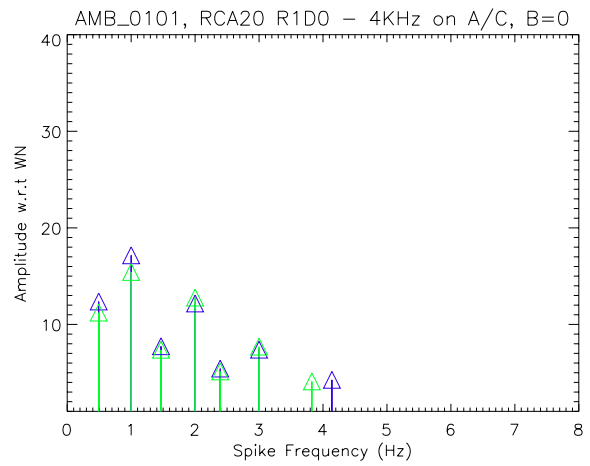
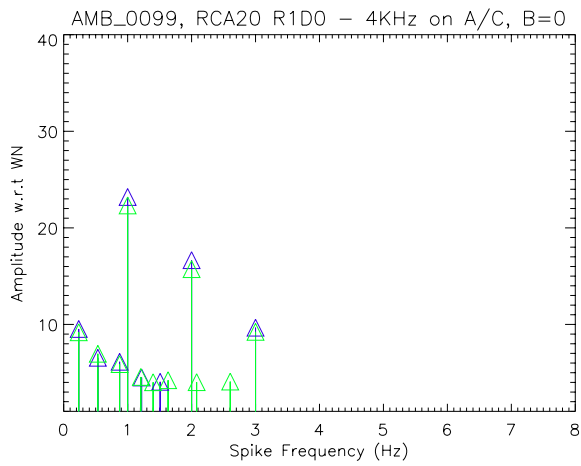
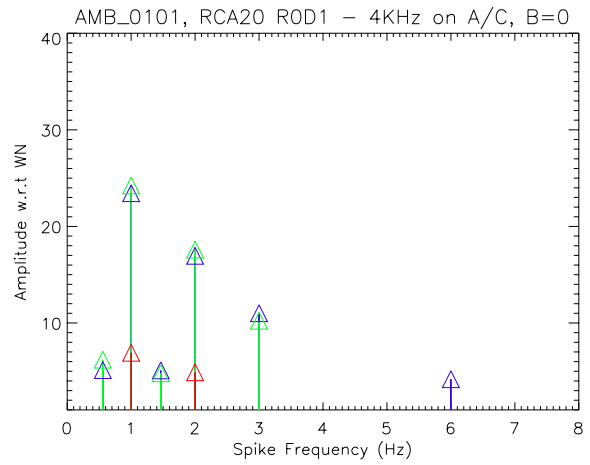
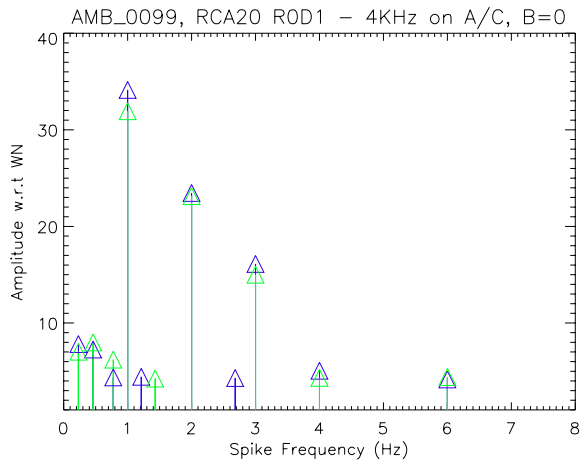
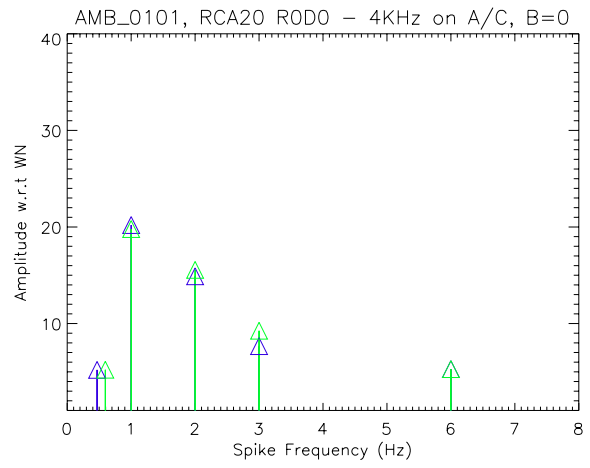
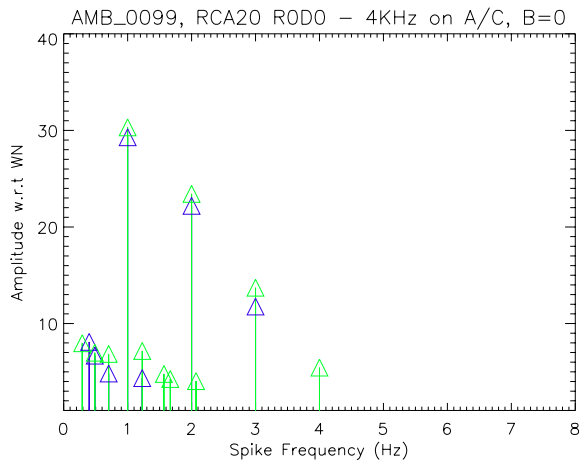


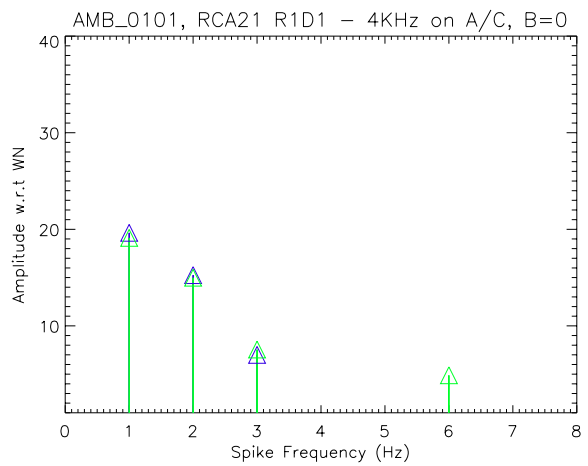
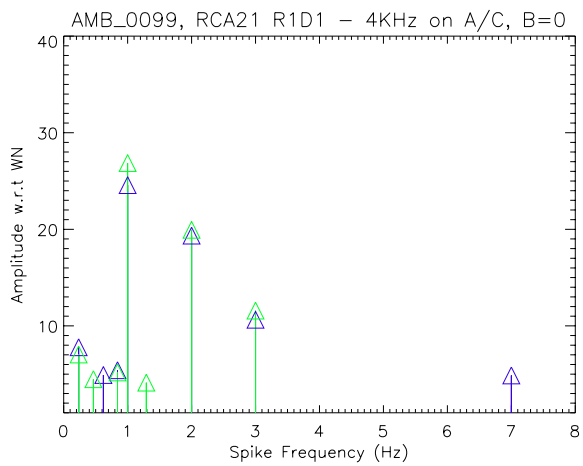
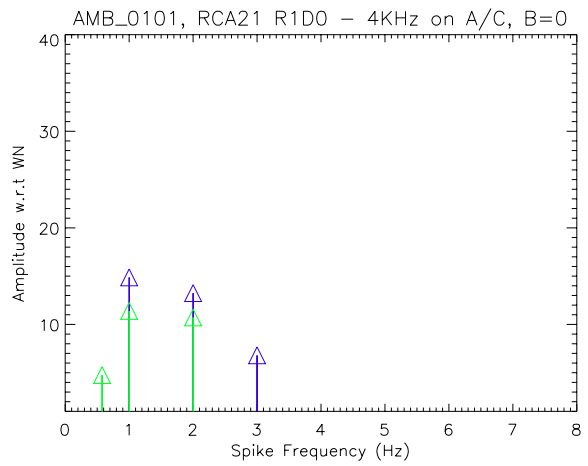
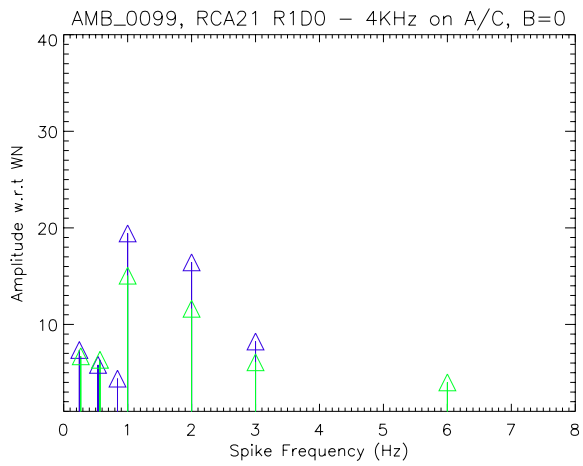
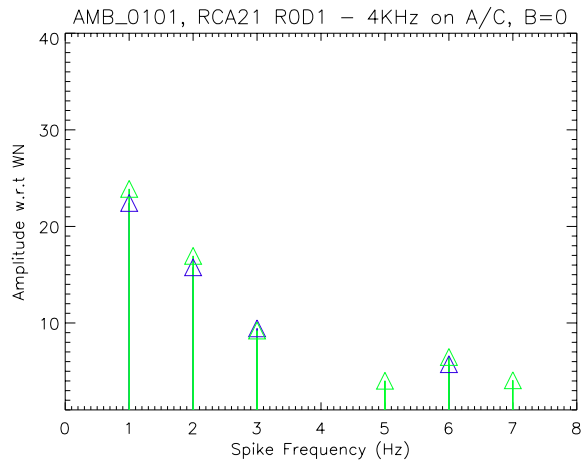
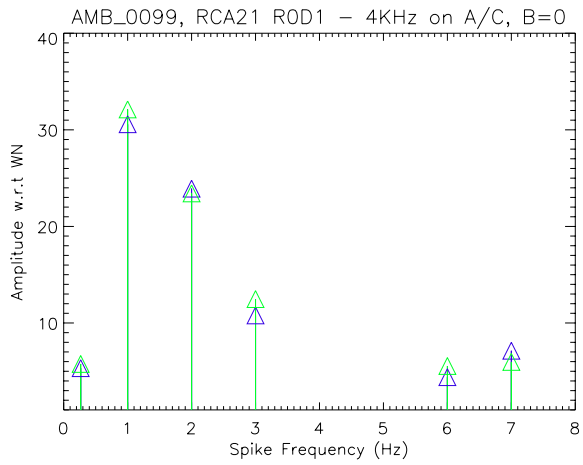
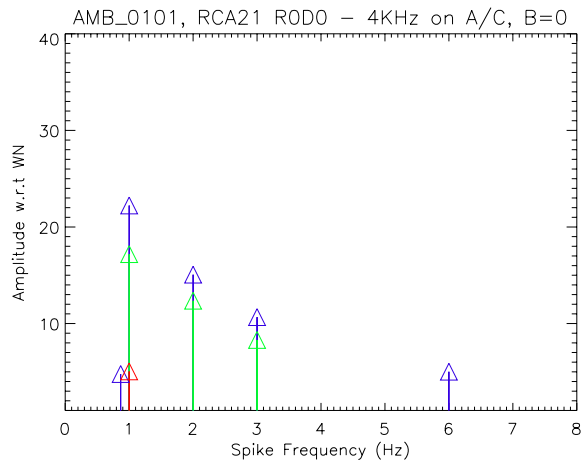
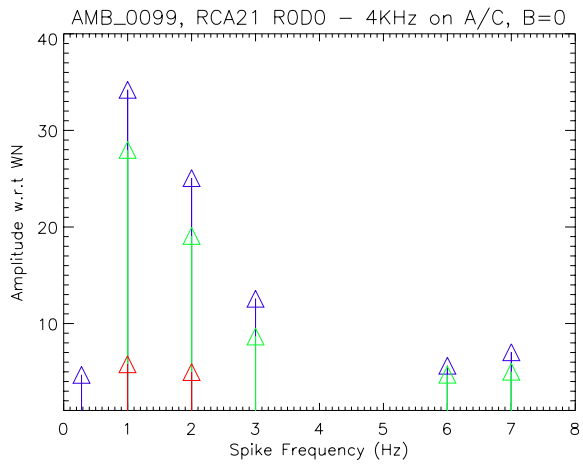
## **SFT in Cannes vs WFT in Milan**

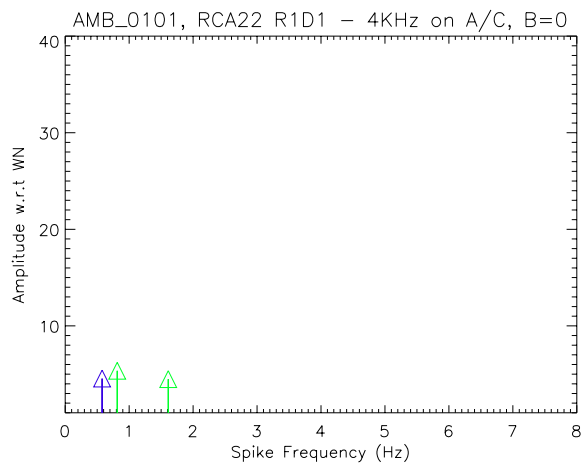
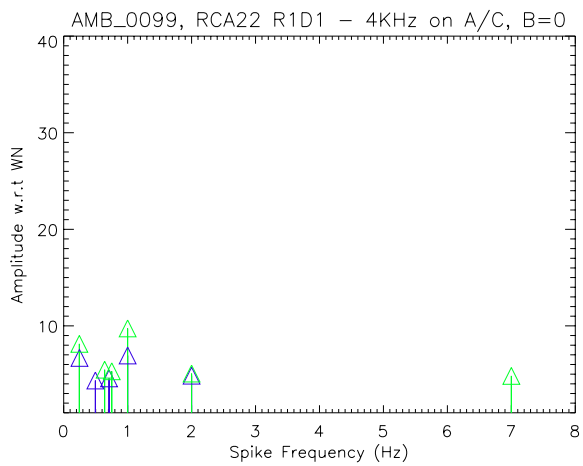
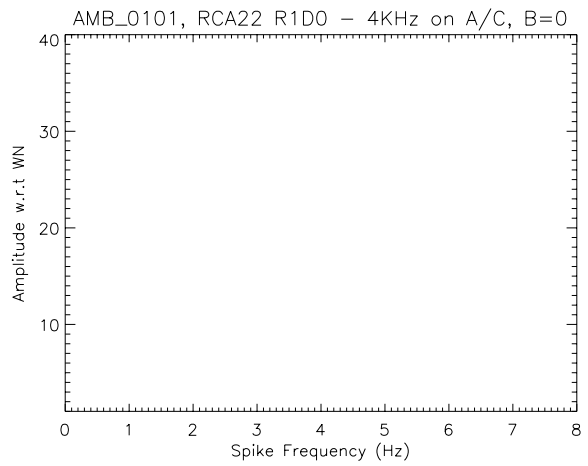
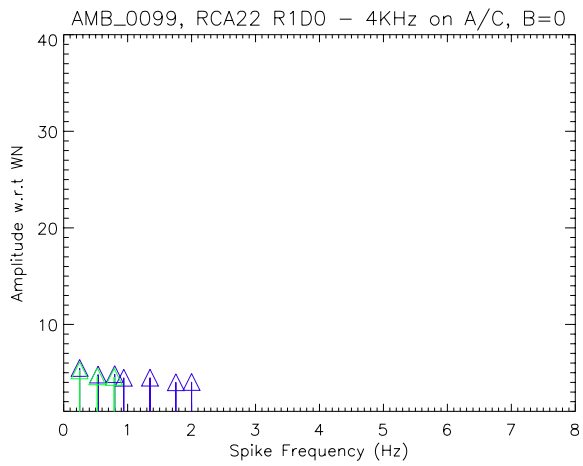
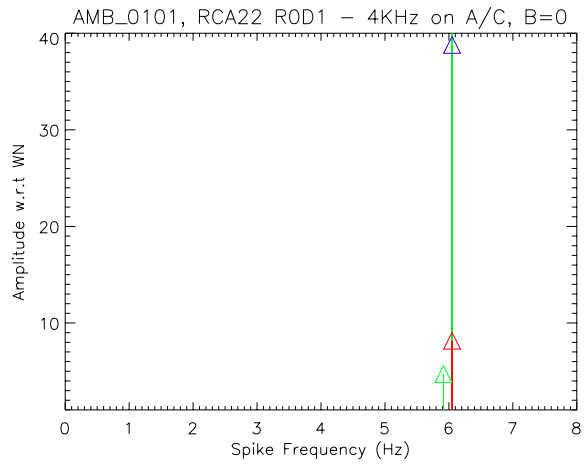
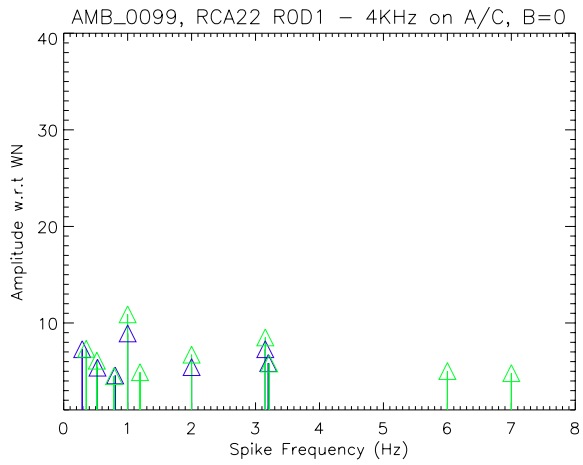
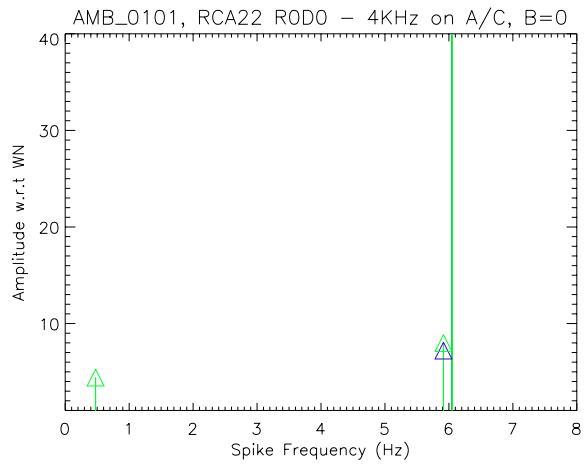
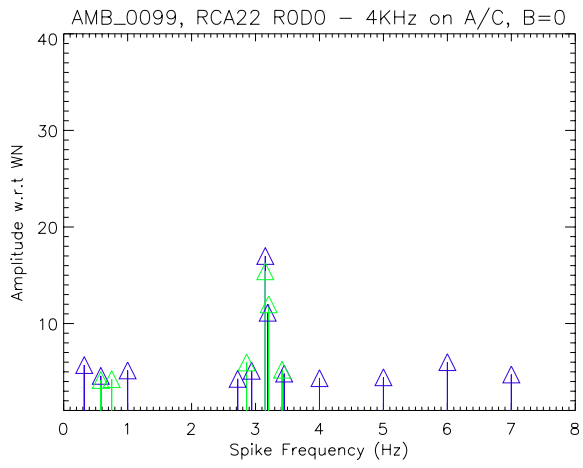


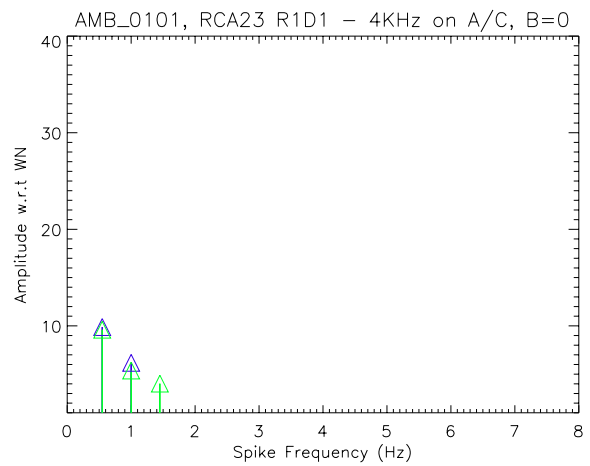
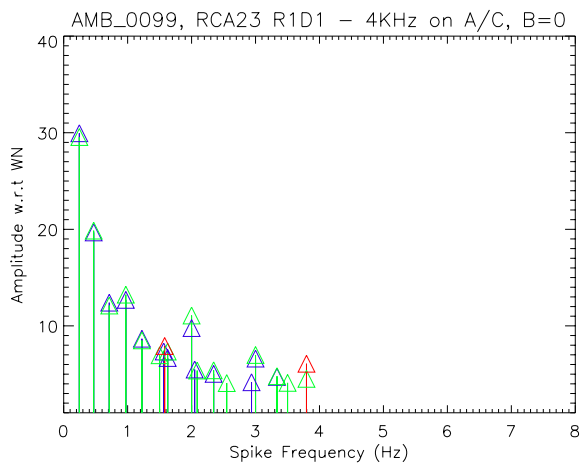
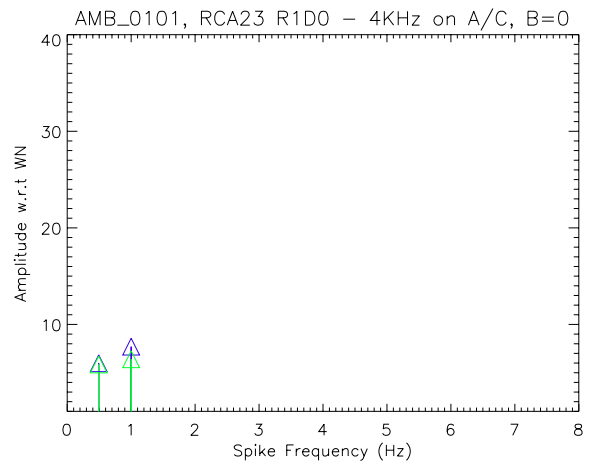
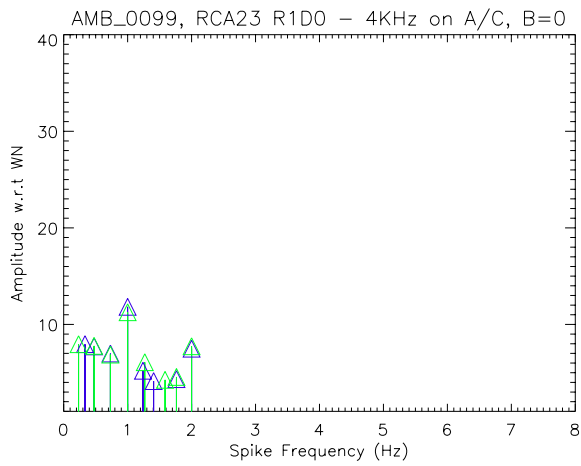
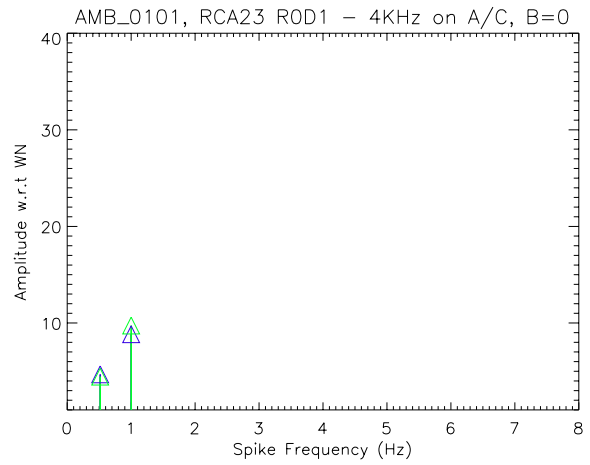
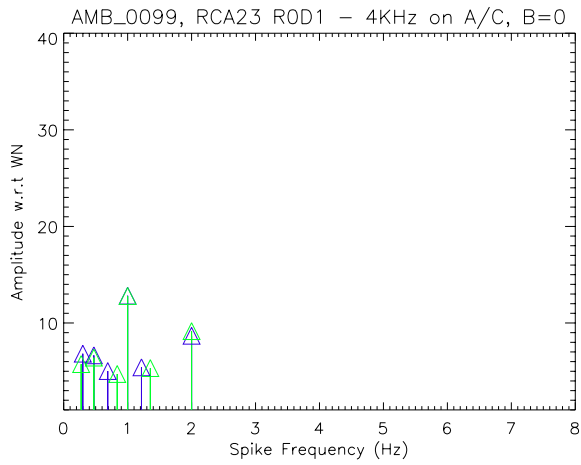
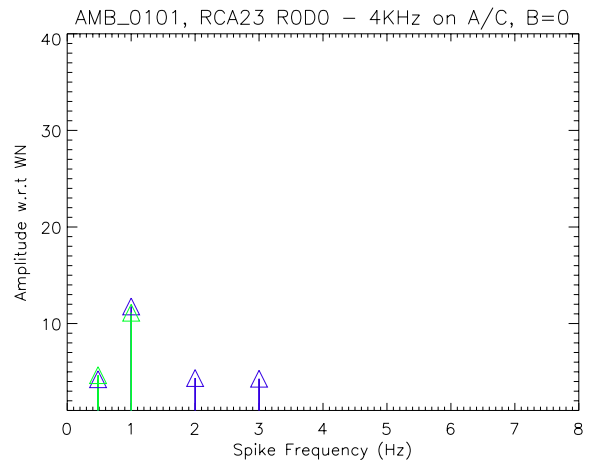
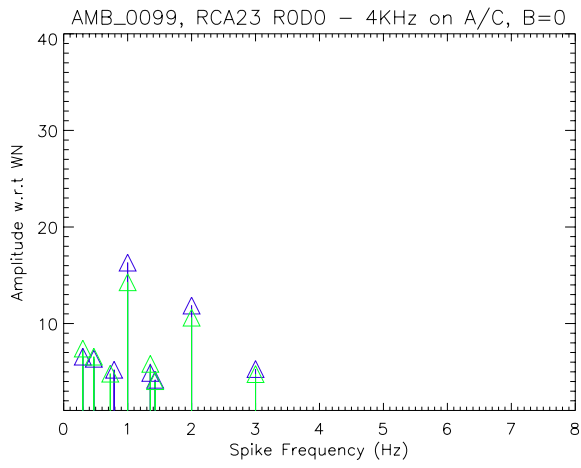


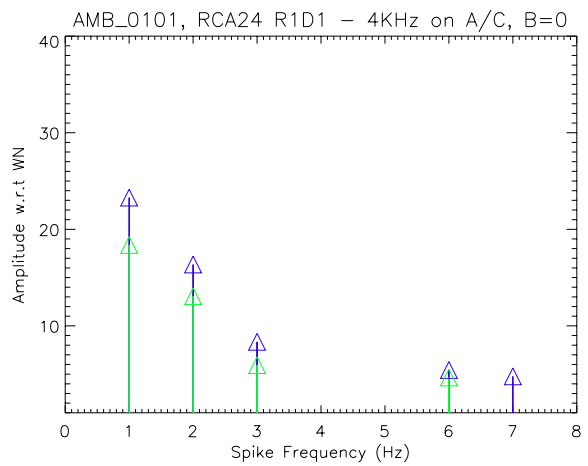
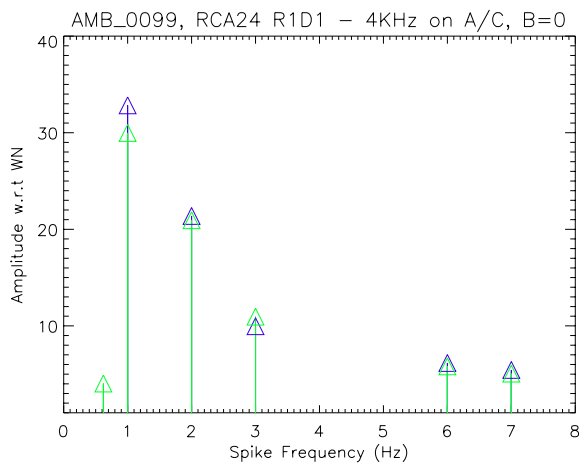
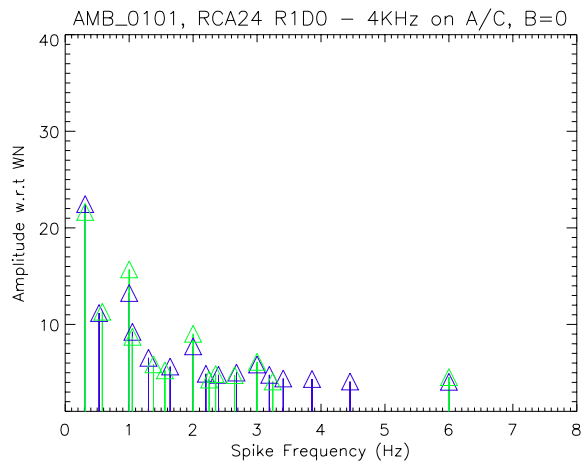
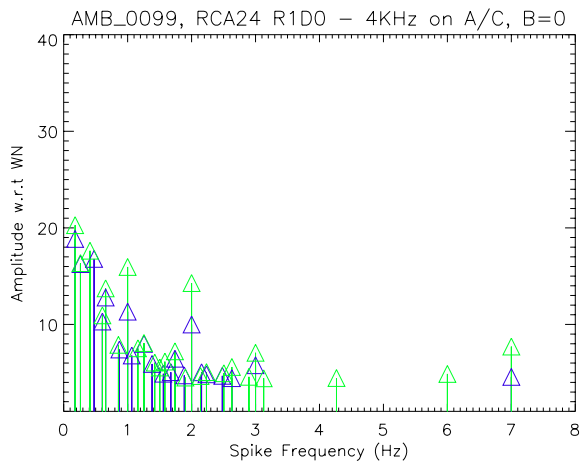
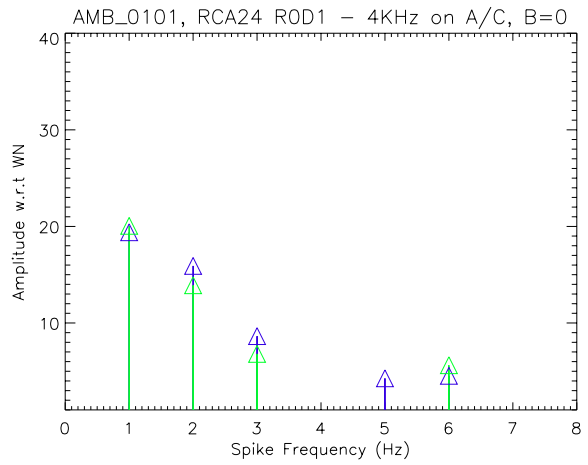
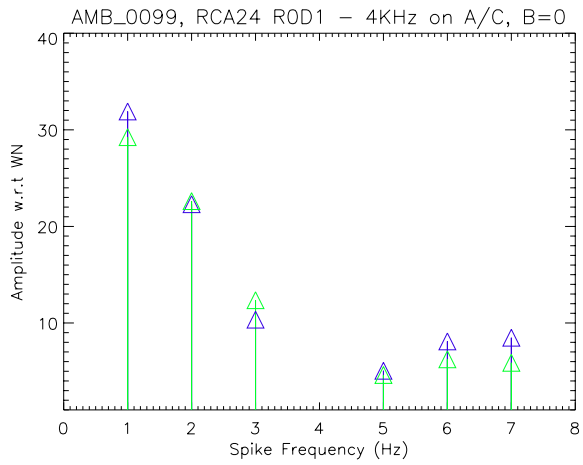
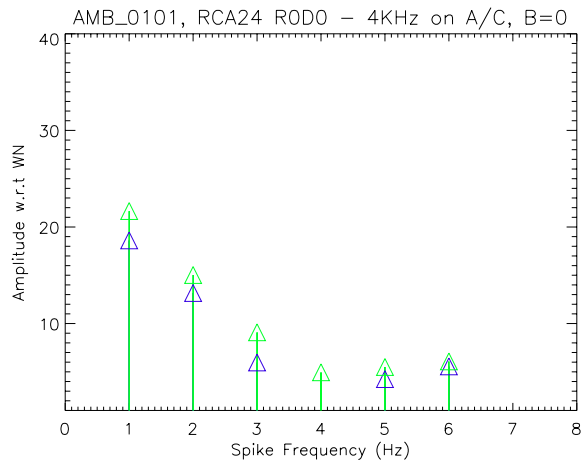
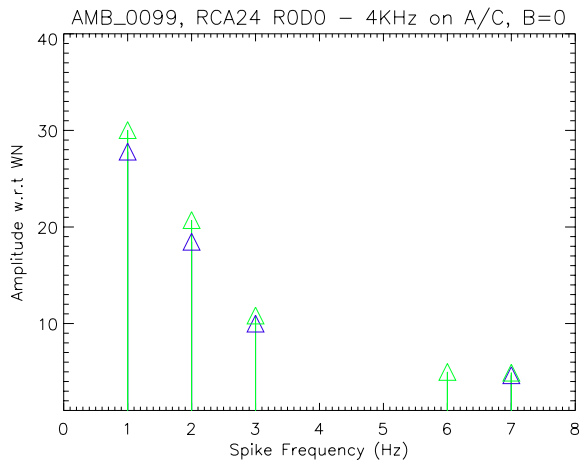


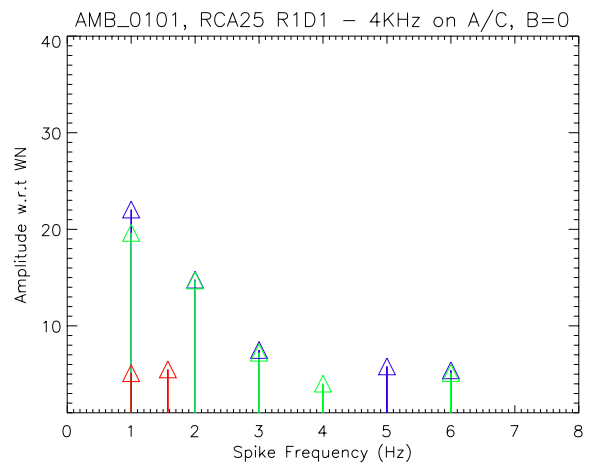
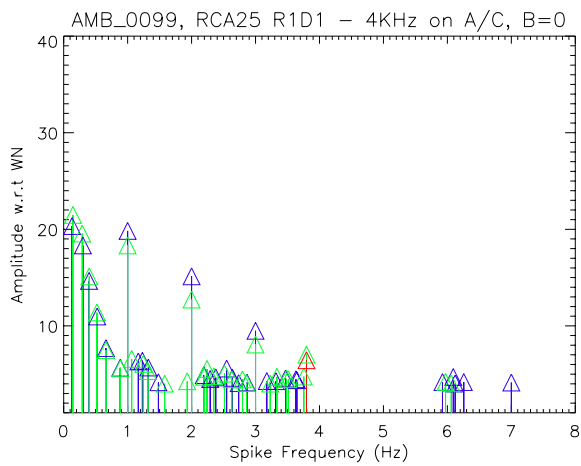
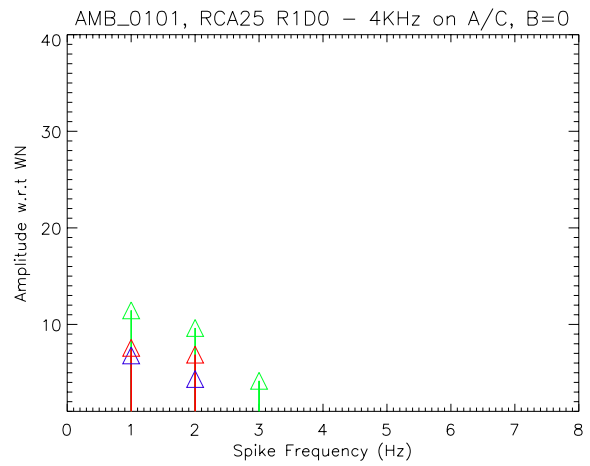
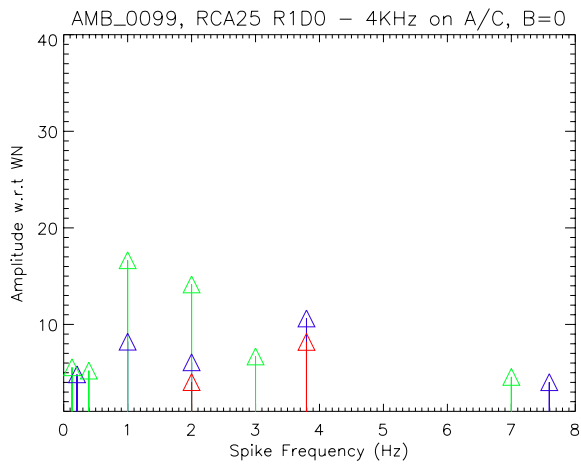
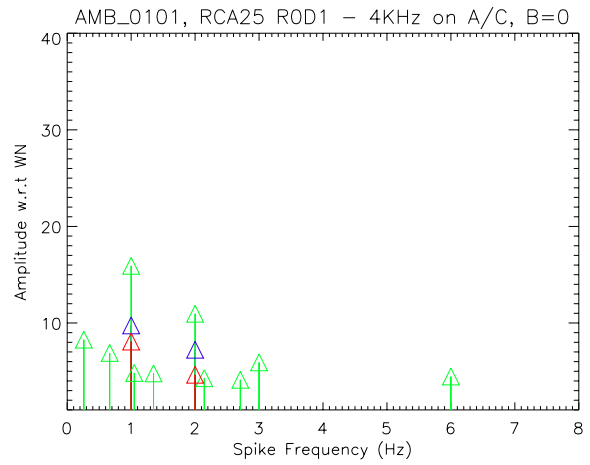
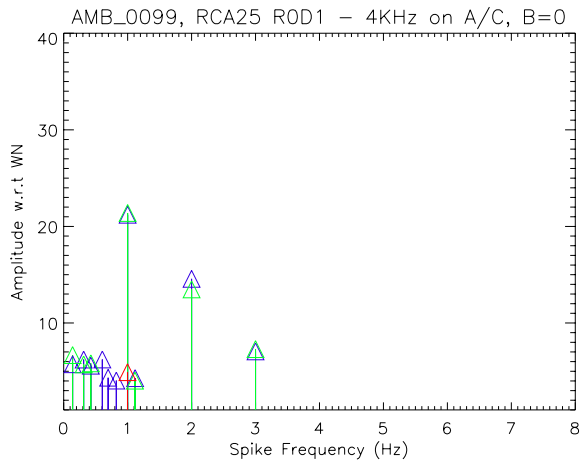
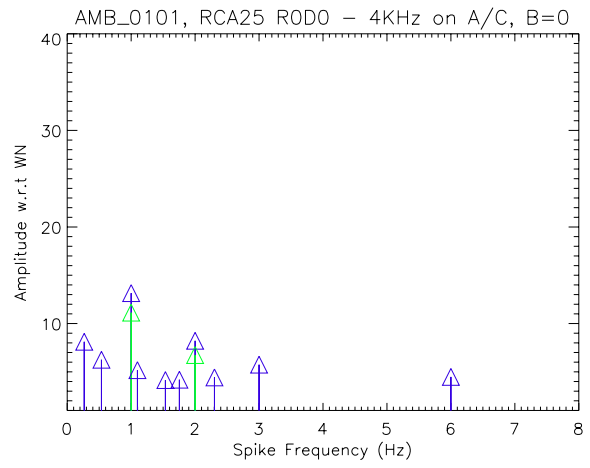
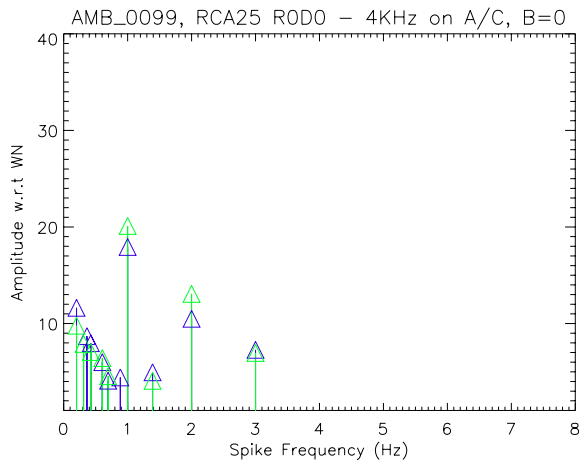


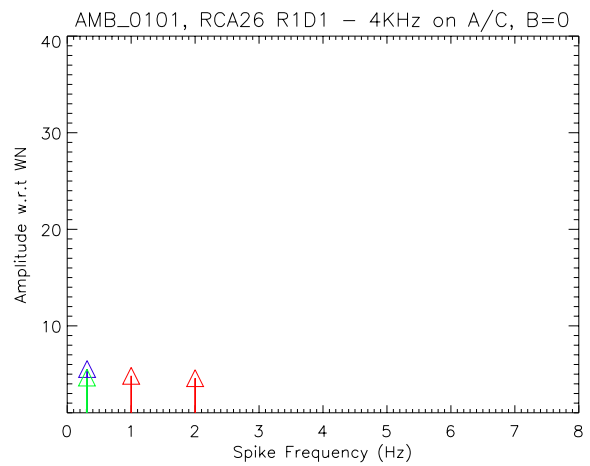
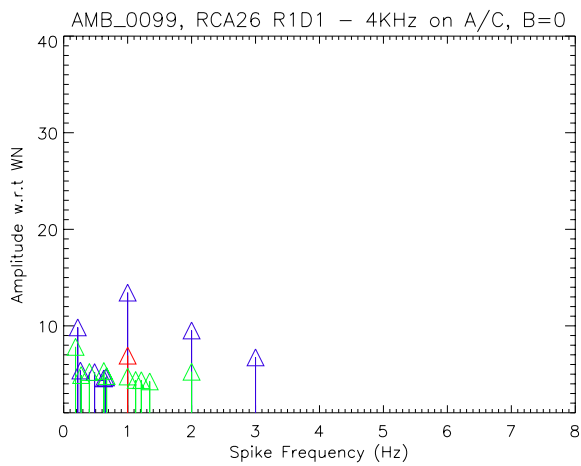
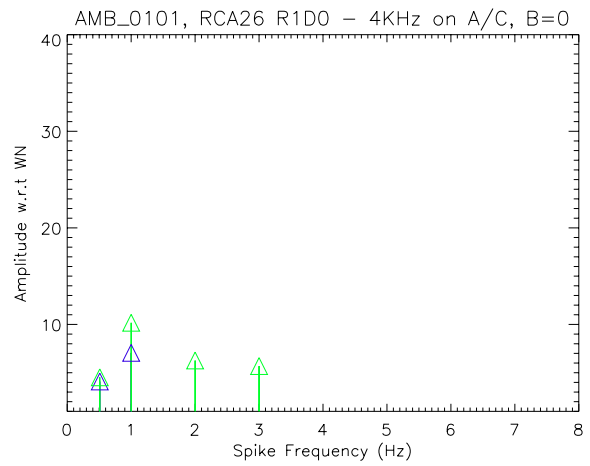
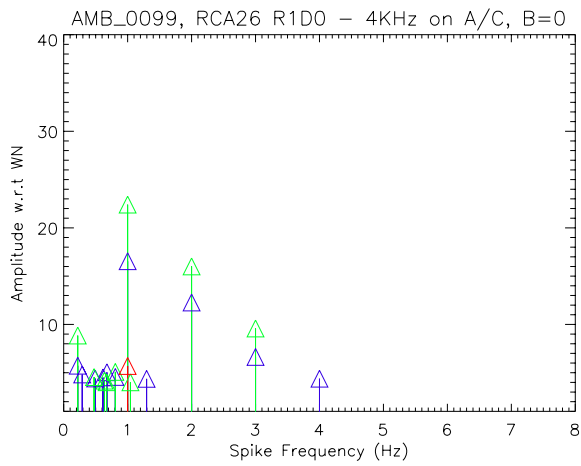
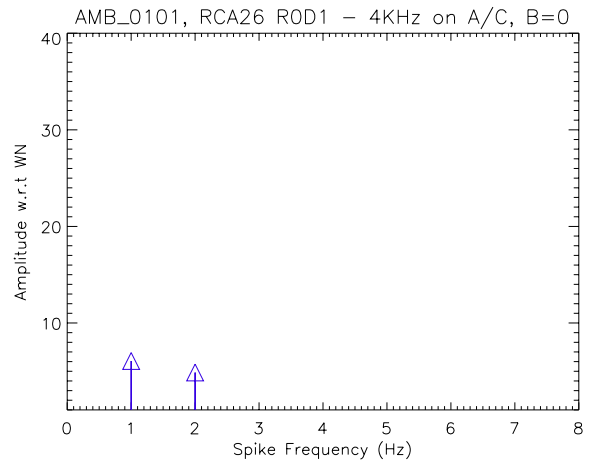
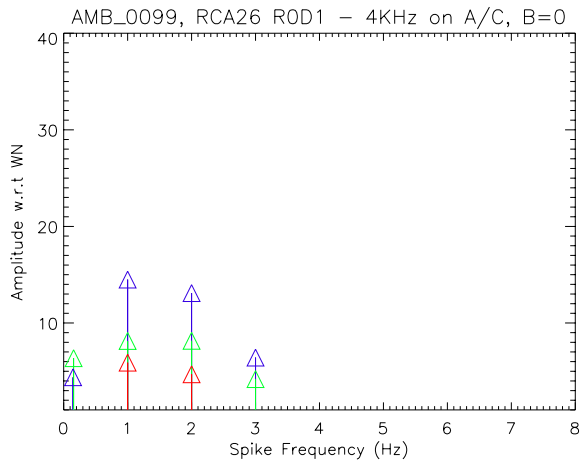
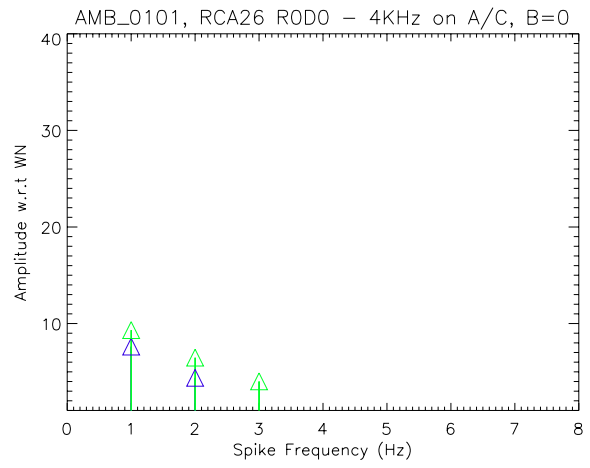
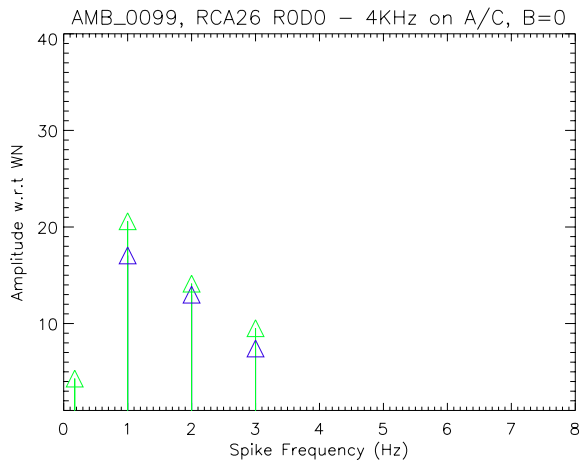




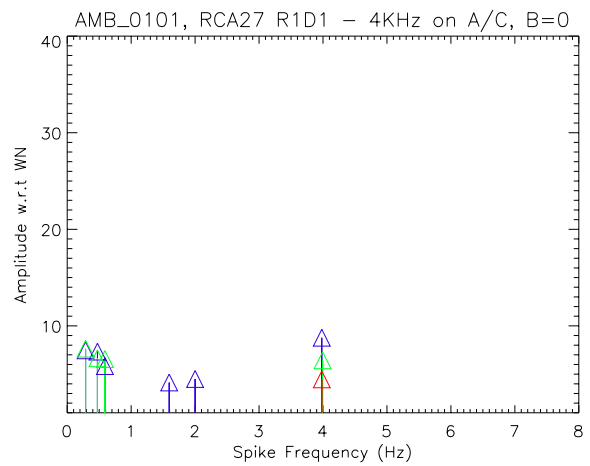
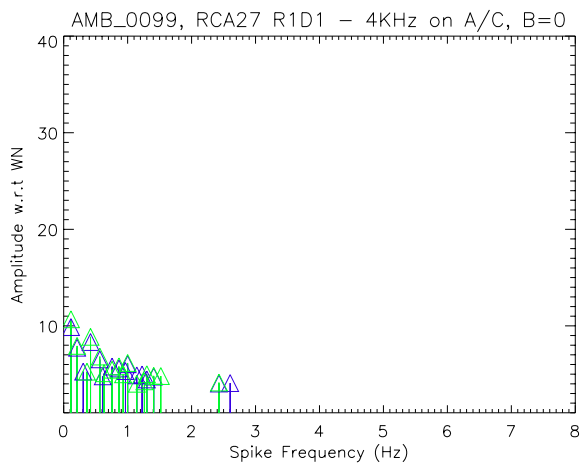
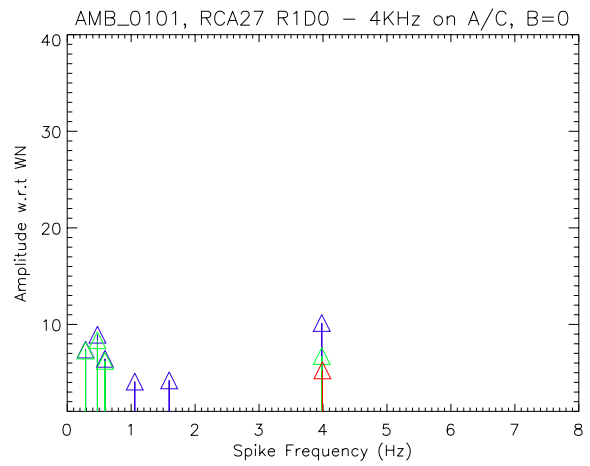
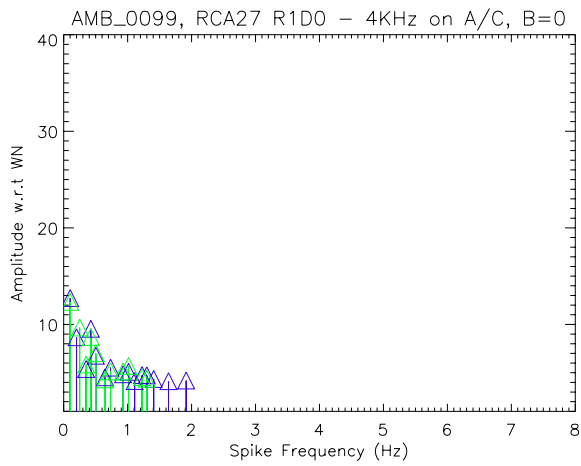
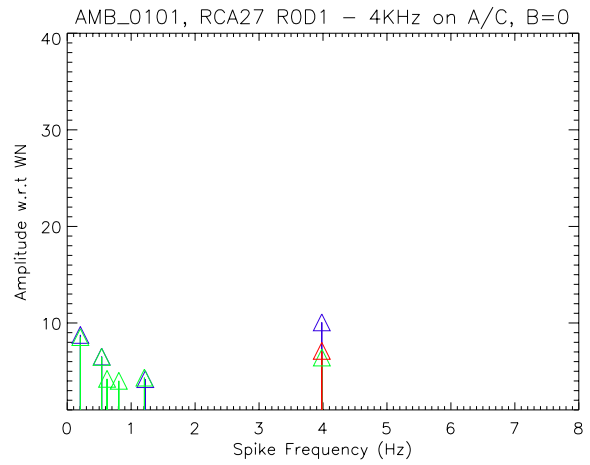
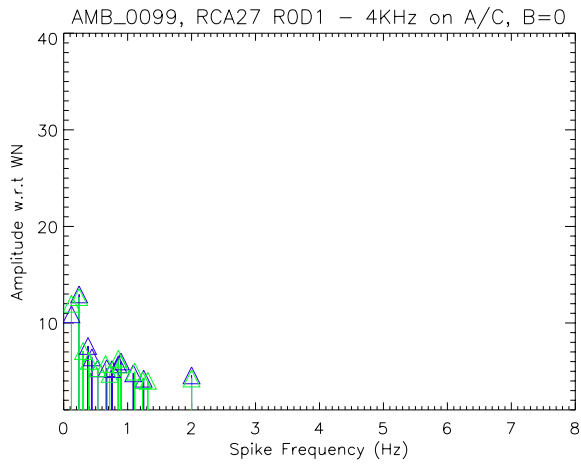
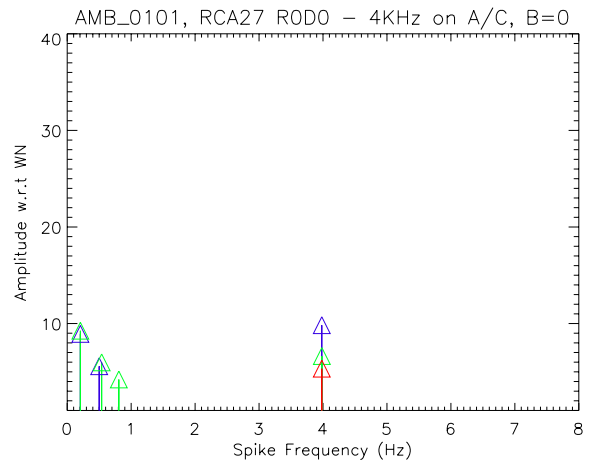
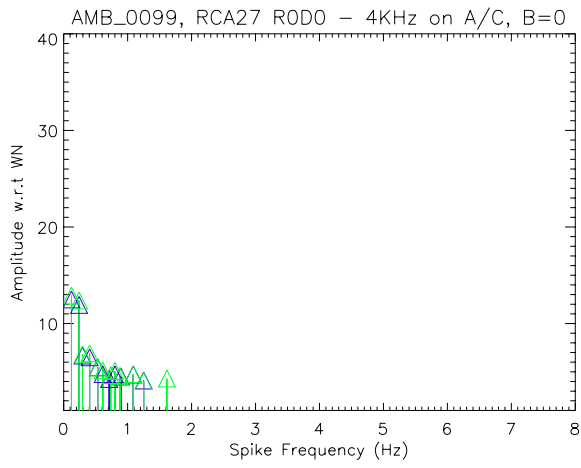


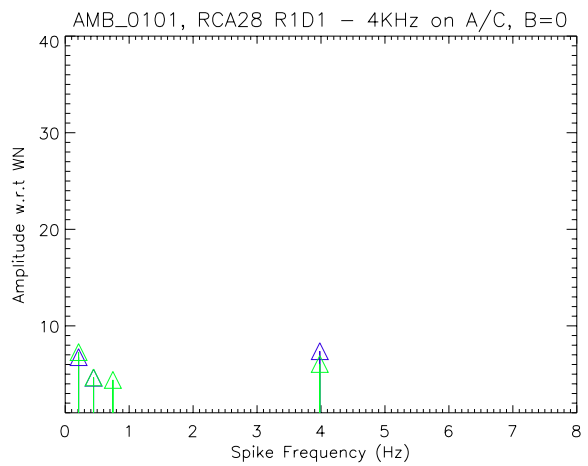
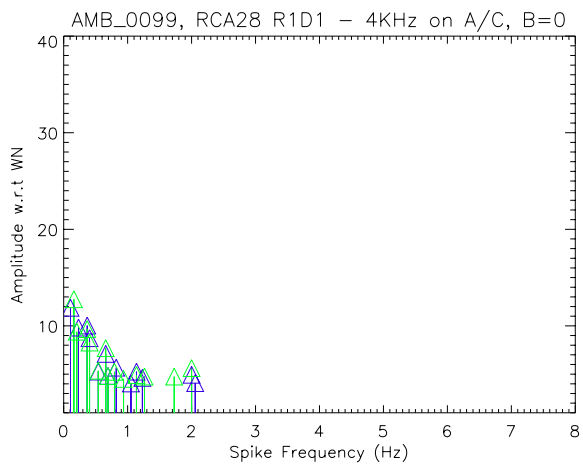
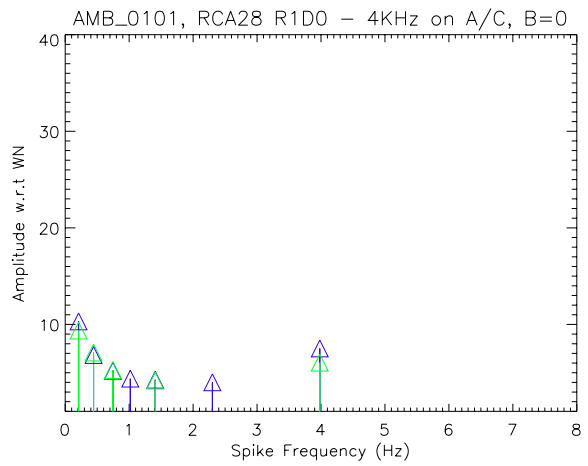
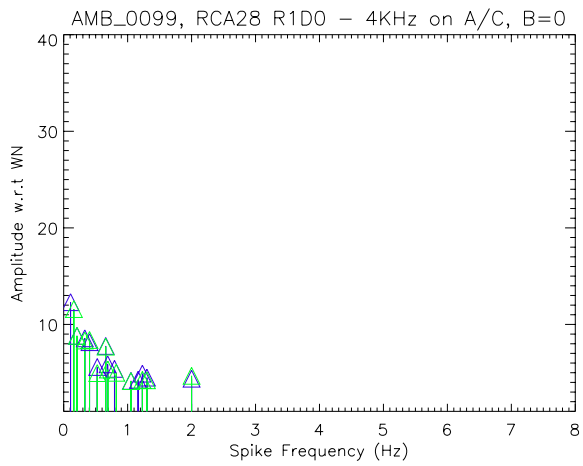
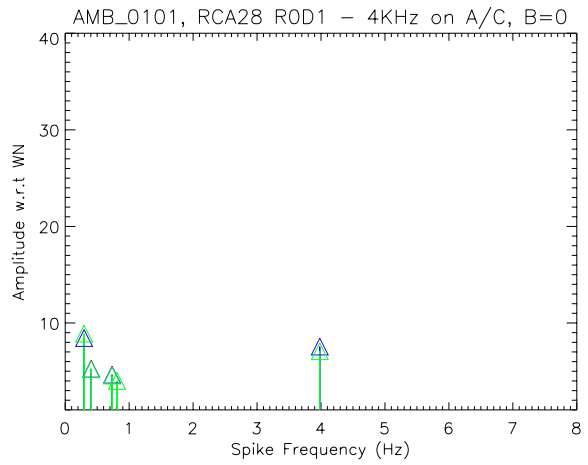
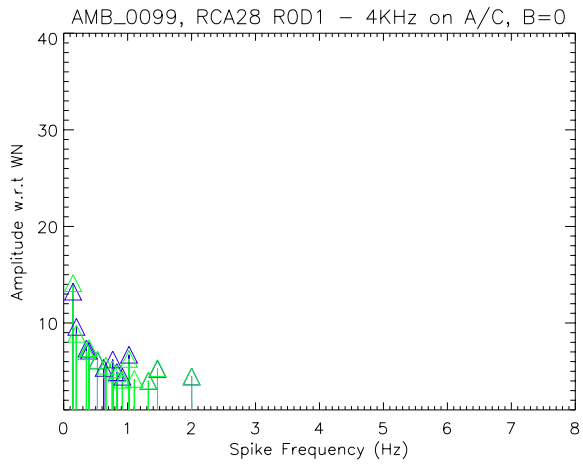
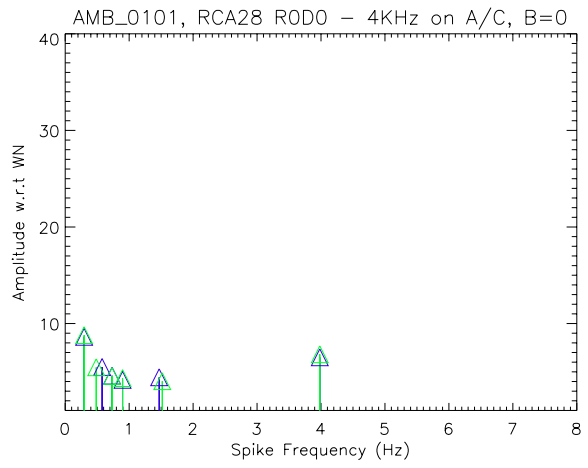
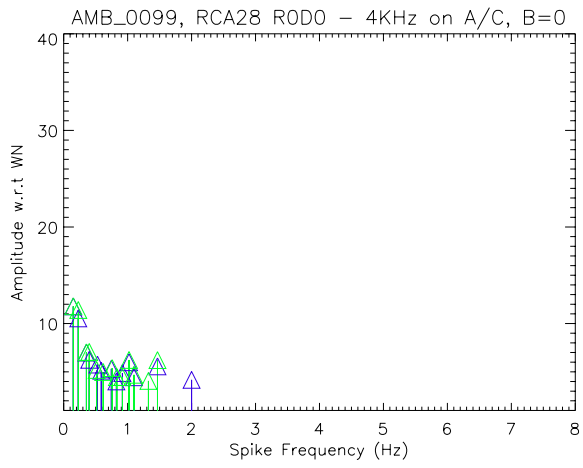


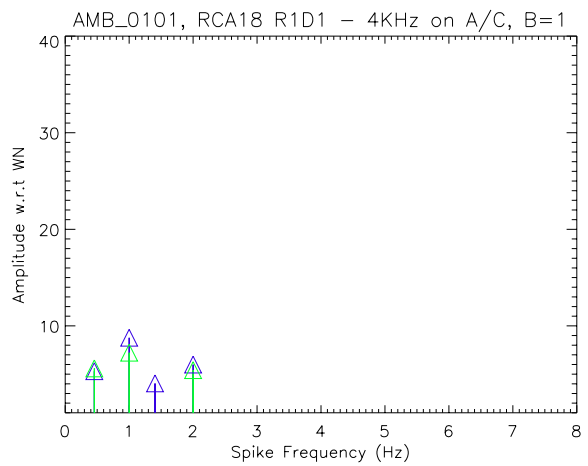
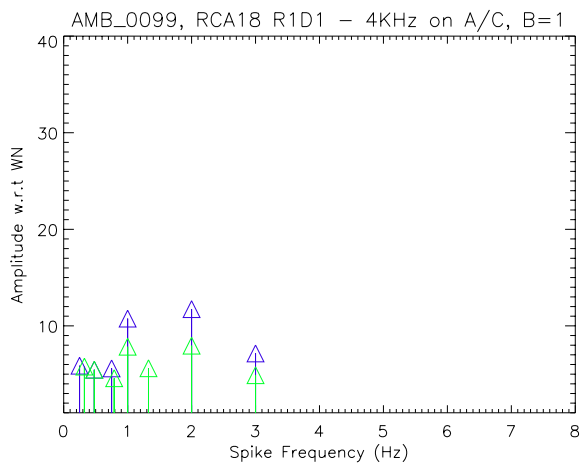
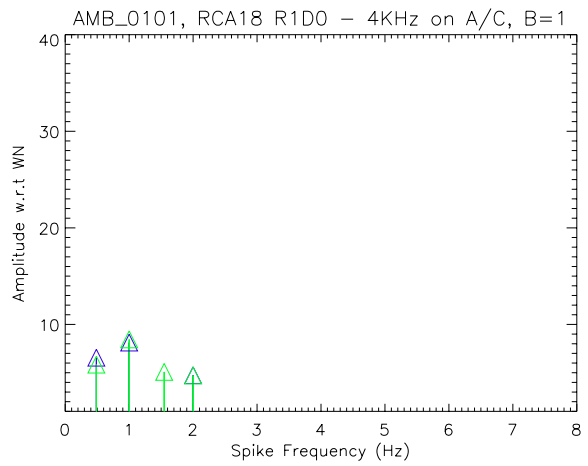
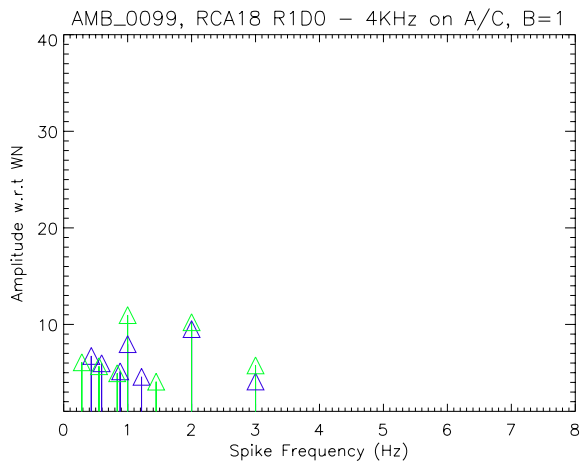
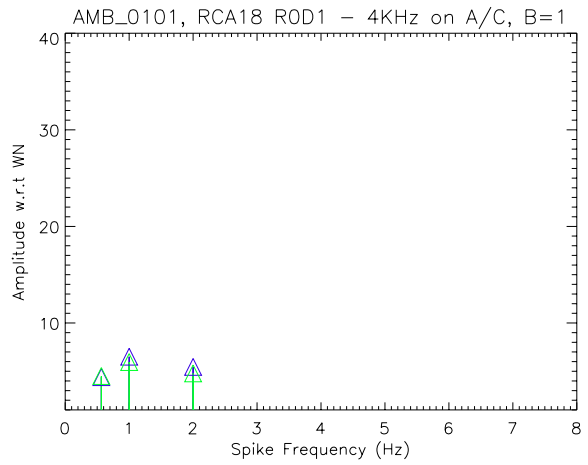
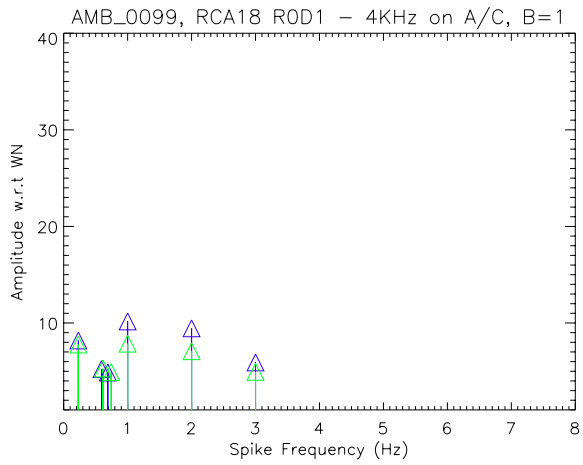
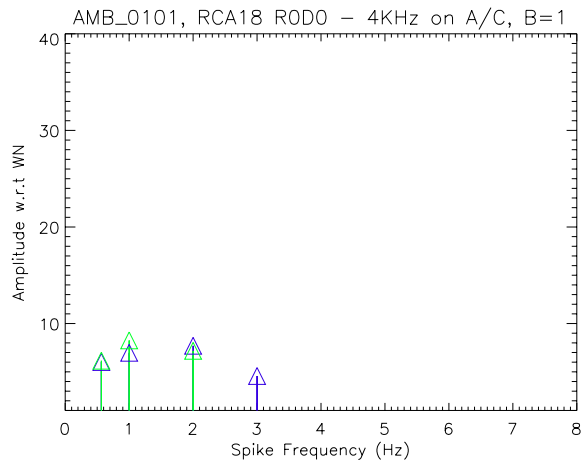
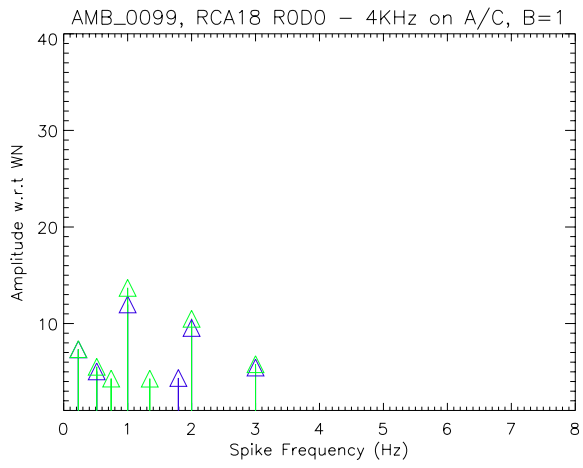


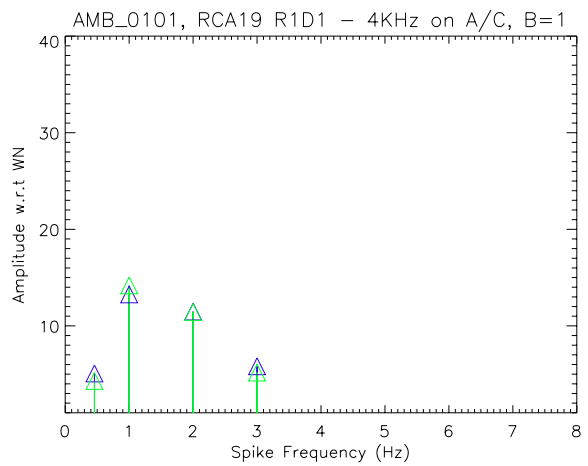
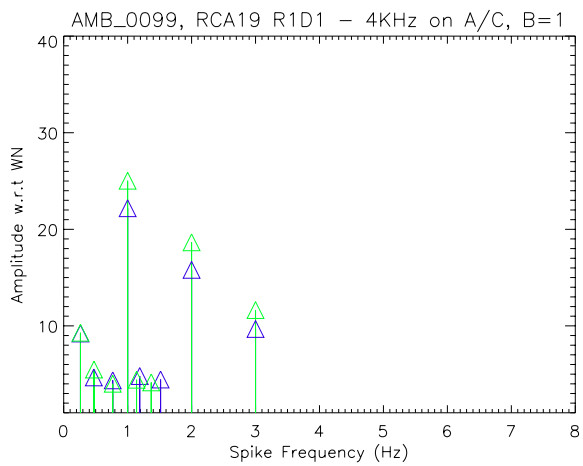
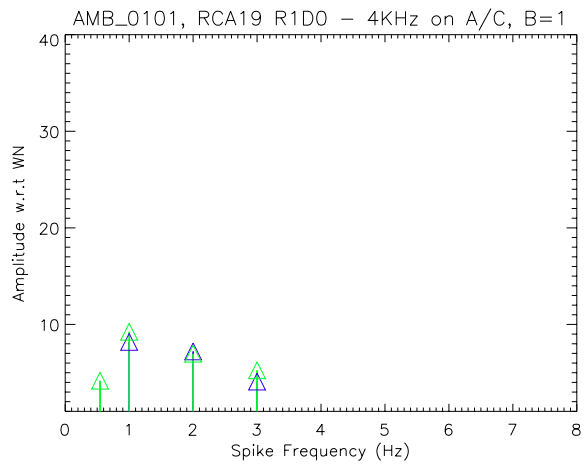
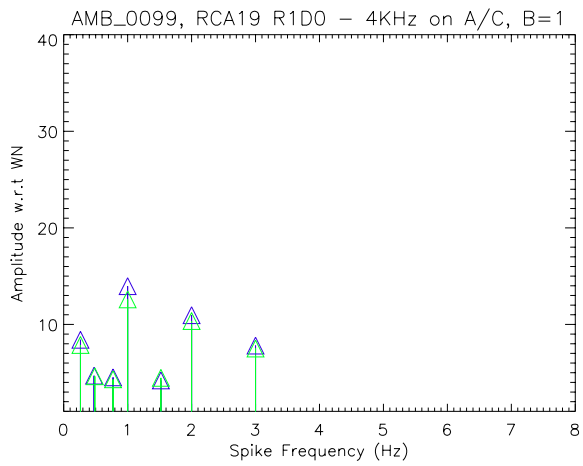
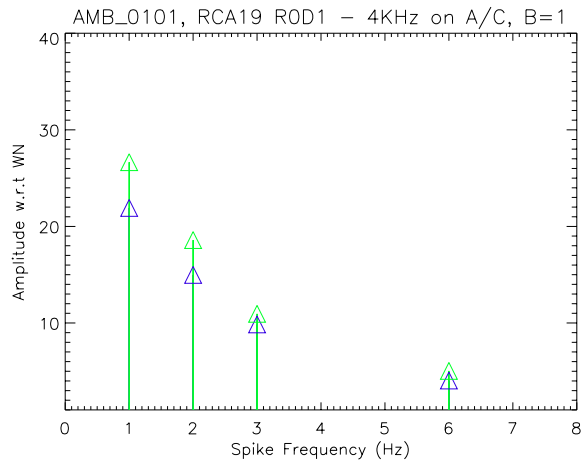
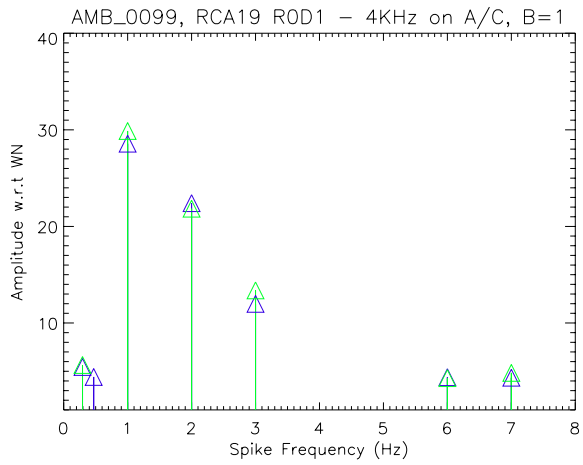
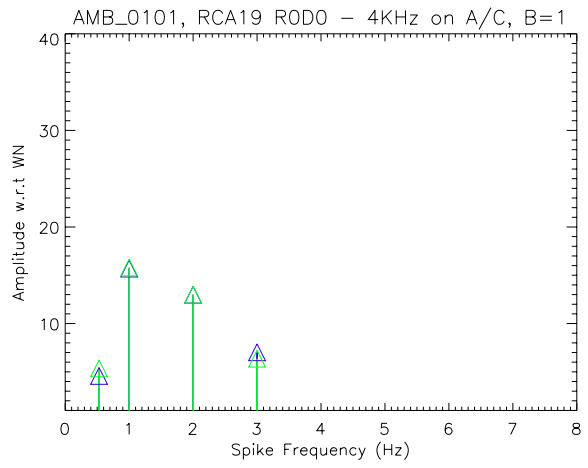
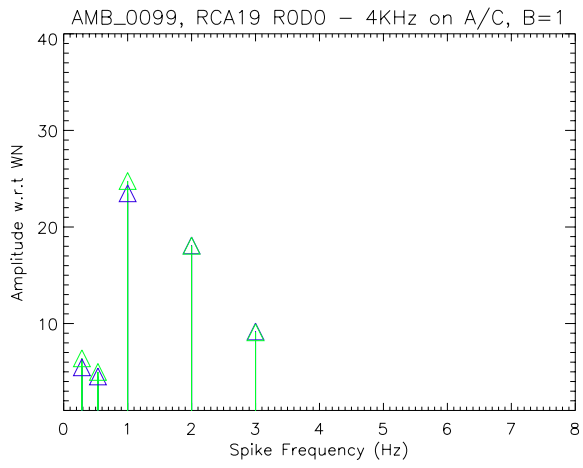


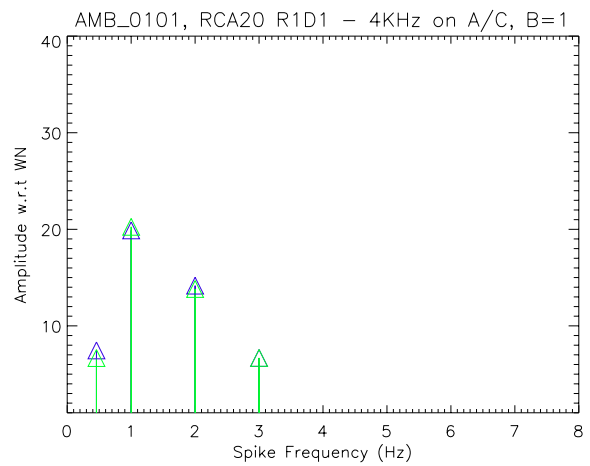
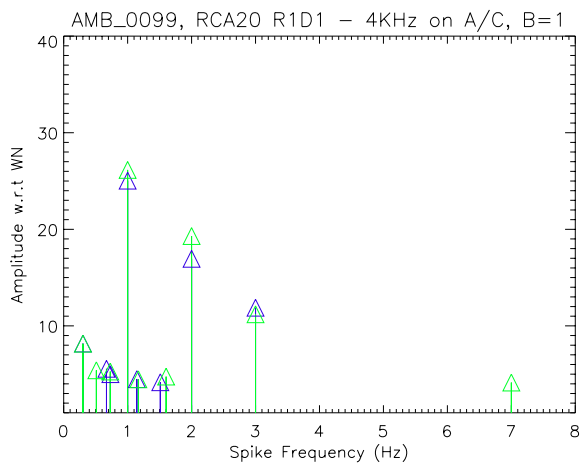
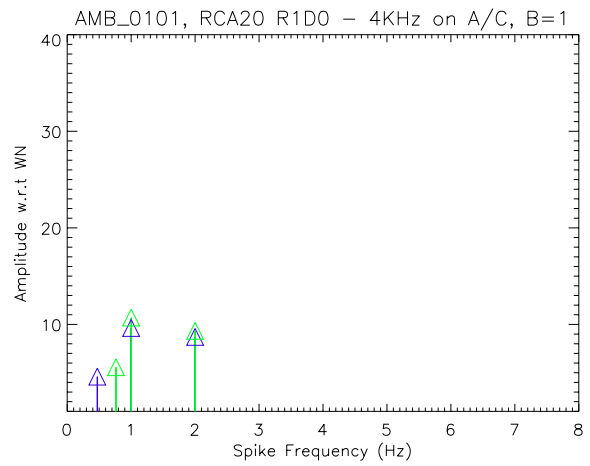
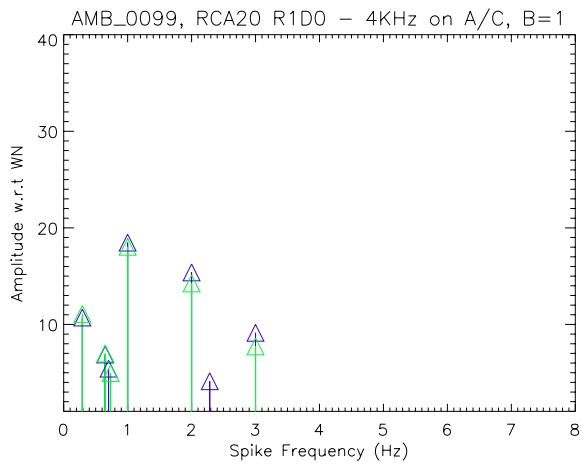
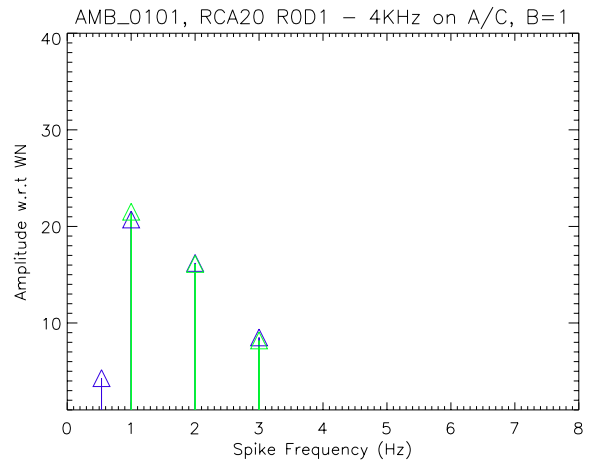
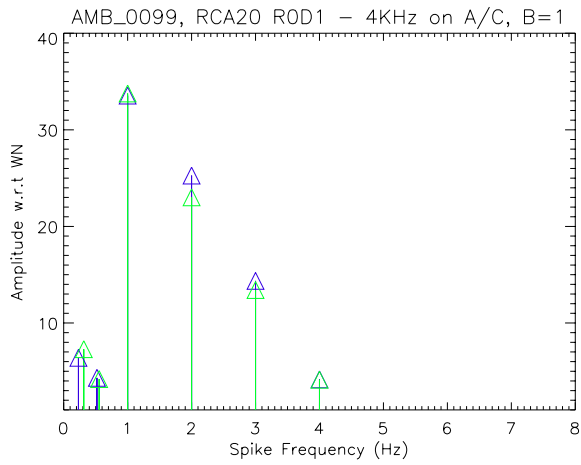
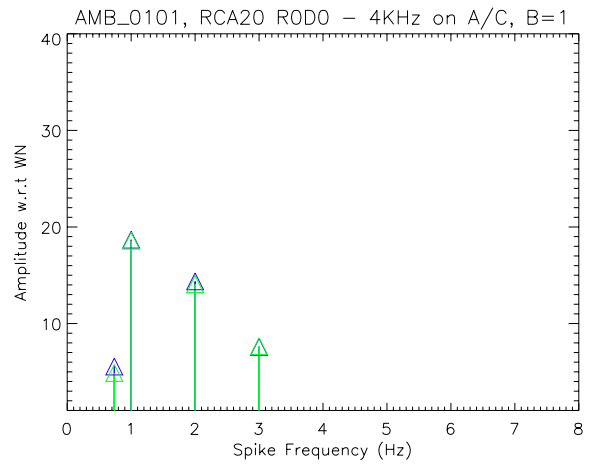
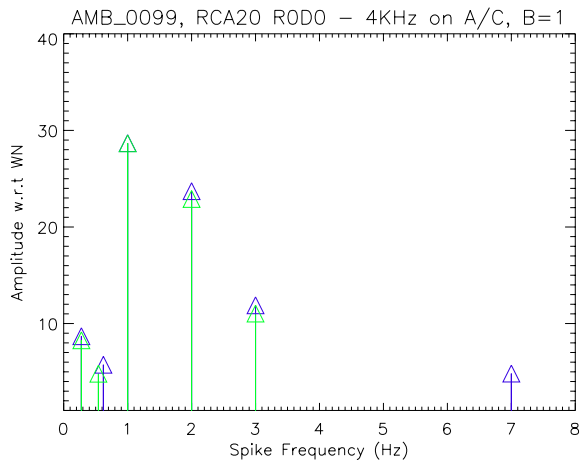


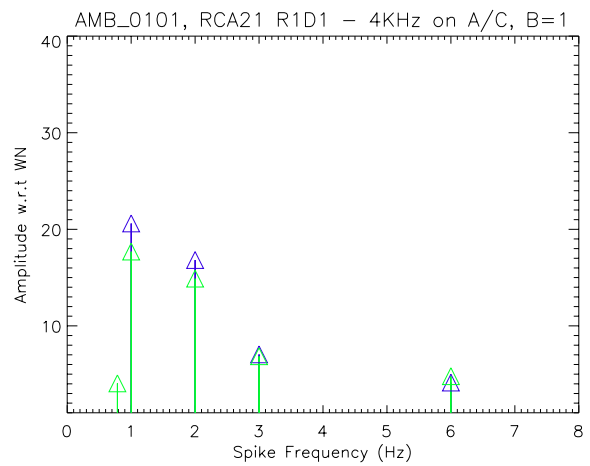
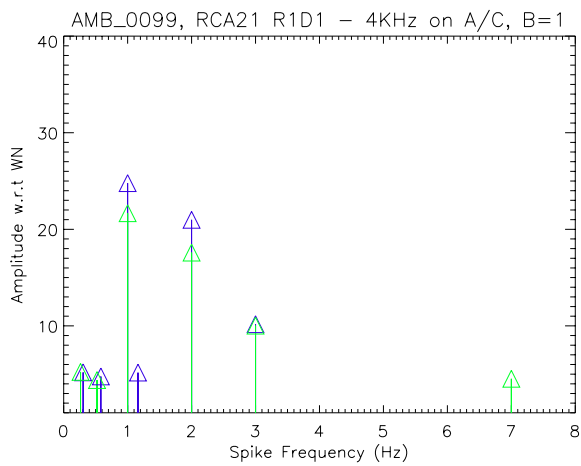
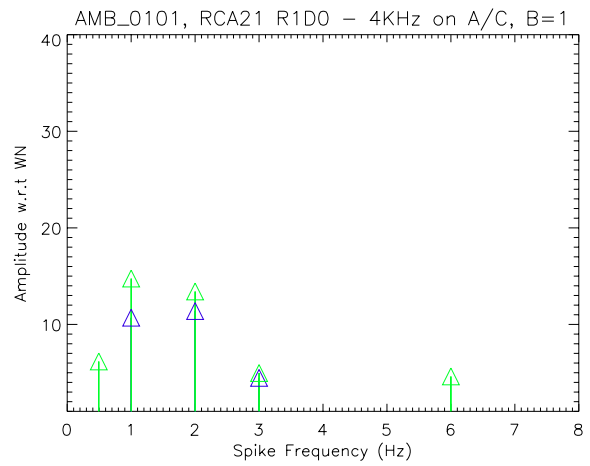
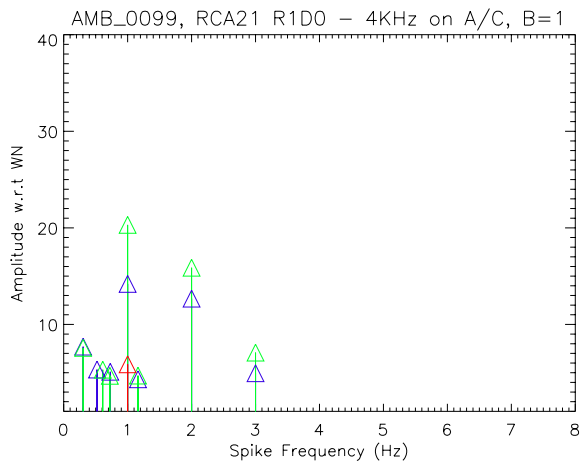
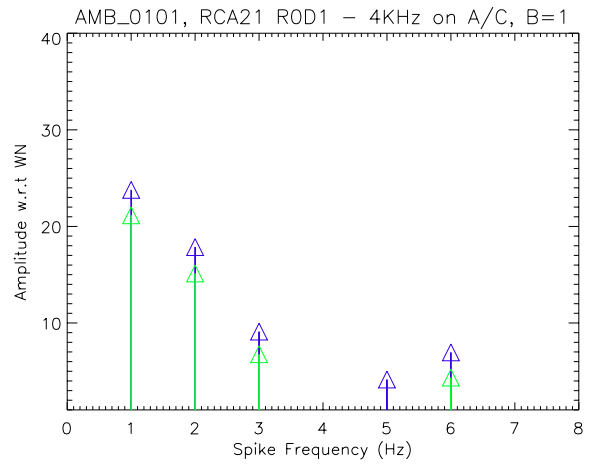
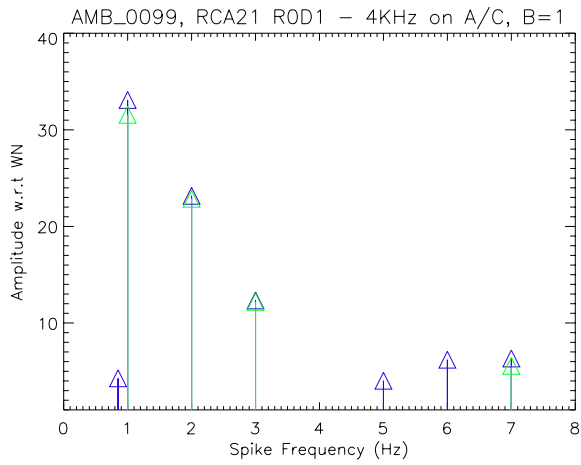
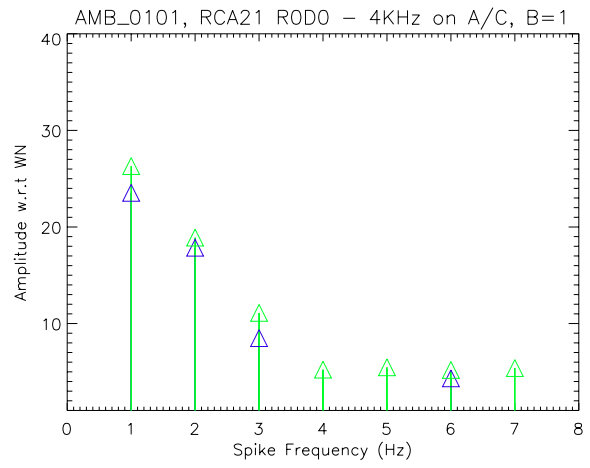
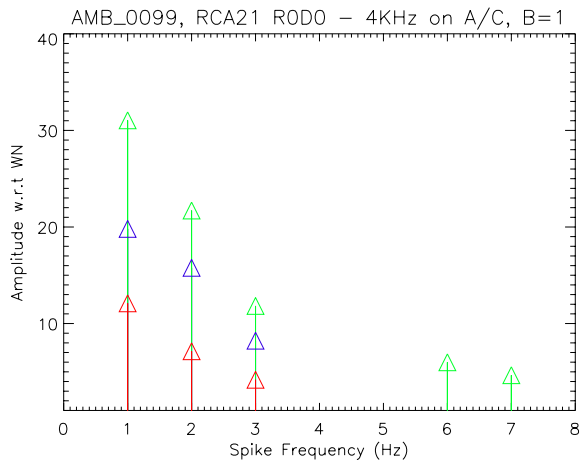


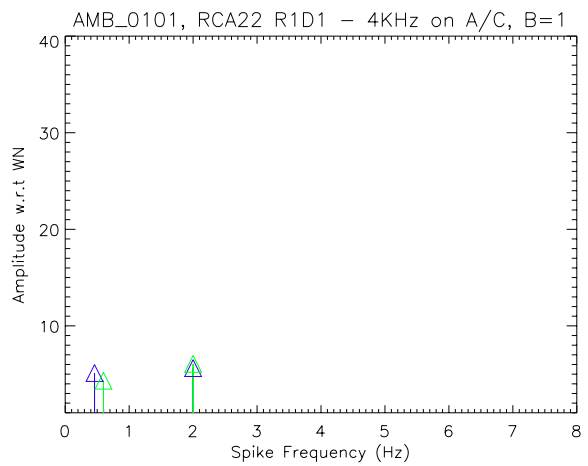
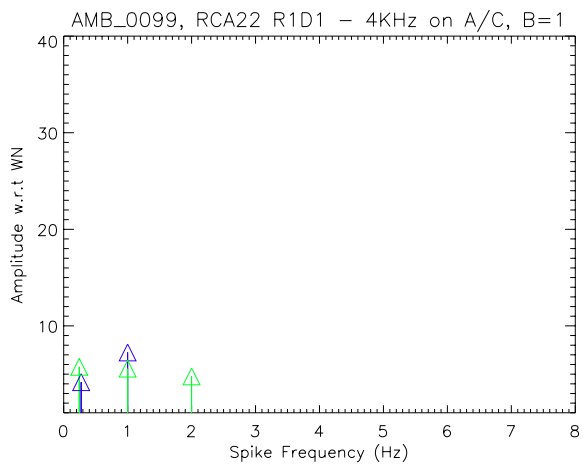
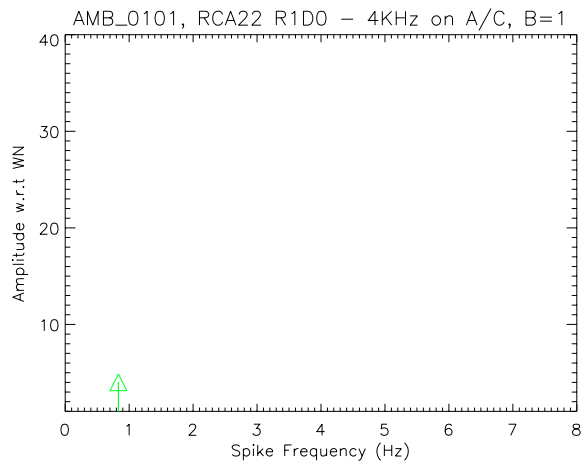
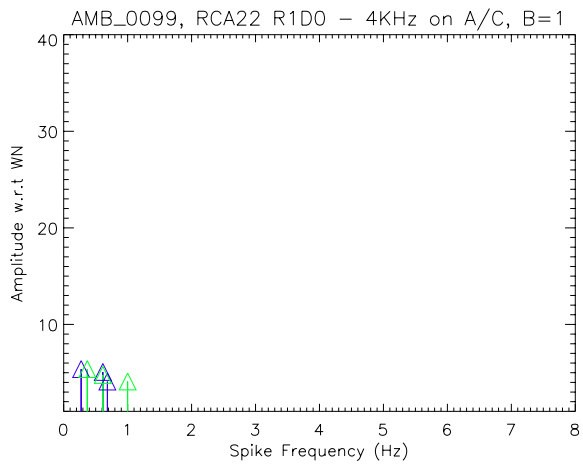
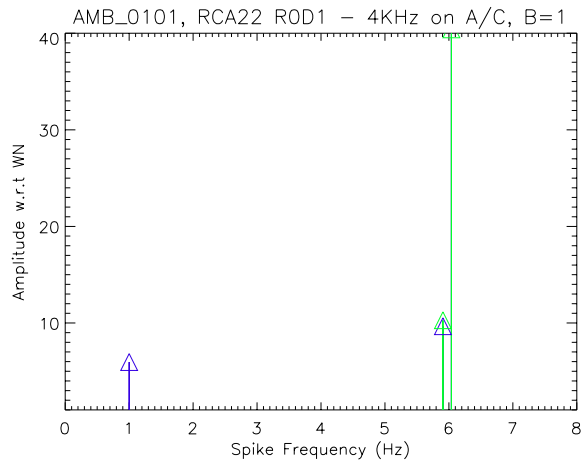
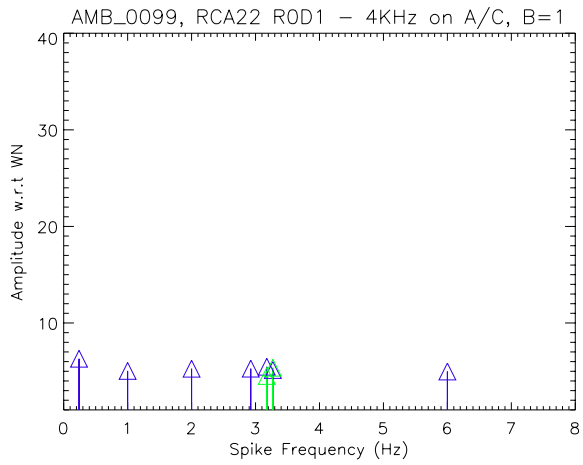
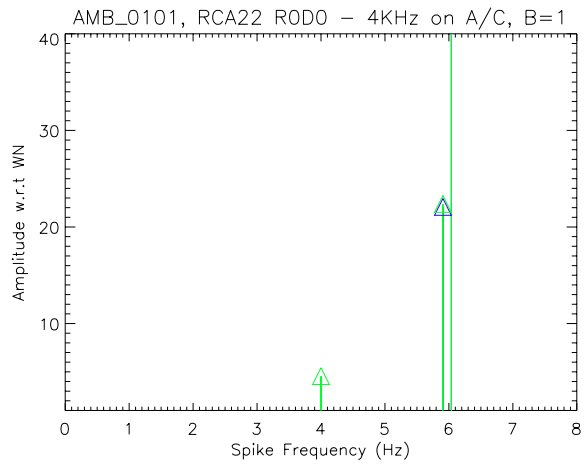
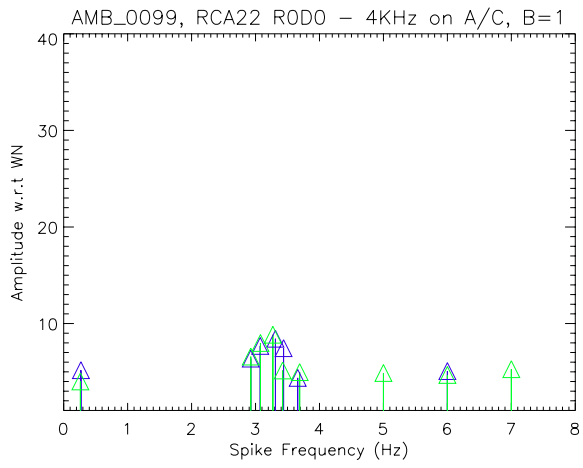


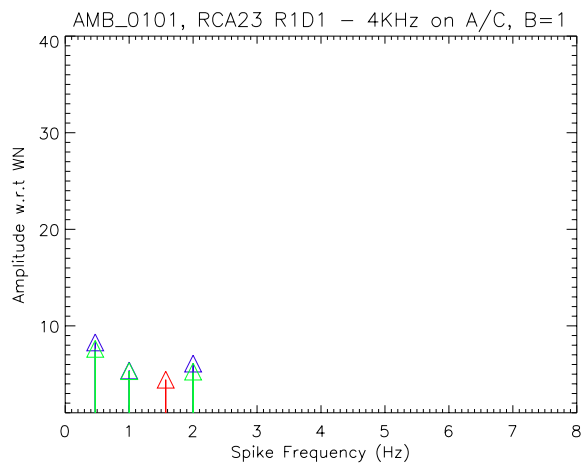
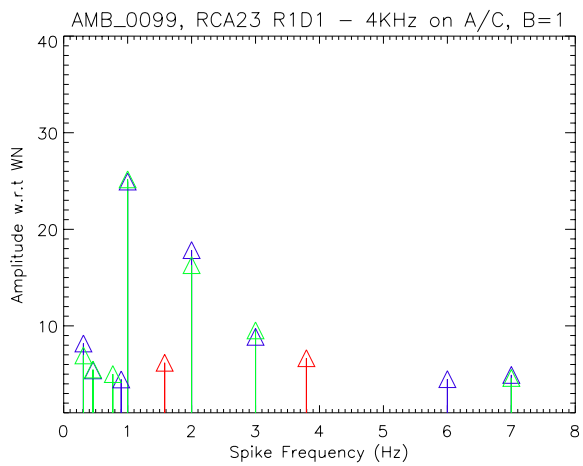
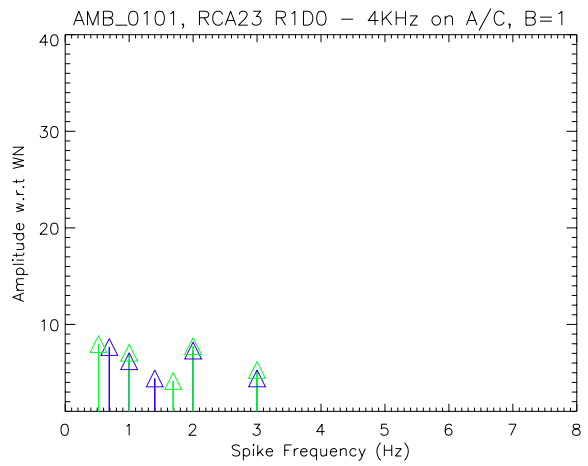
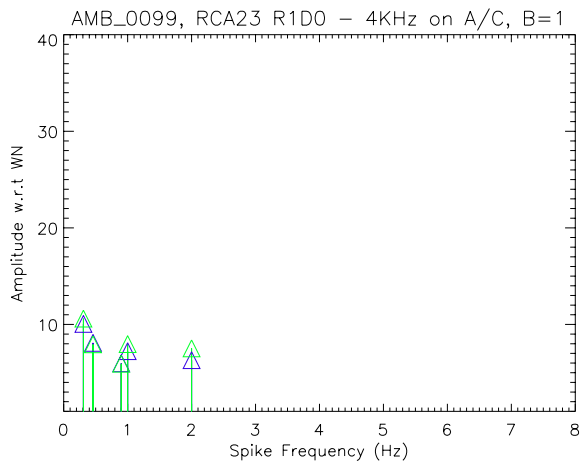
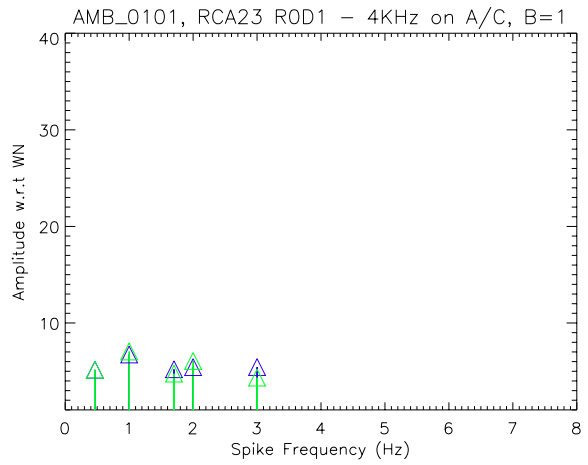
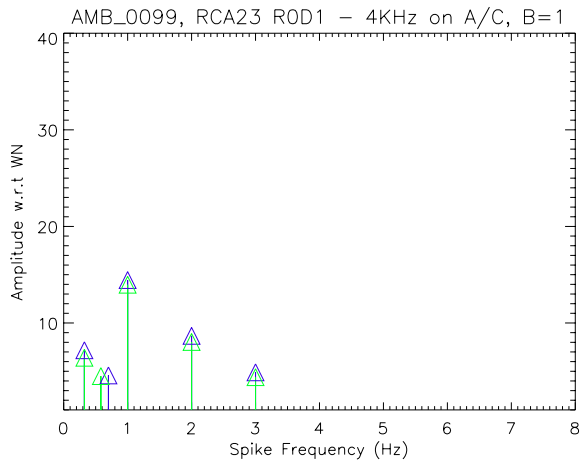
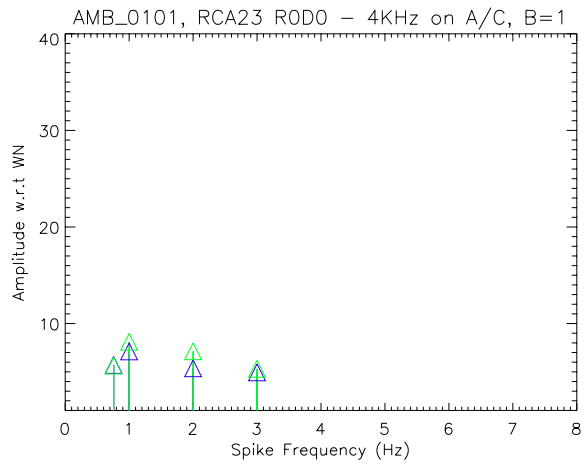
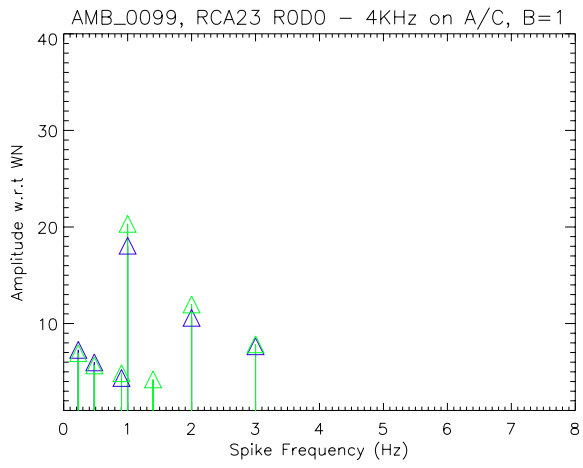




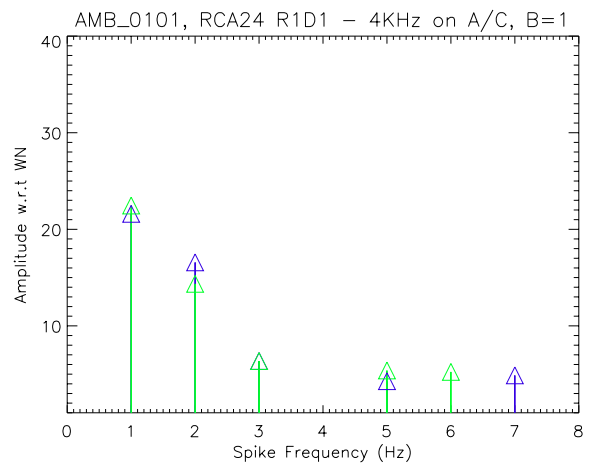
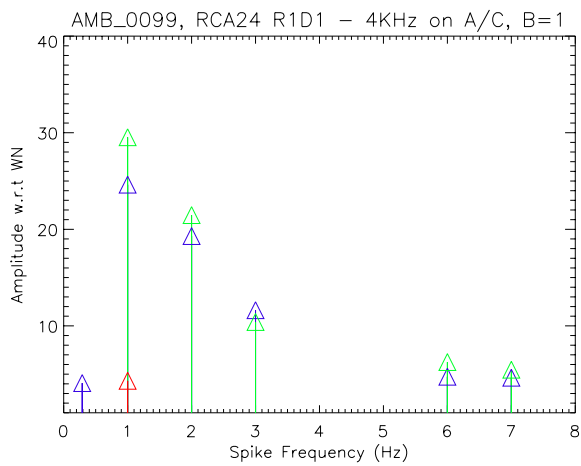
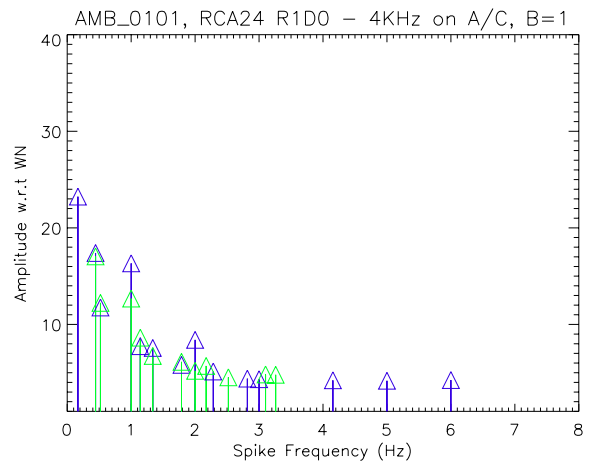
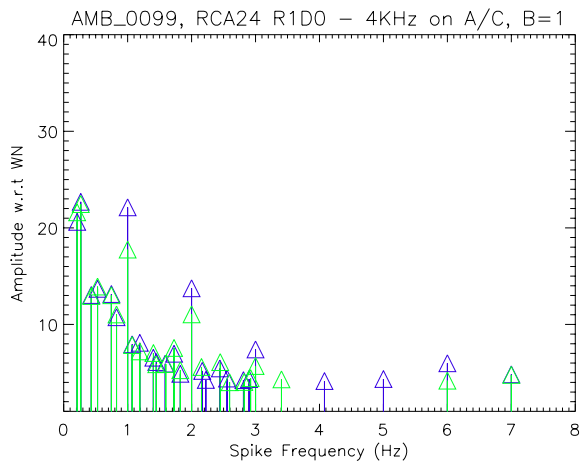
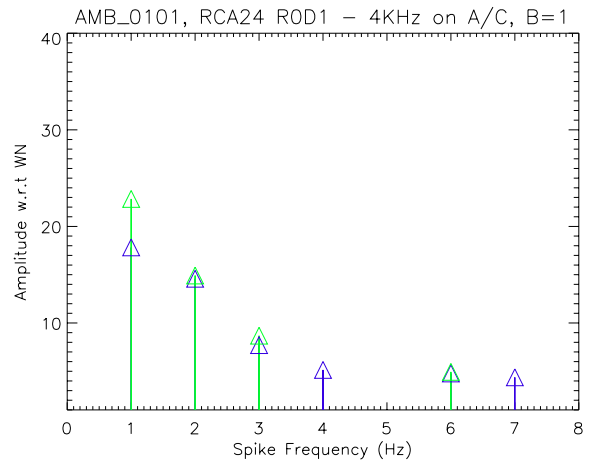
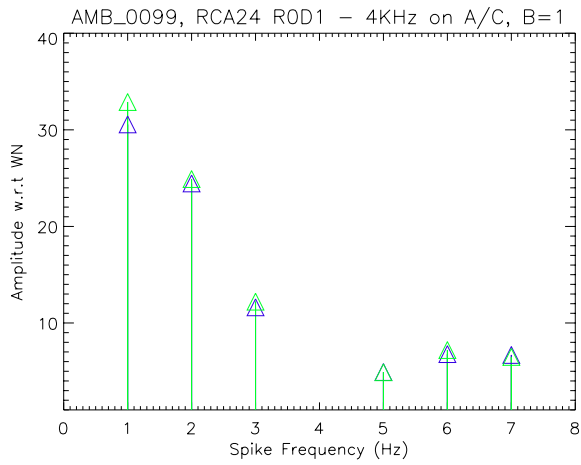
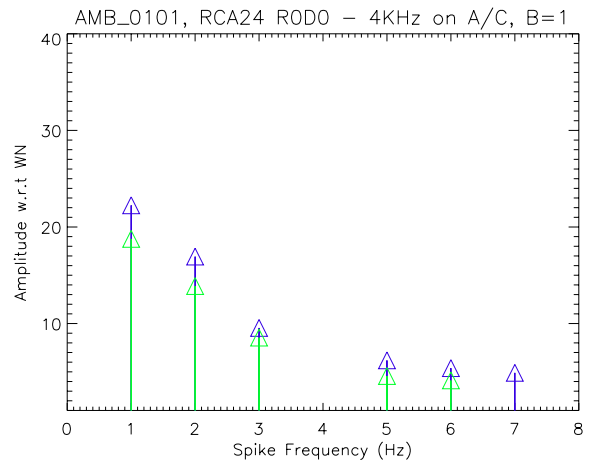
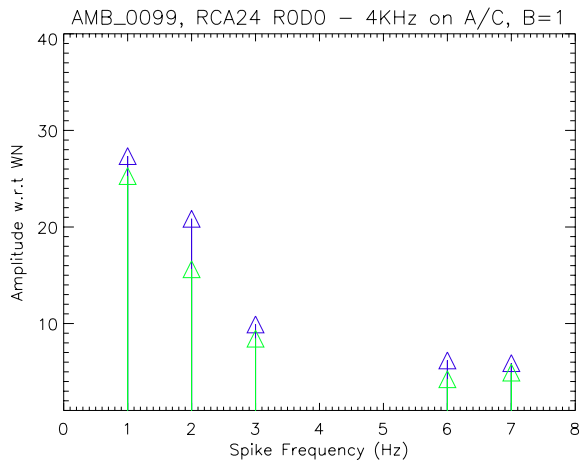


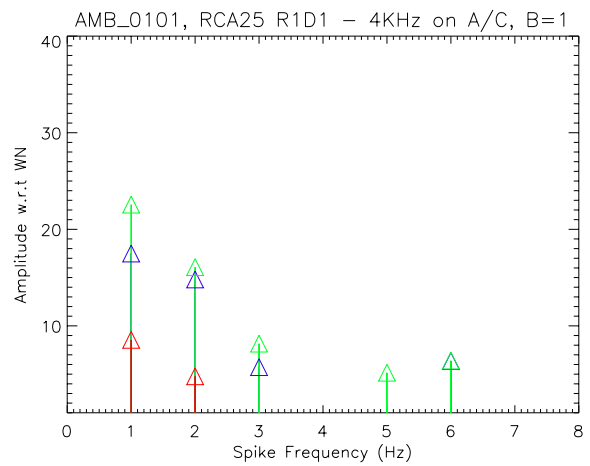
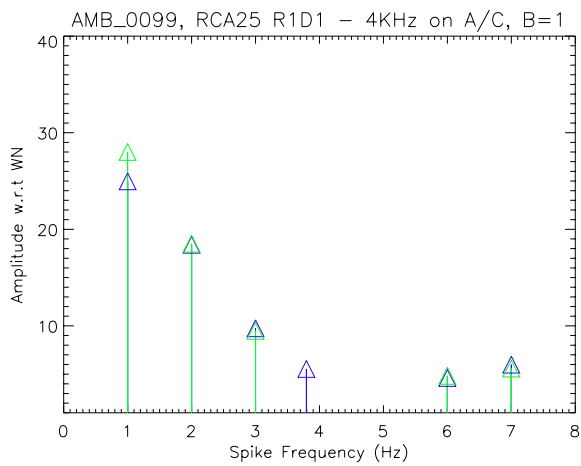
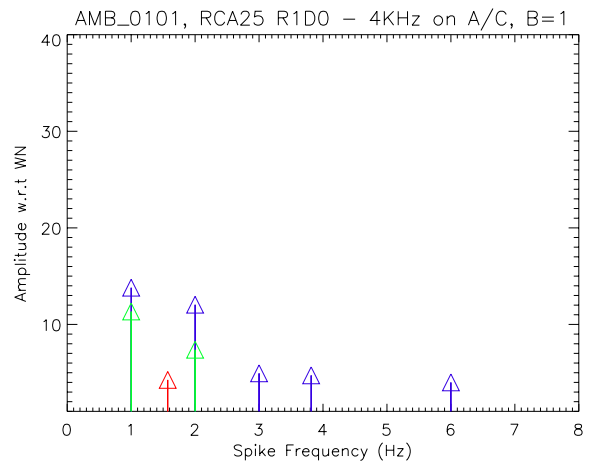
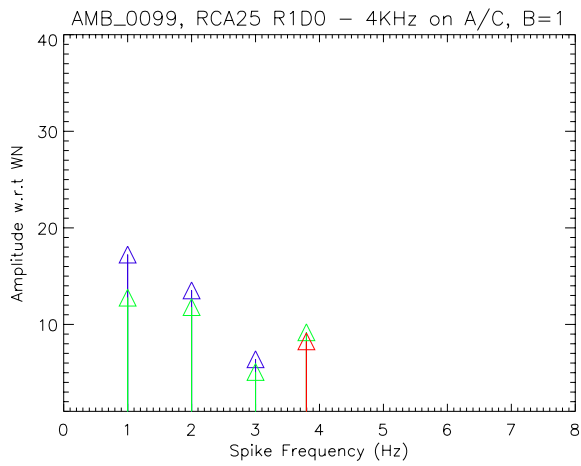
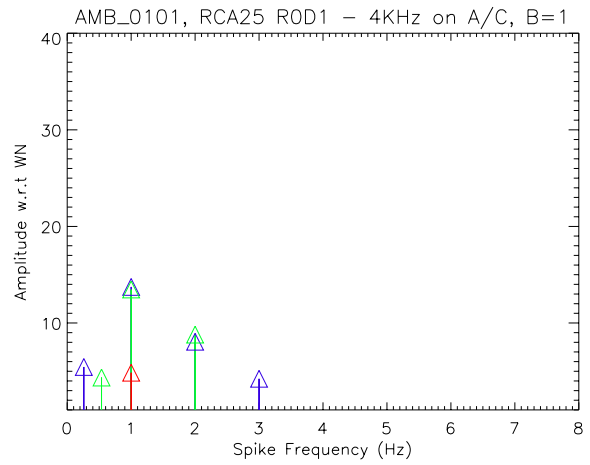
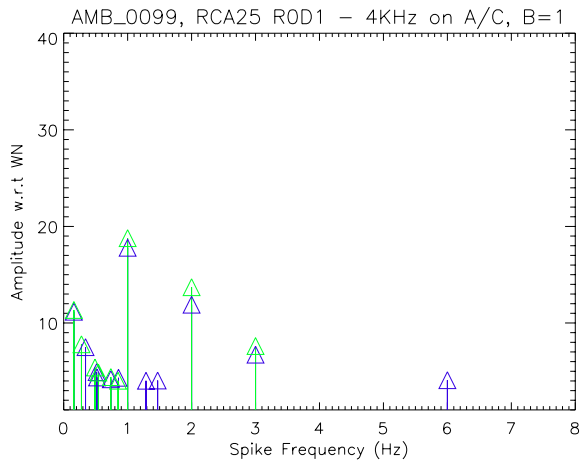
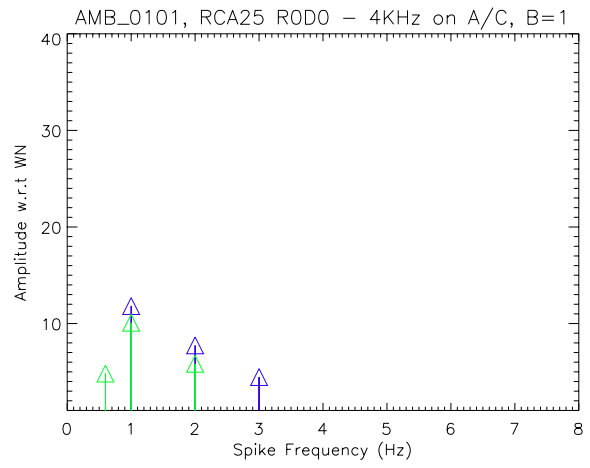
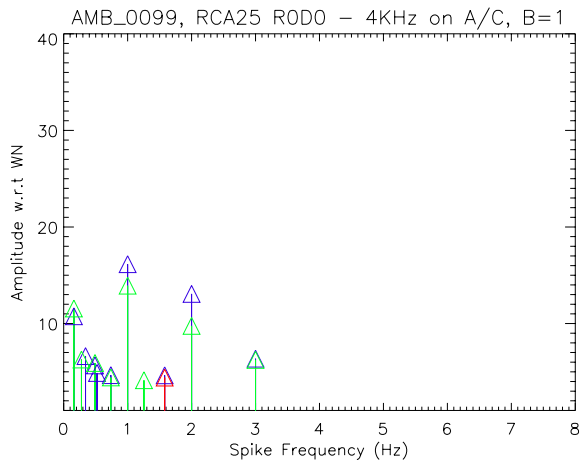


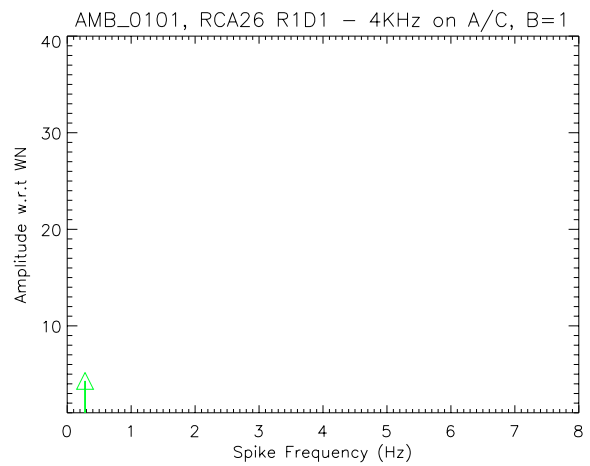
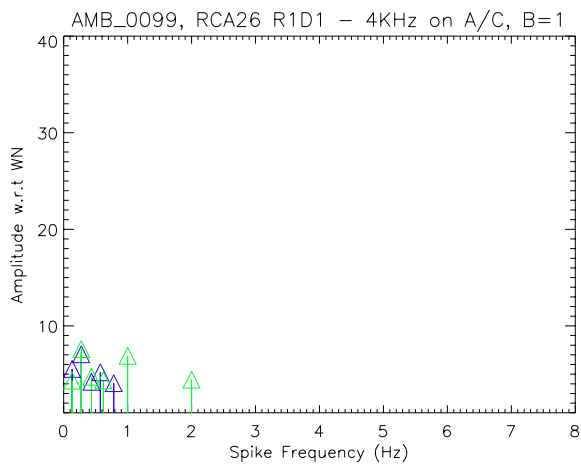
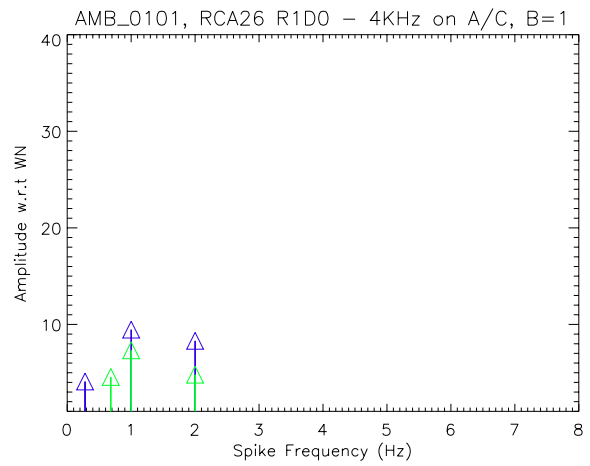
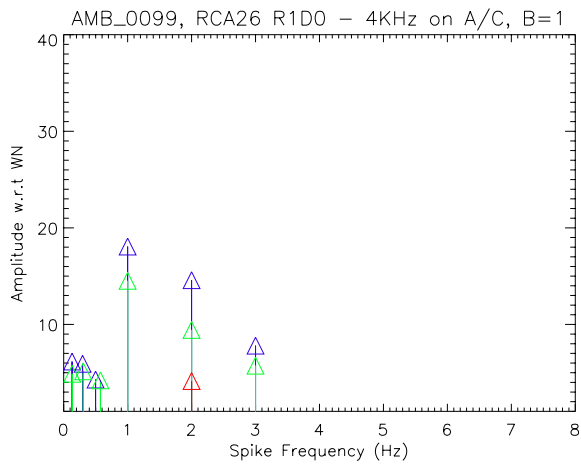
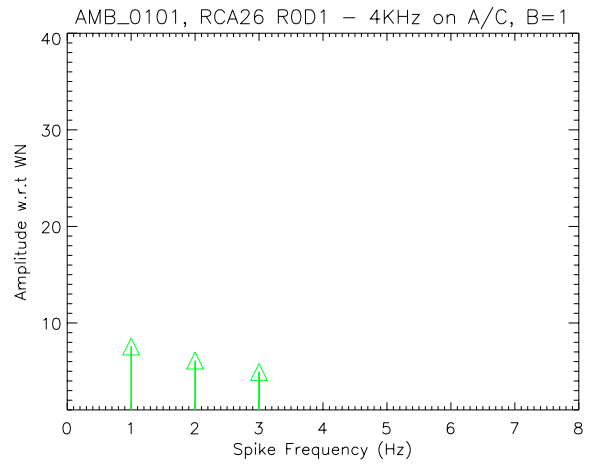
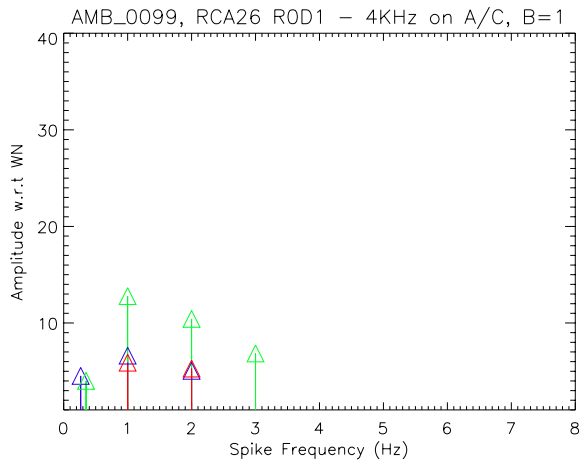
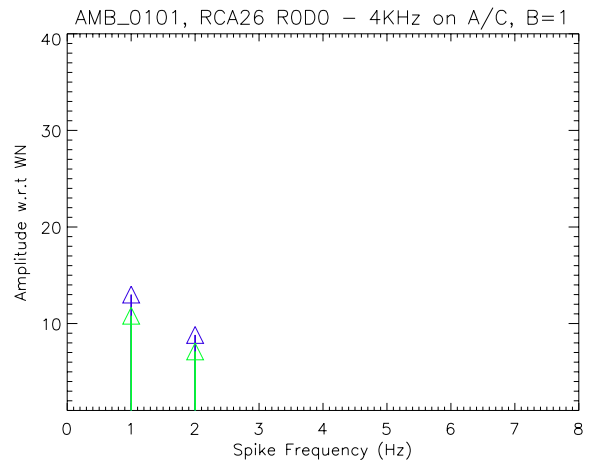
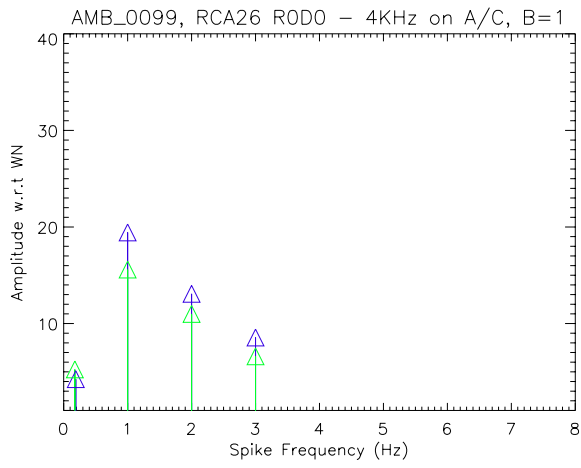


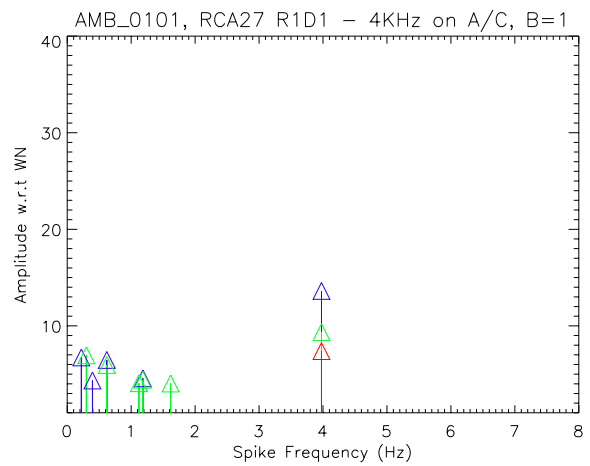
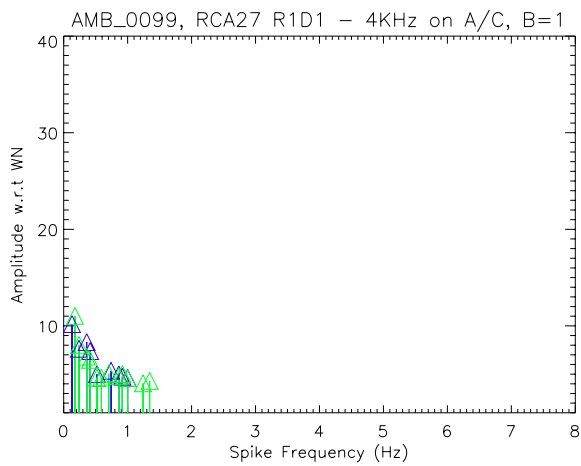
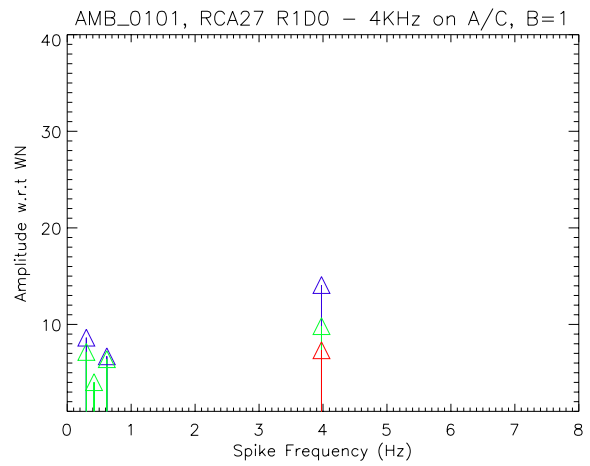
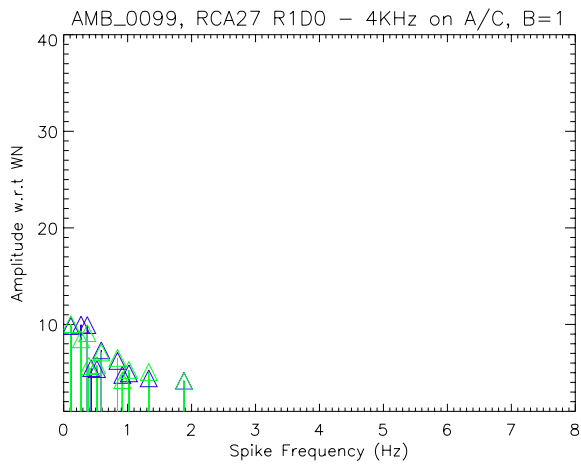
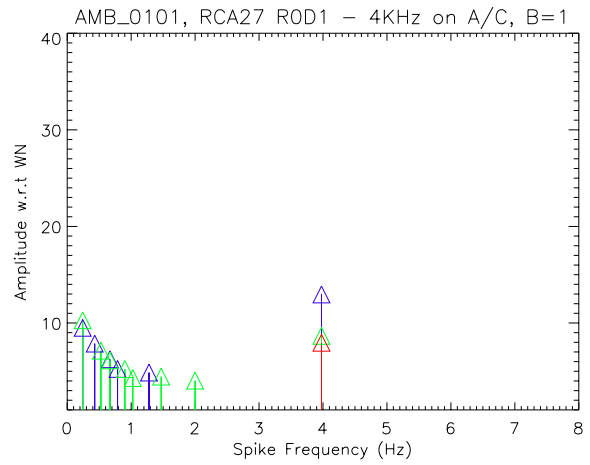
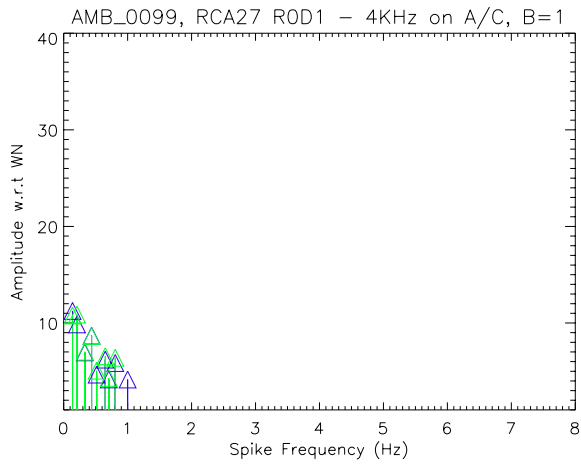
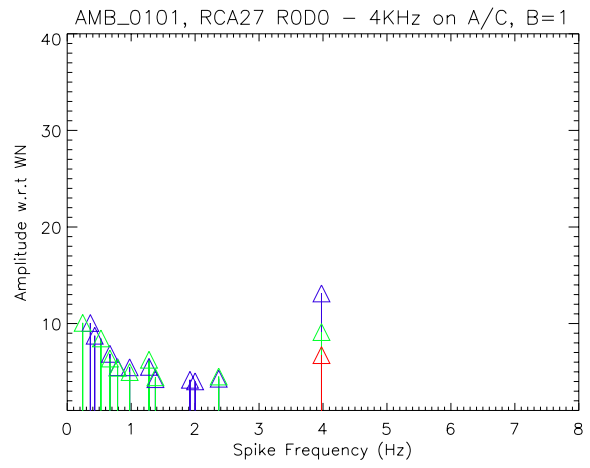
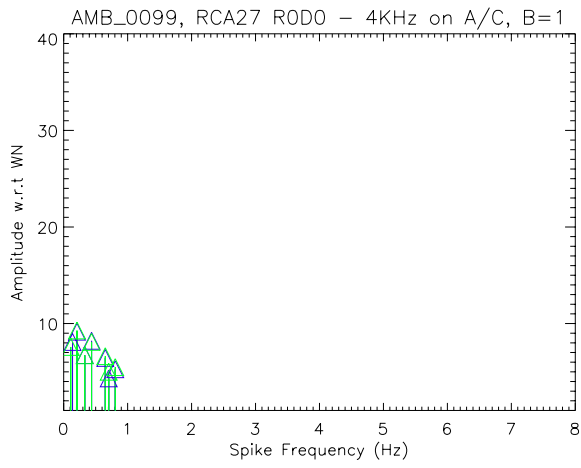


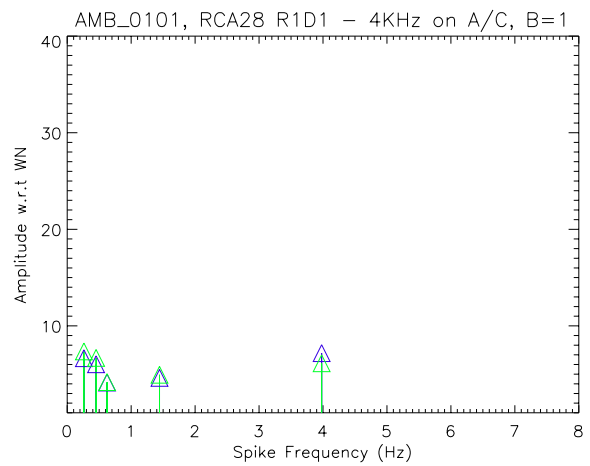
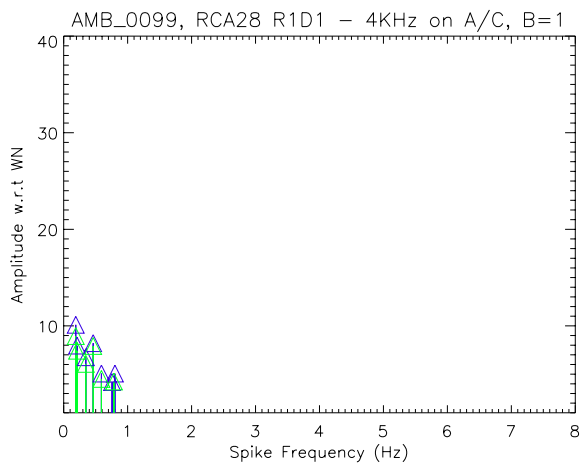
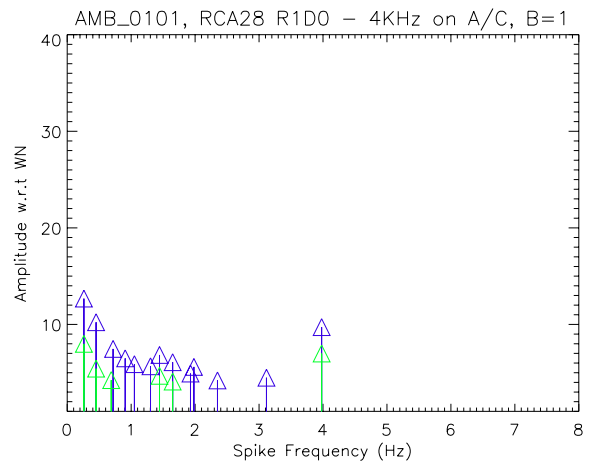
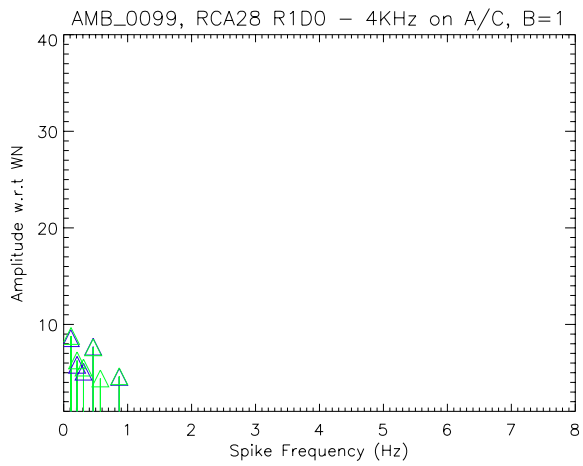
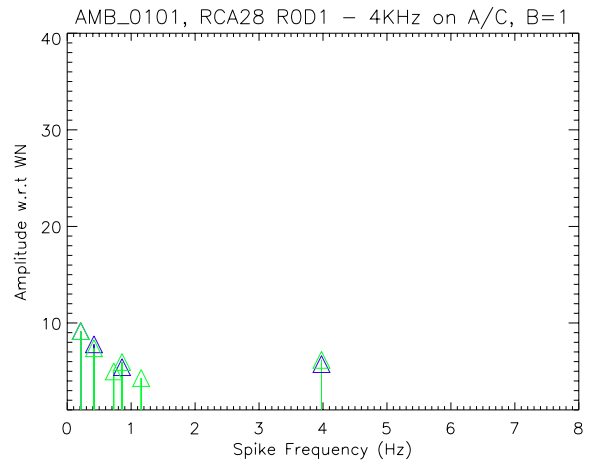
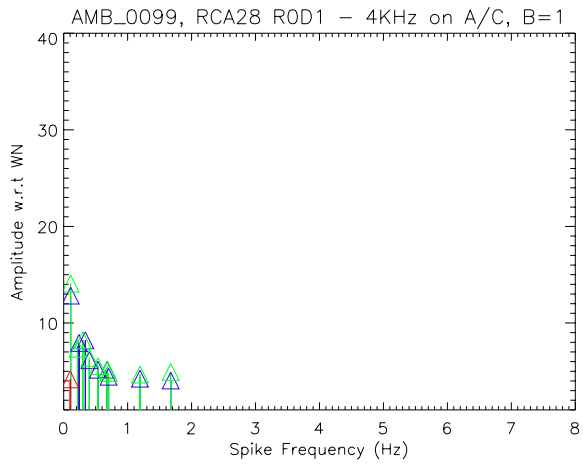
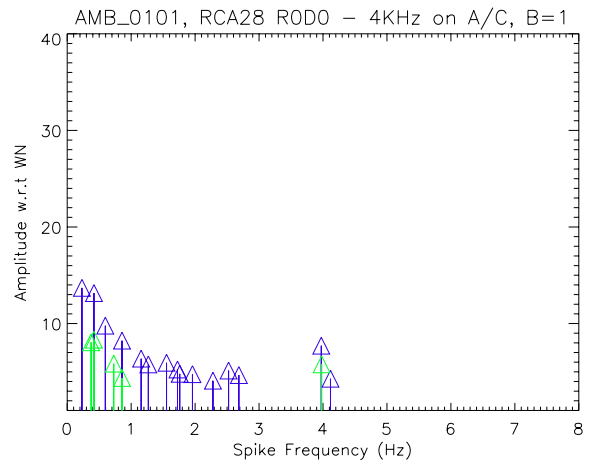
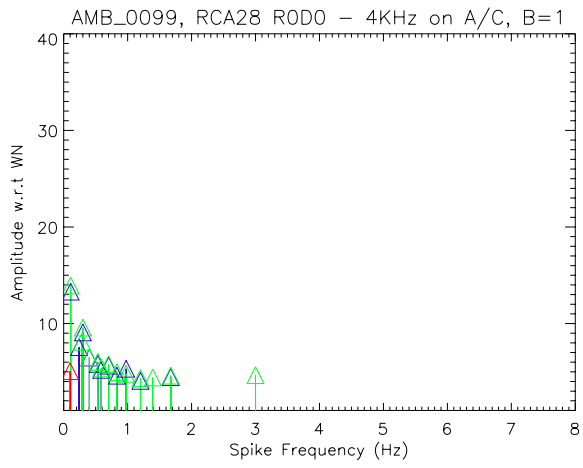


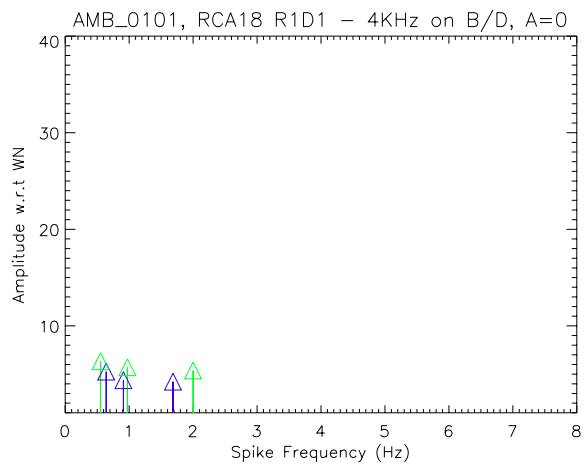
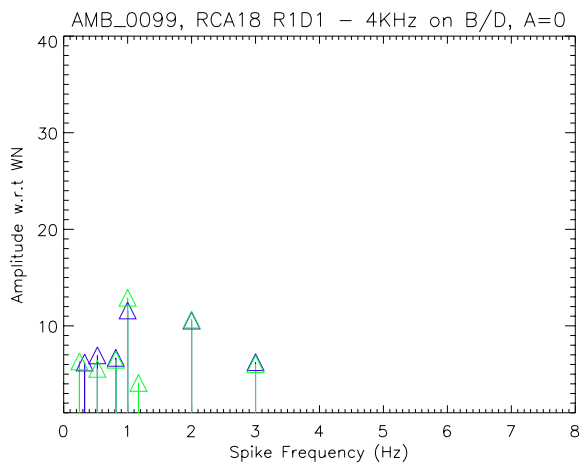
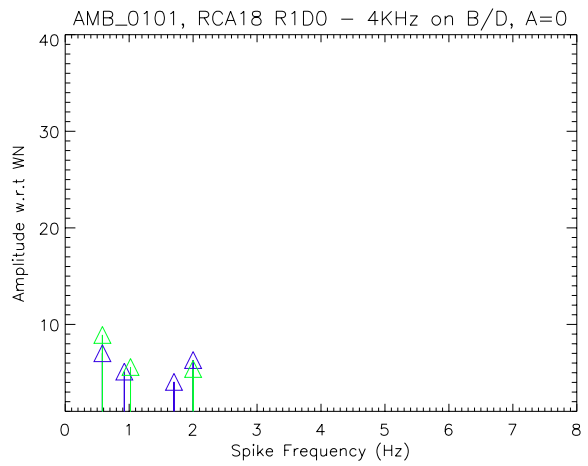
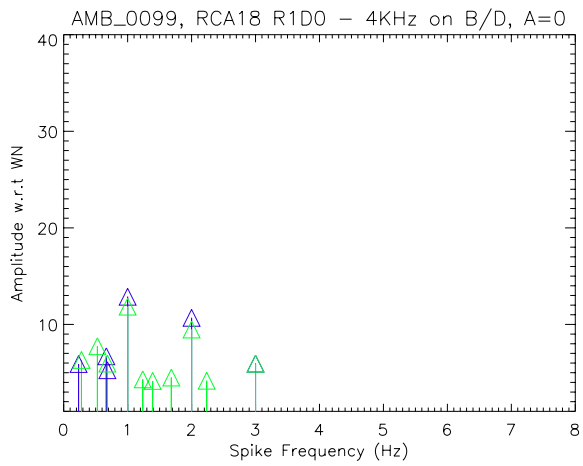
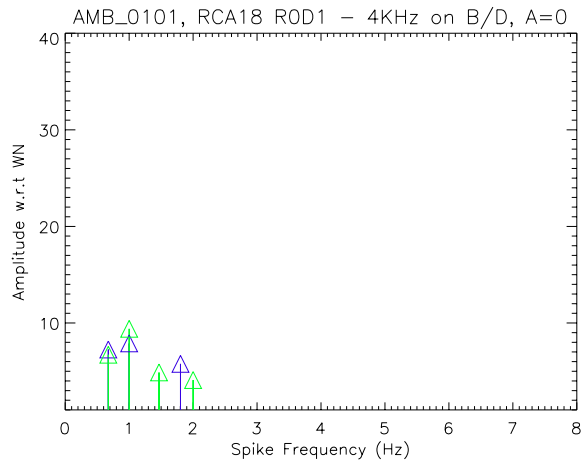
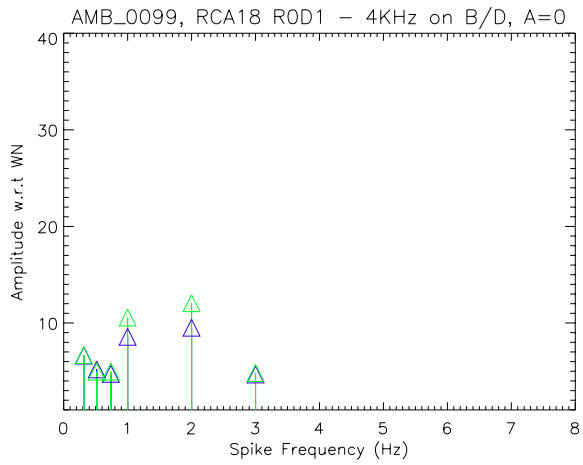
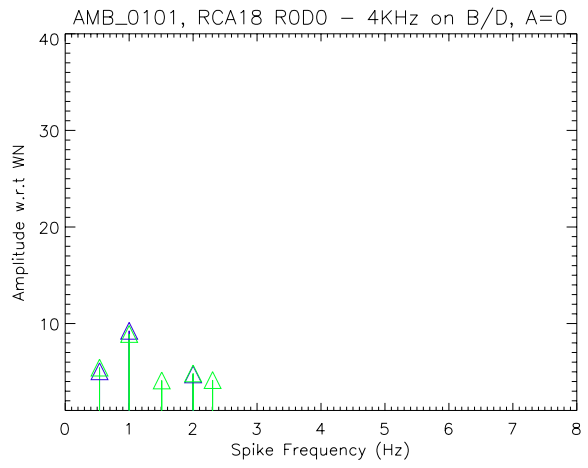
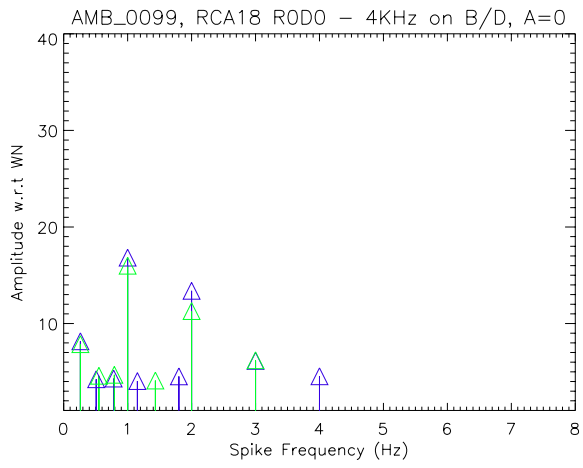


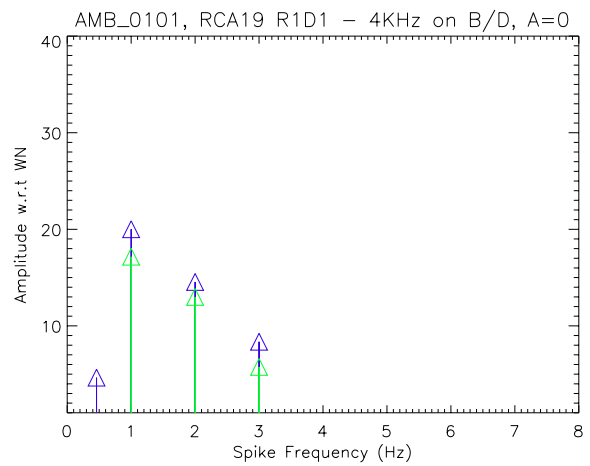
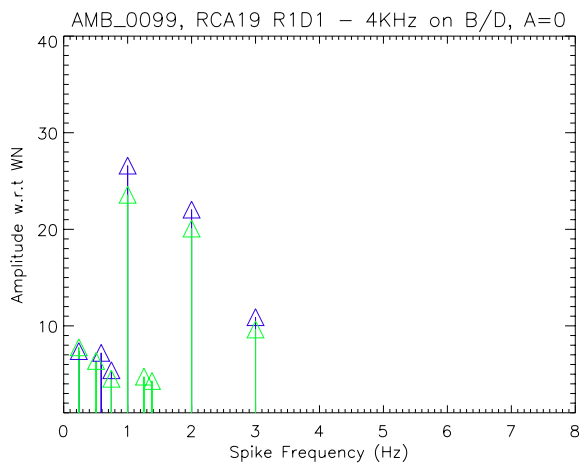
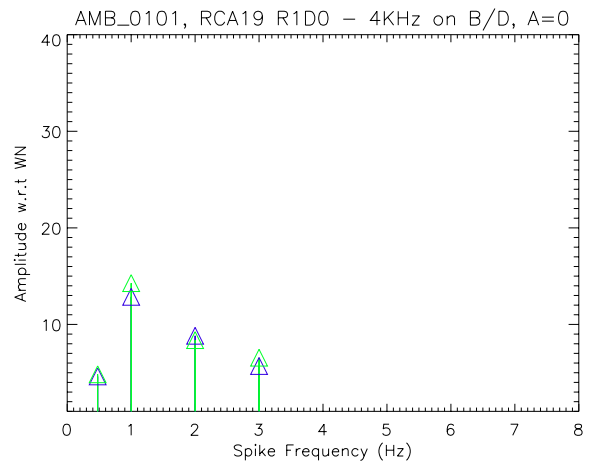
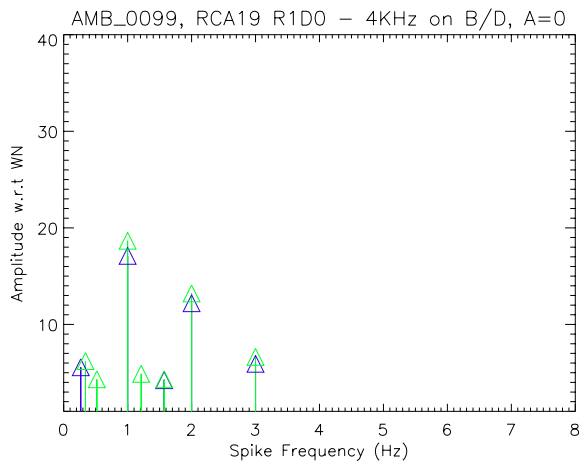
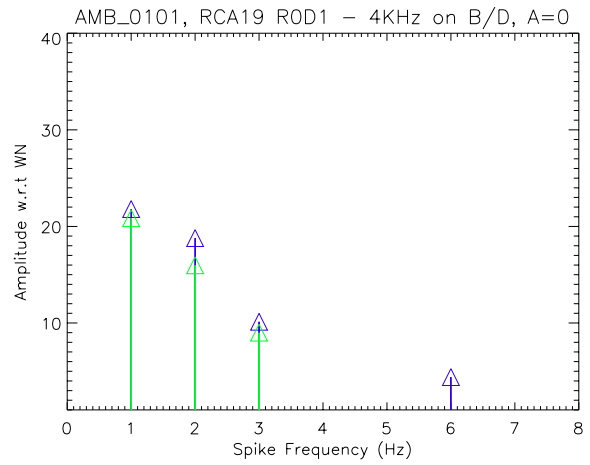
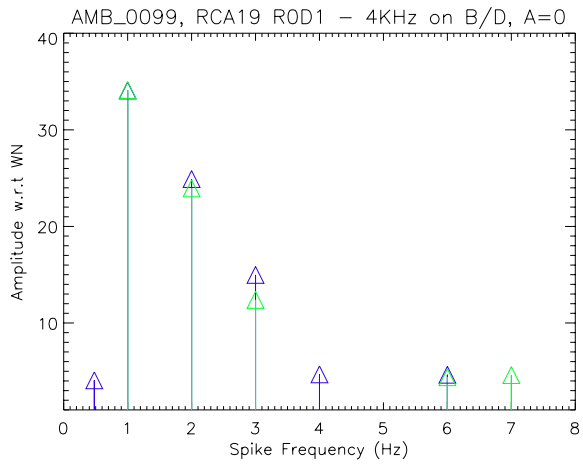
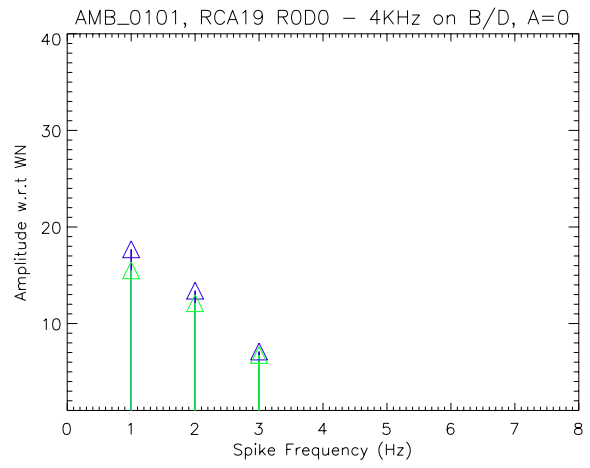
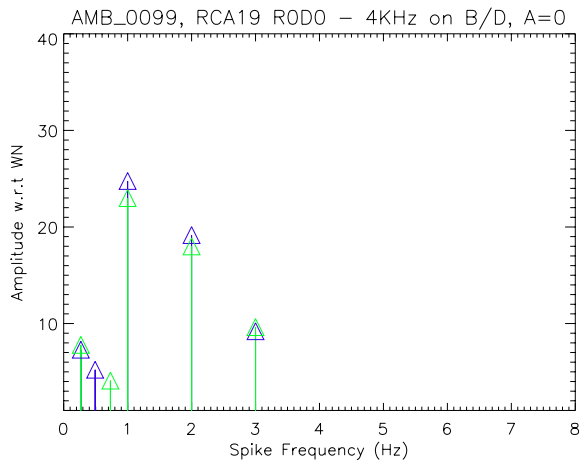


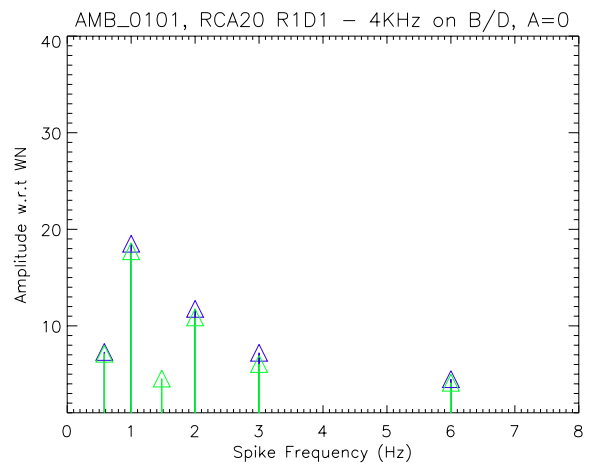
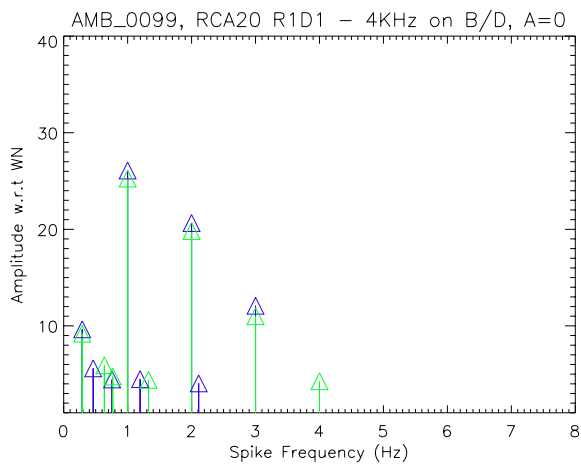
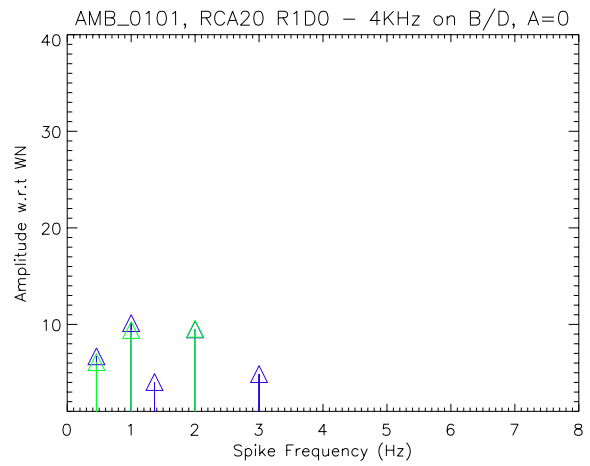
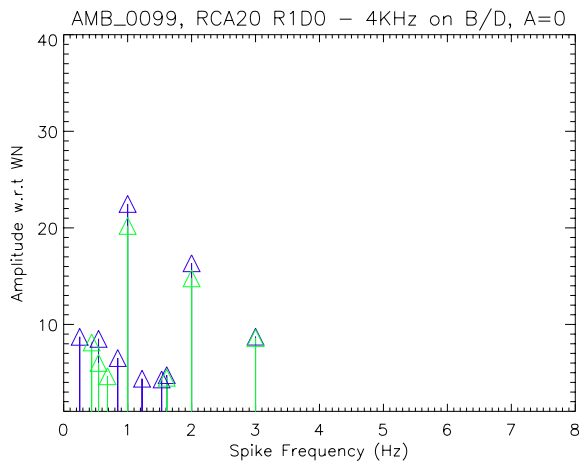
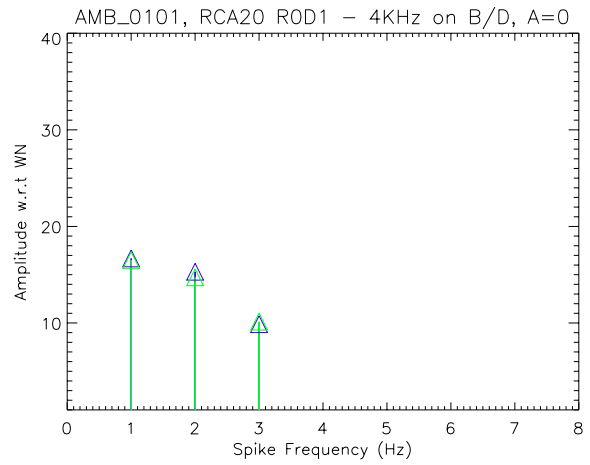
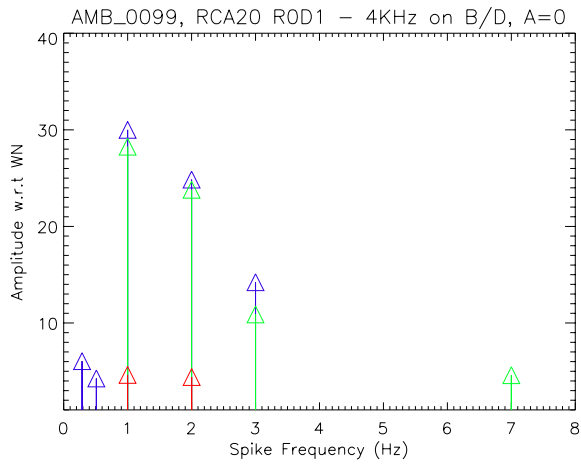
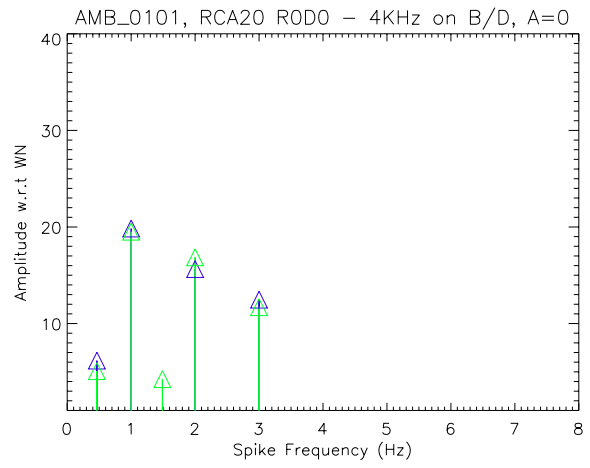
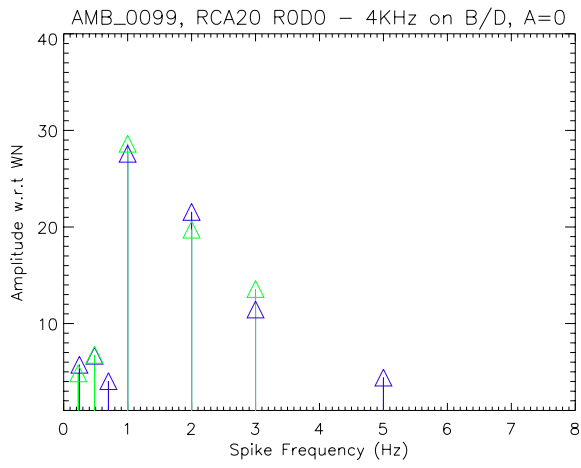




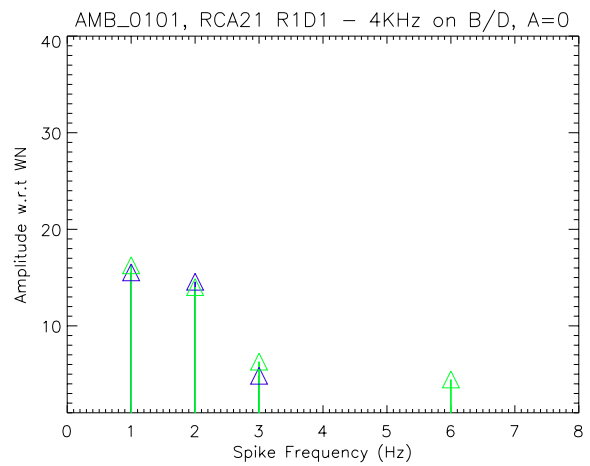
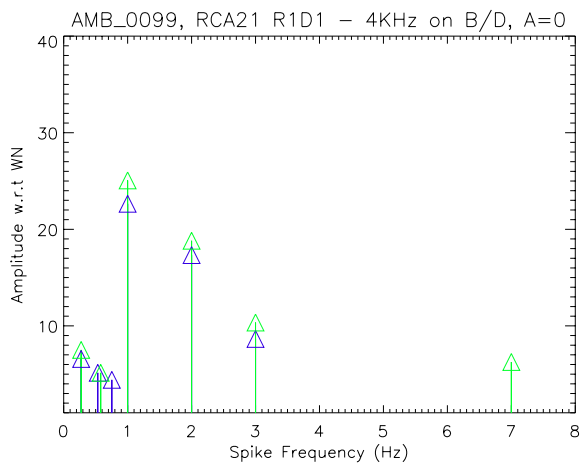
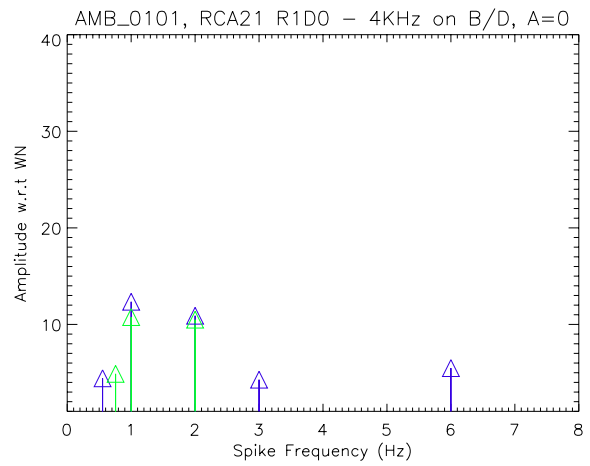
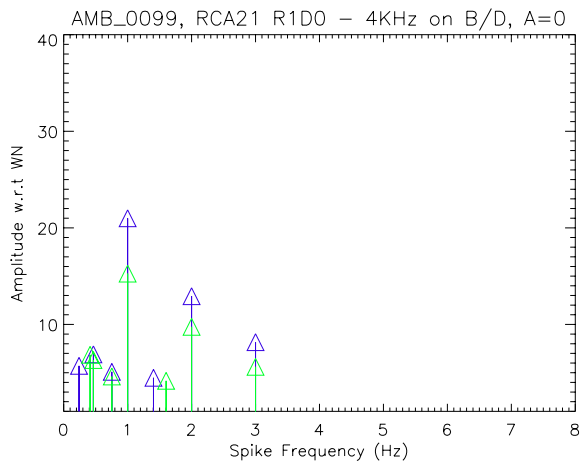
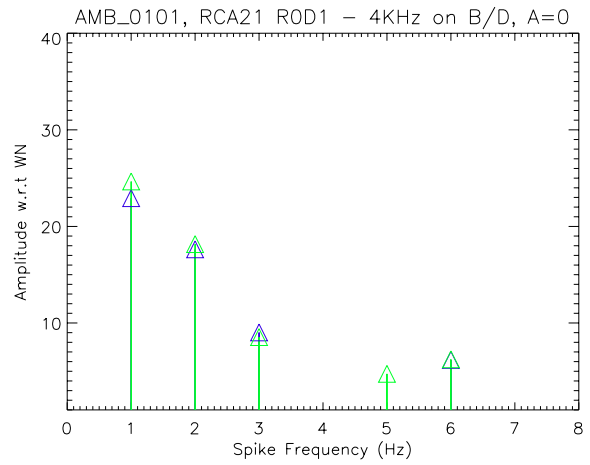
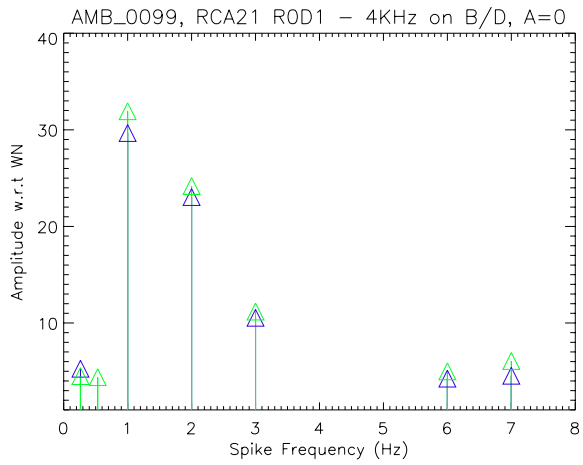
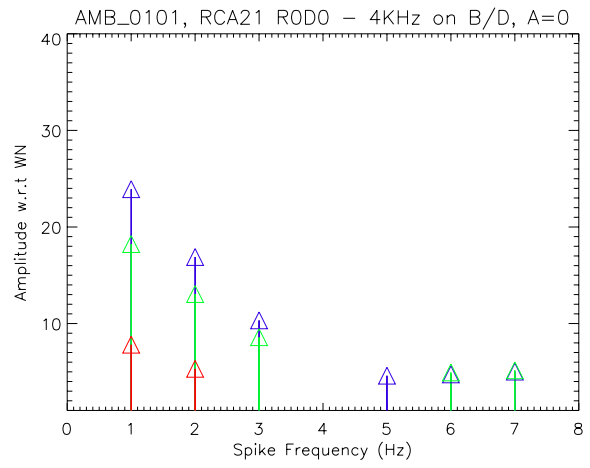
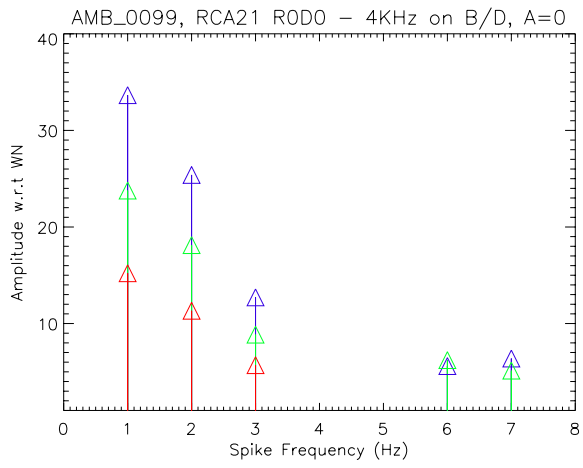


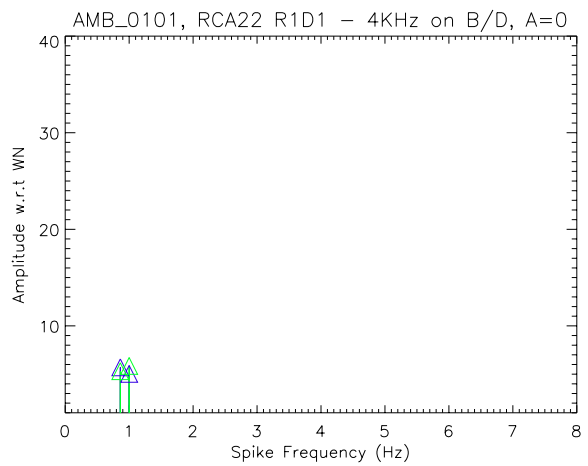
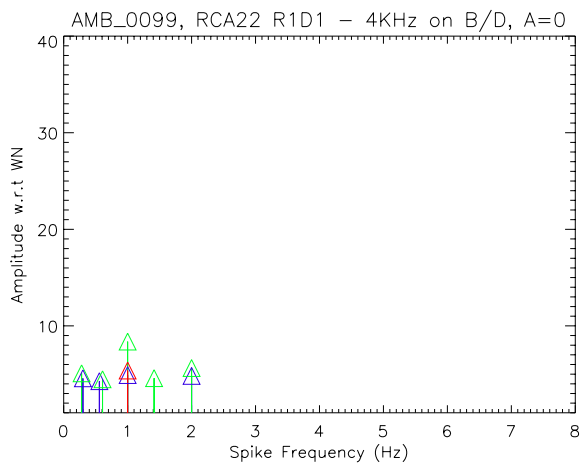
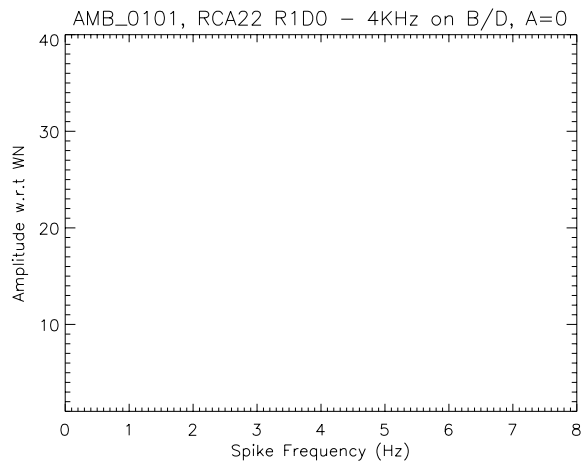
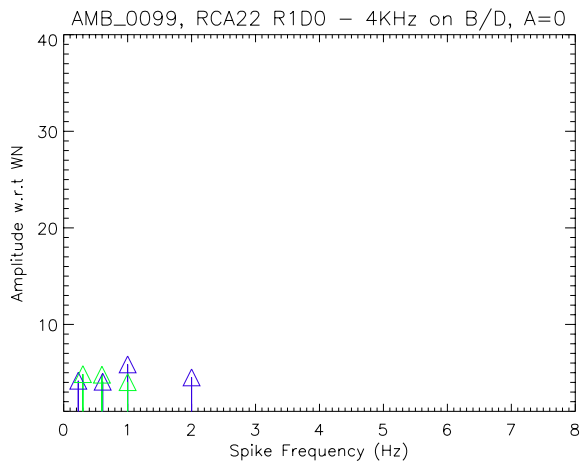
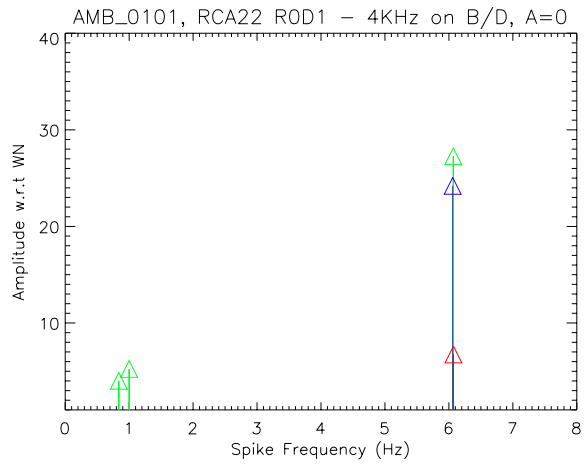
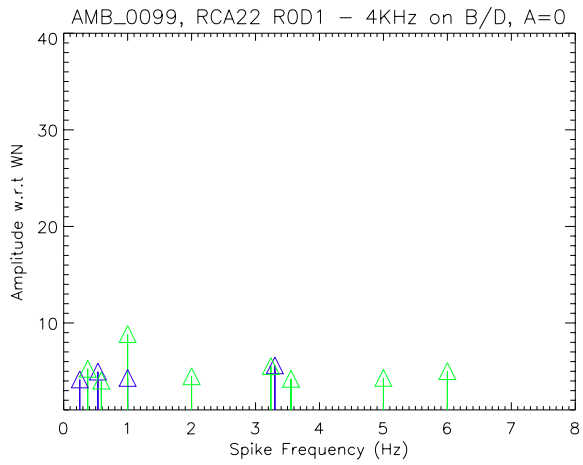
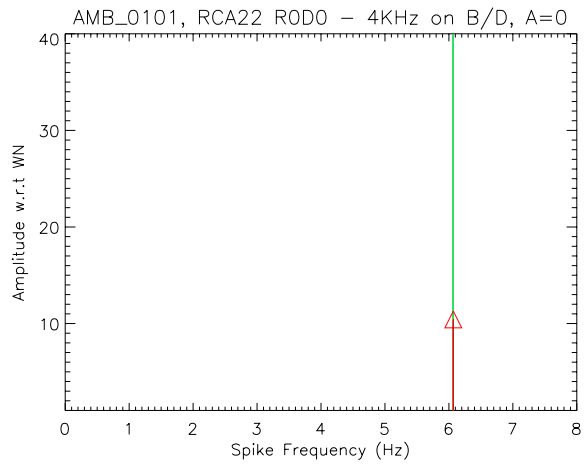
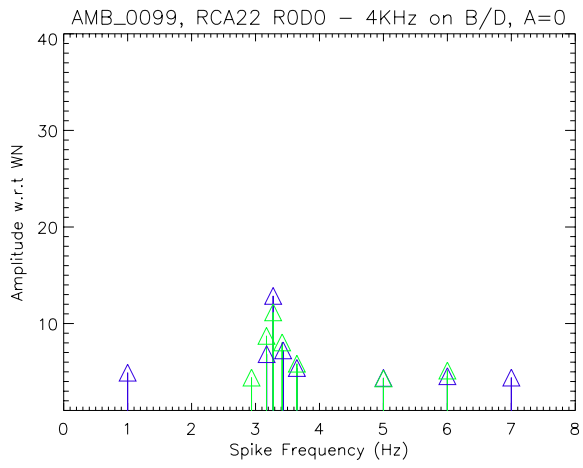


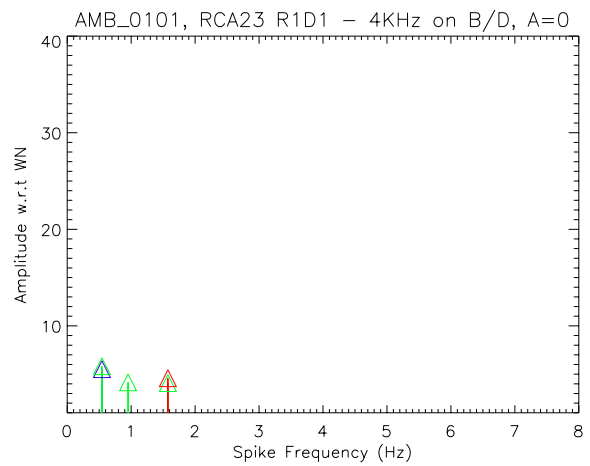
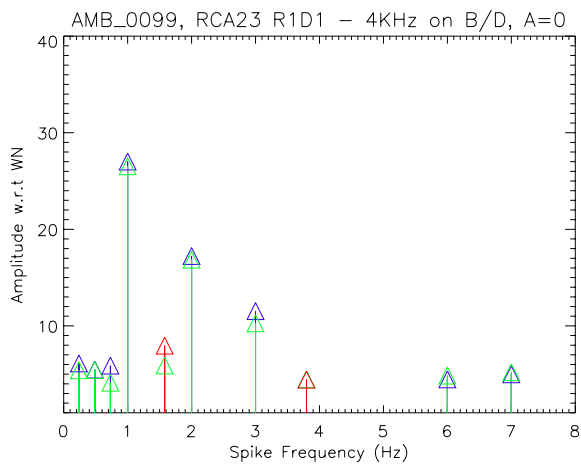
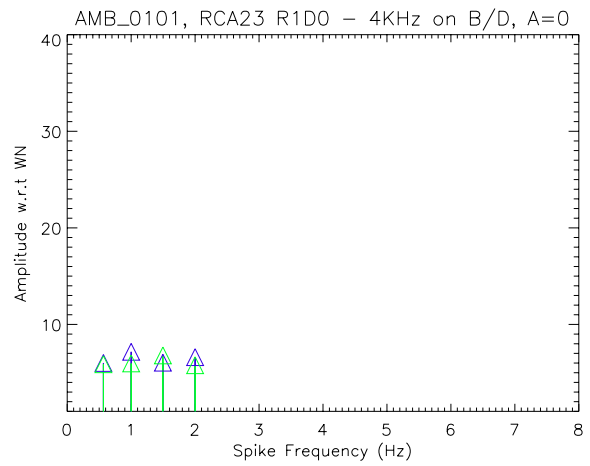
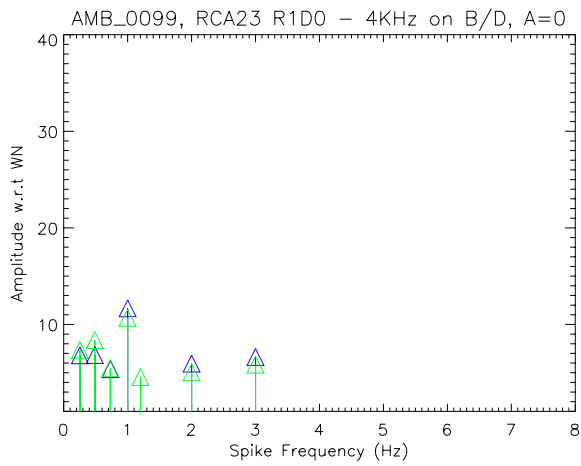
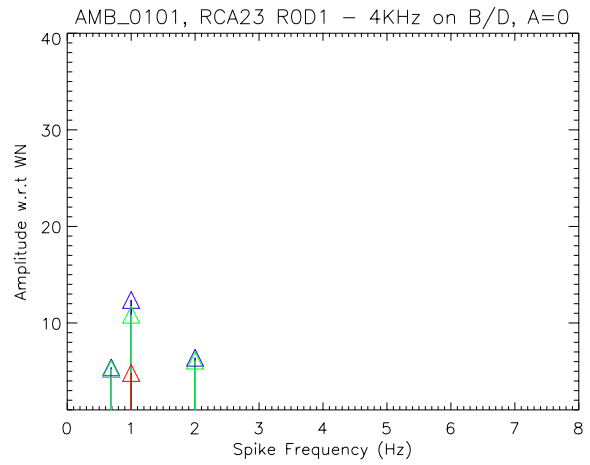
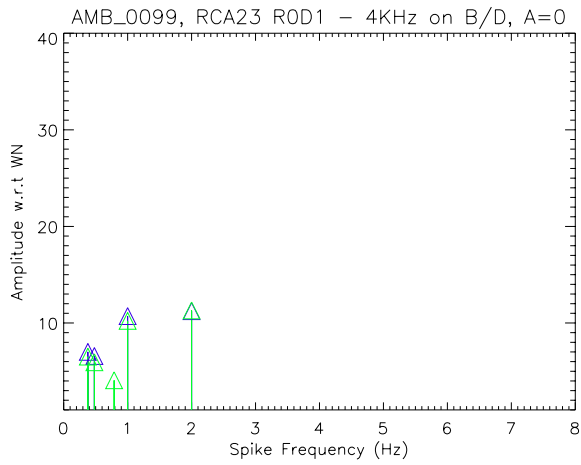
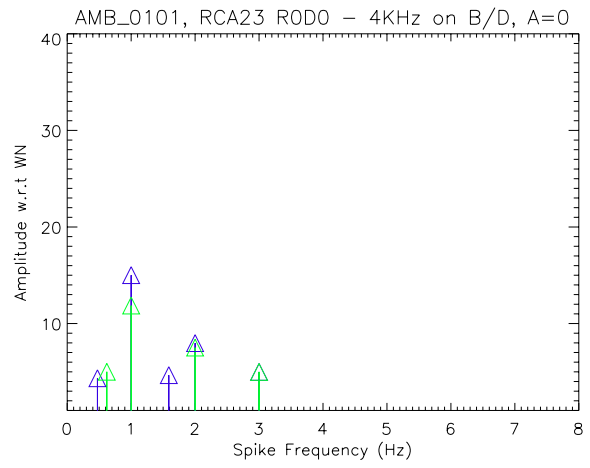
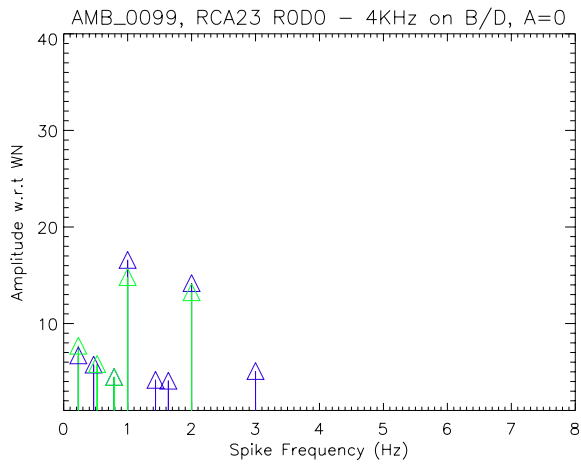


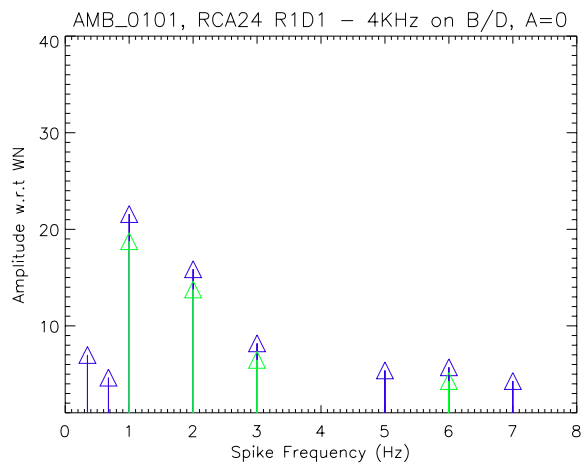
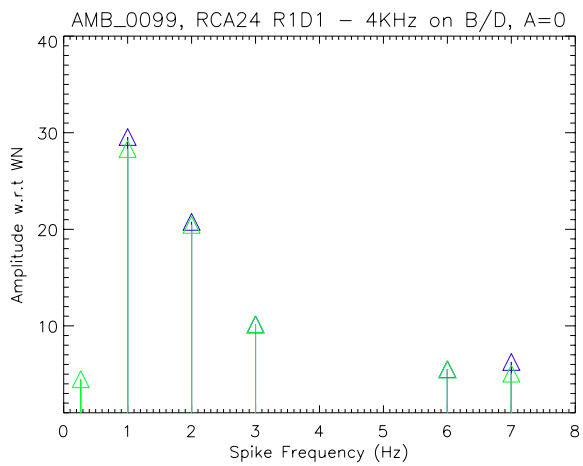
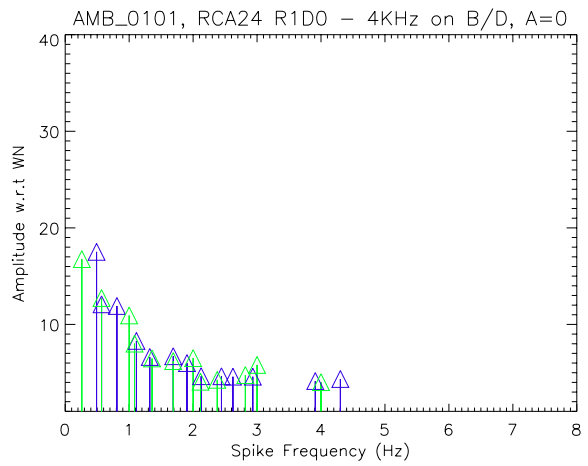
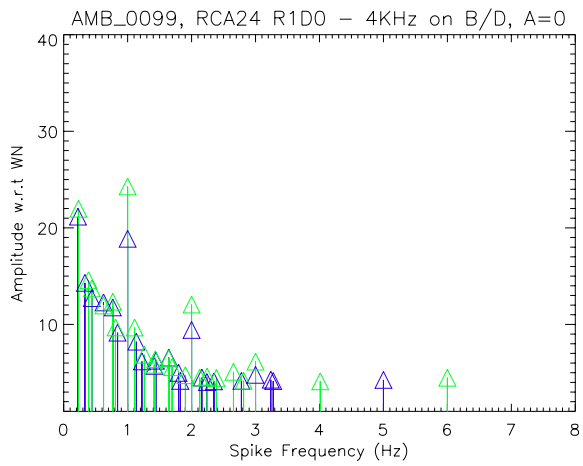
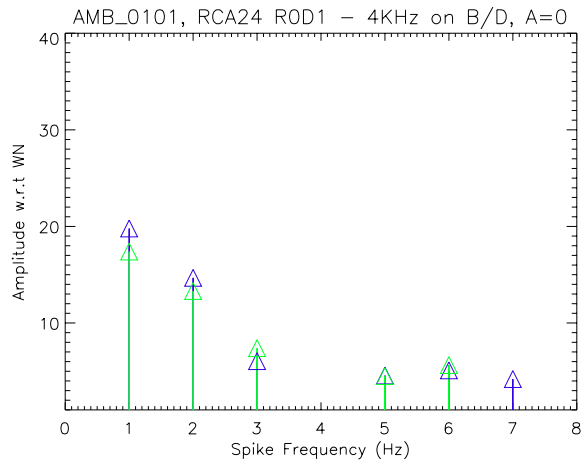
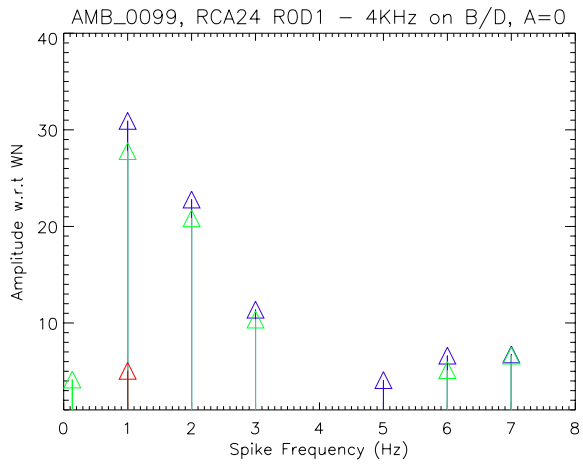
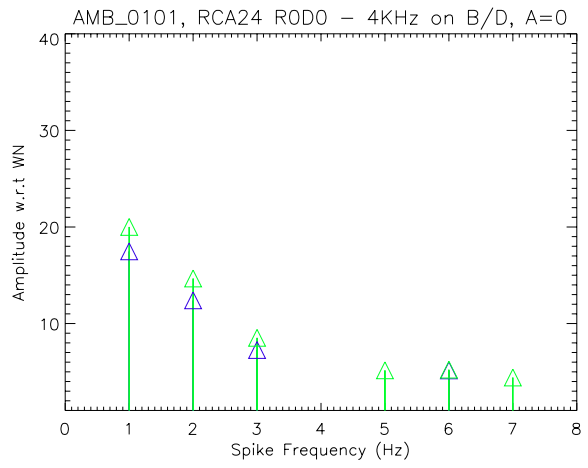
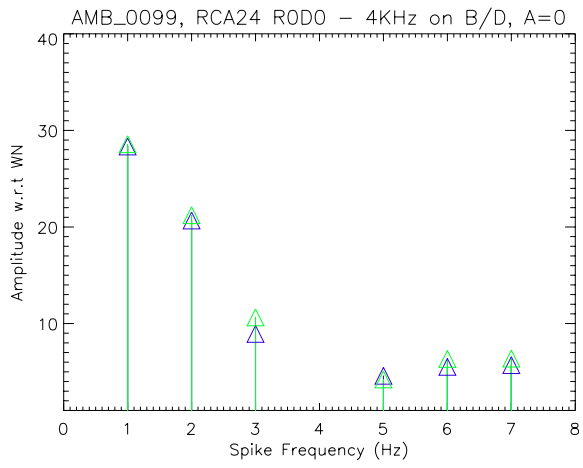


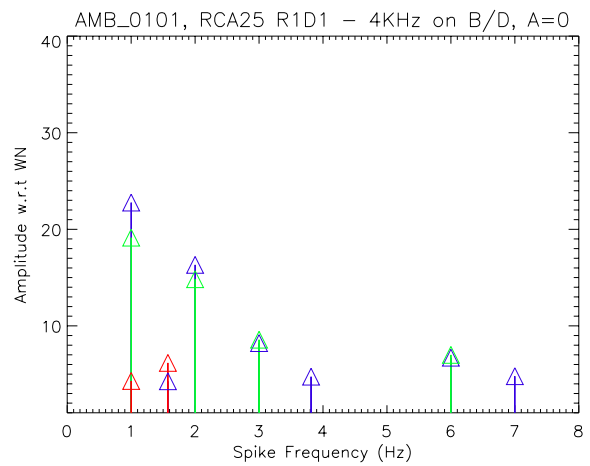
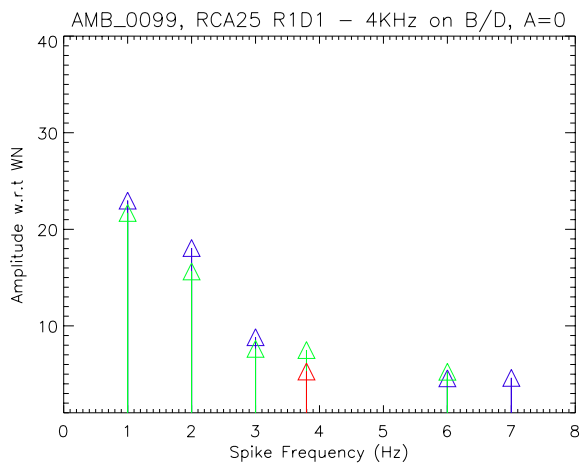
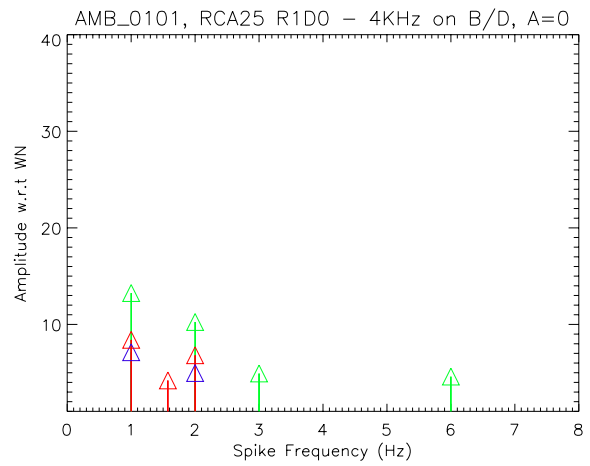
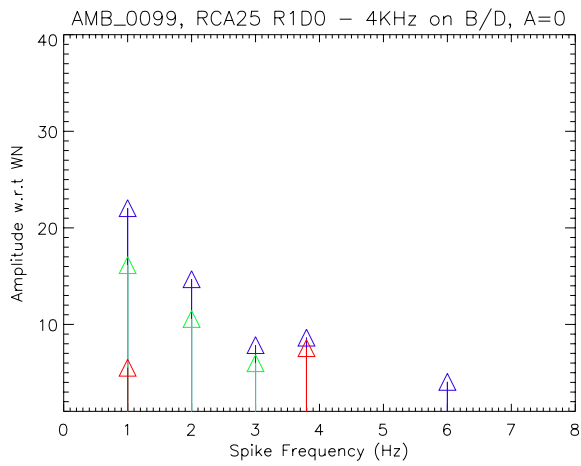
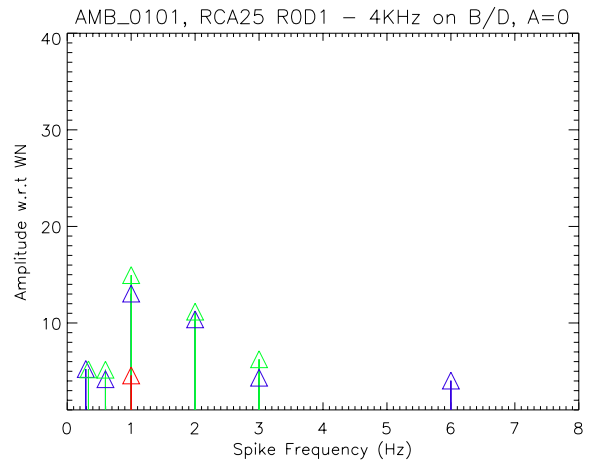
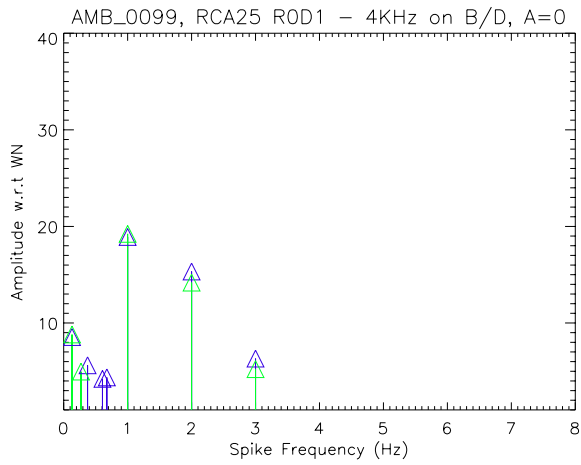
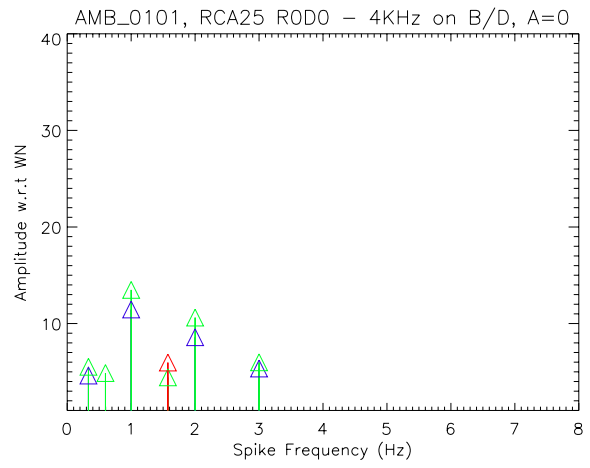
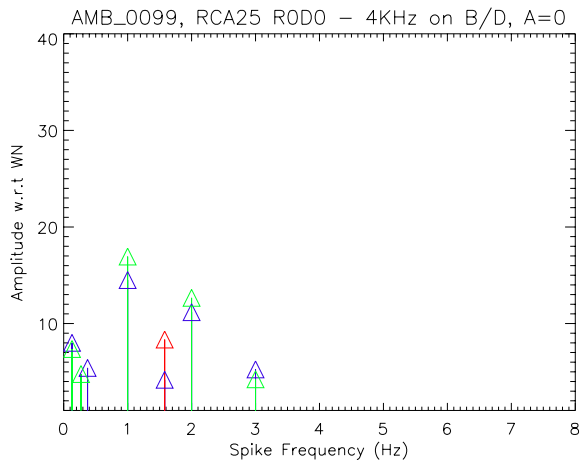


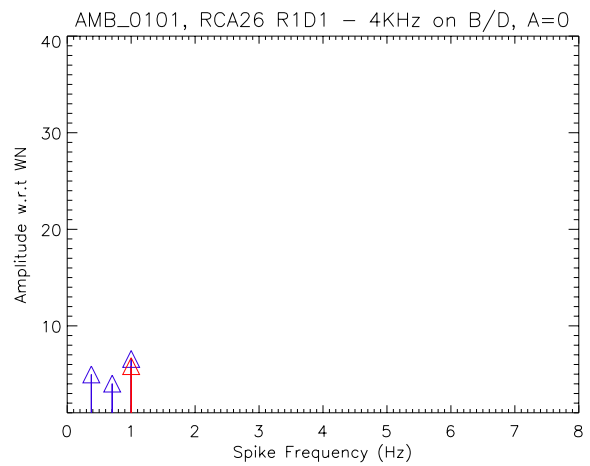
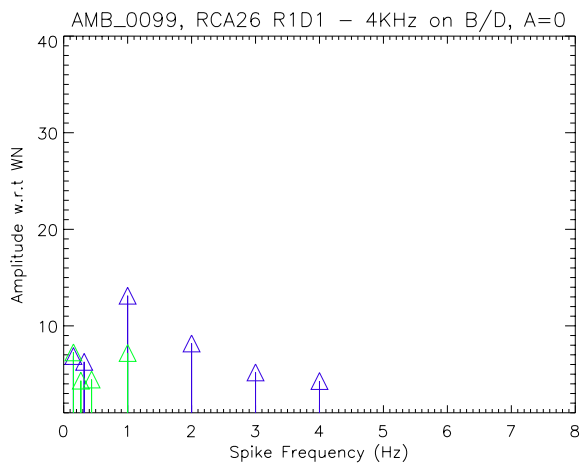
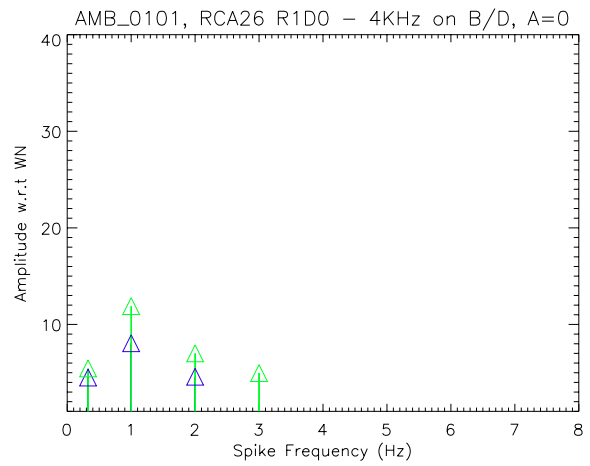
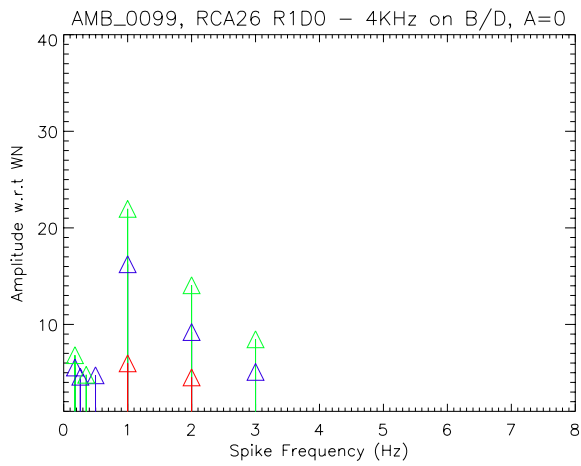
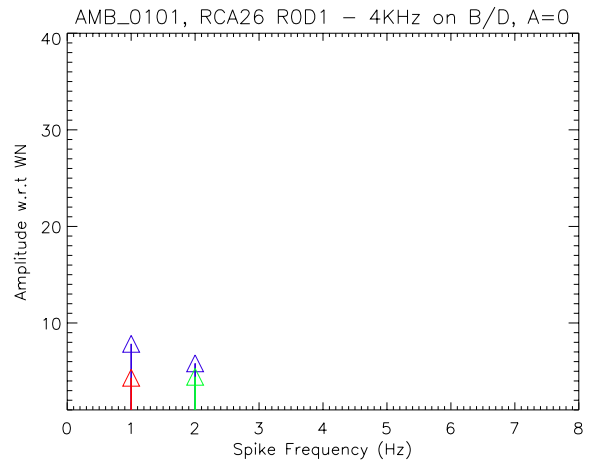
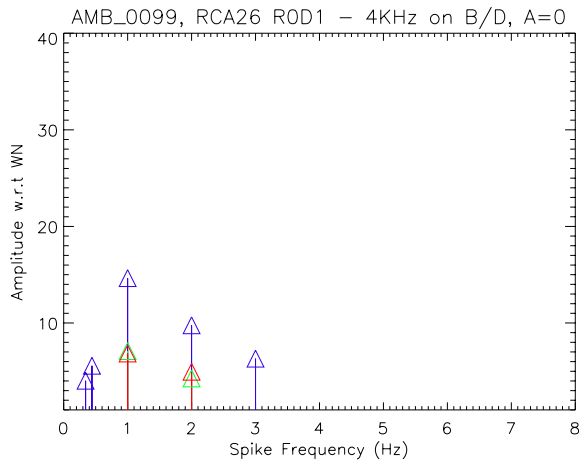
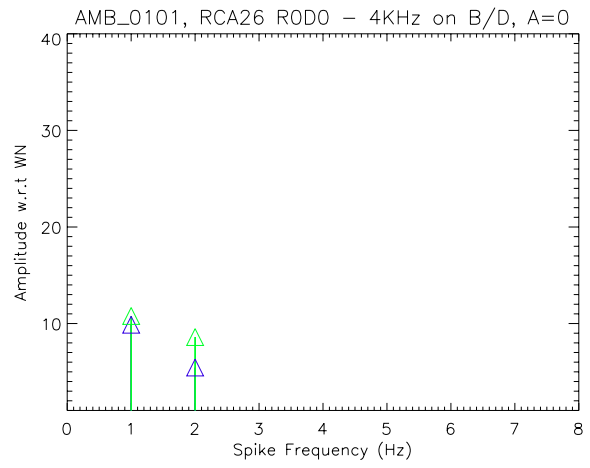
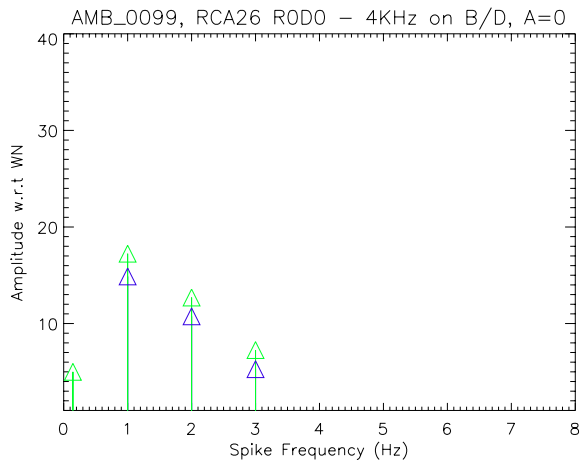


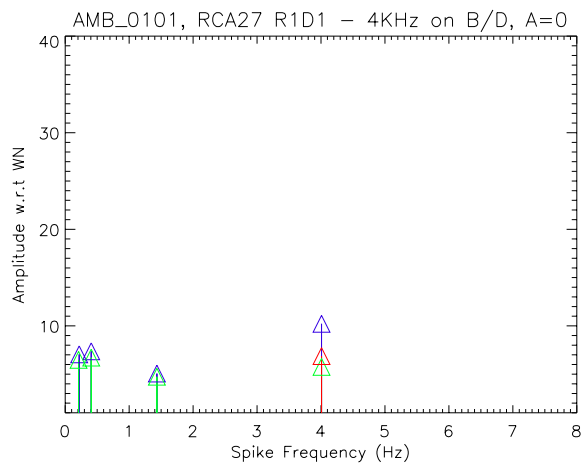
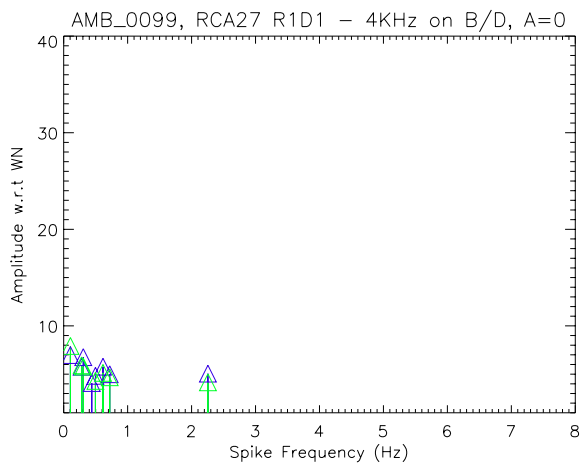
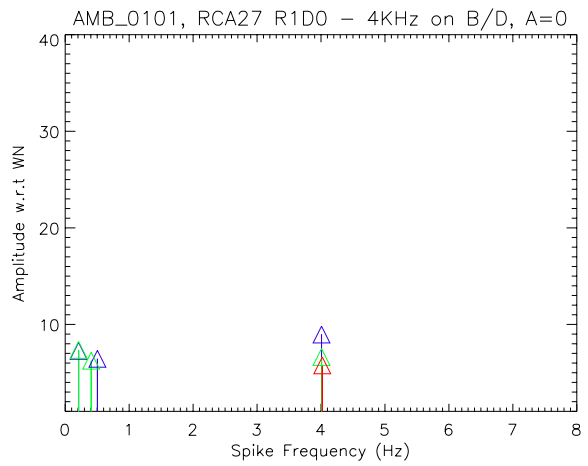
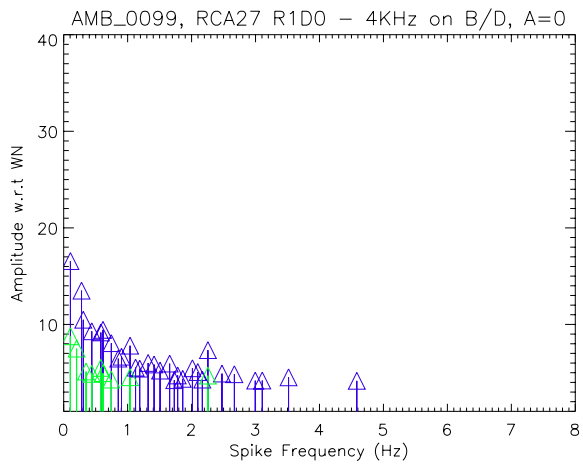
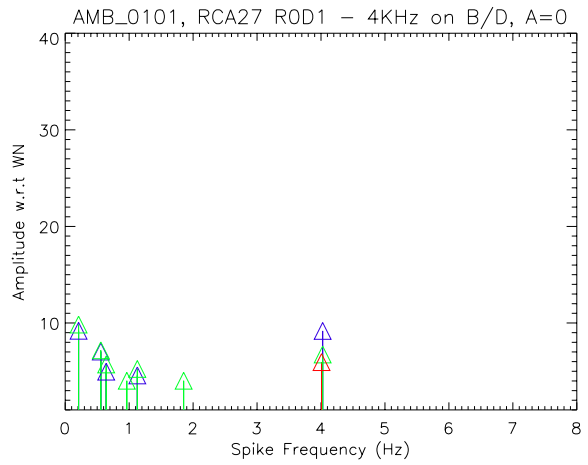
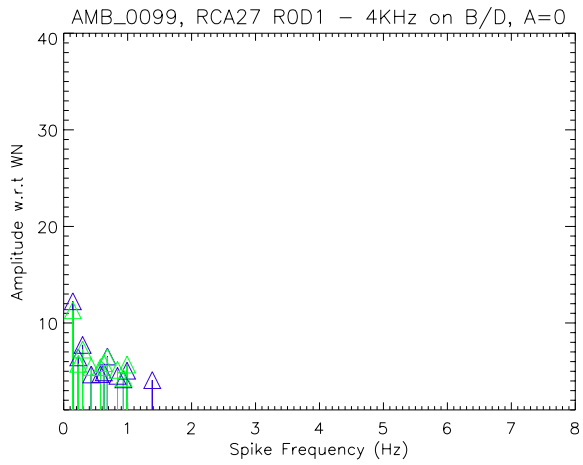
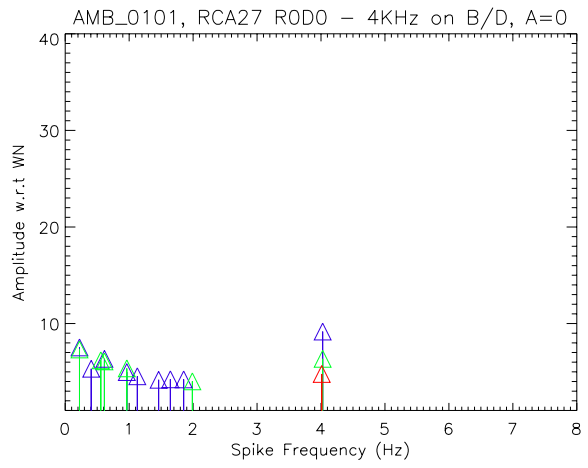
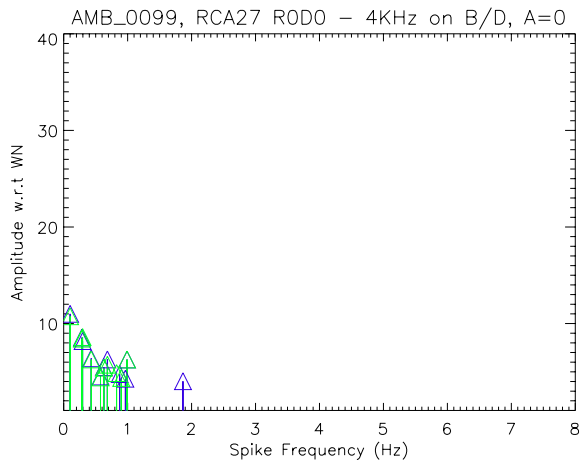


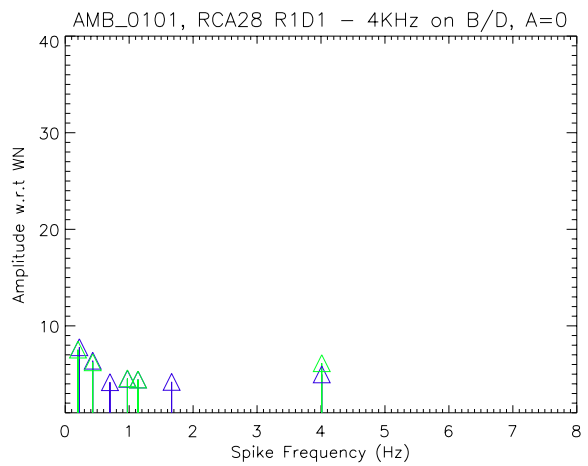
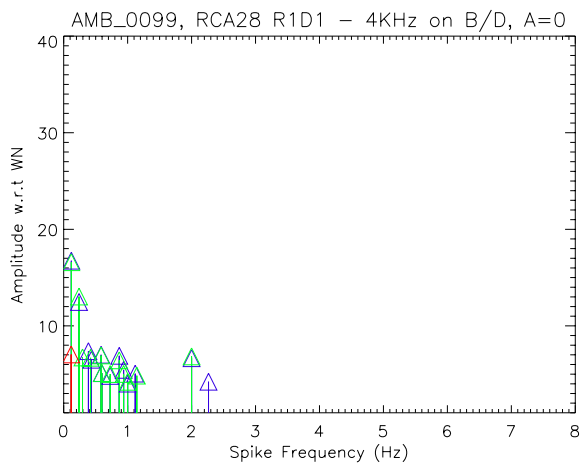
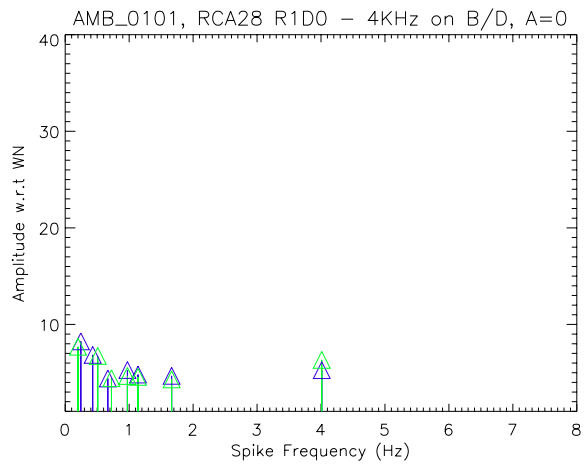
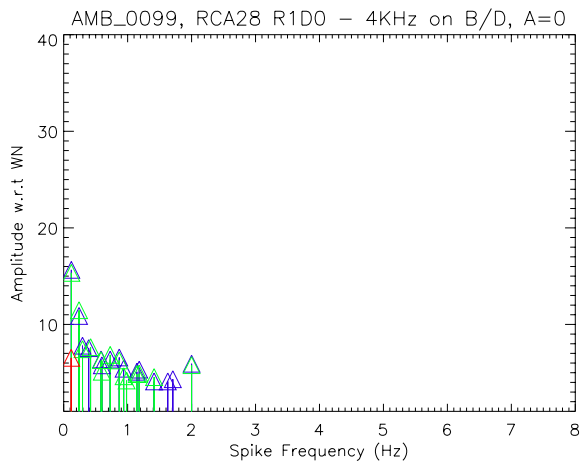
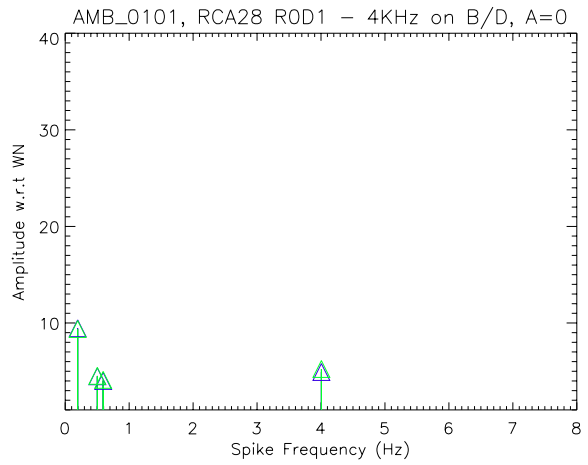
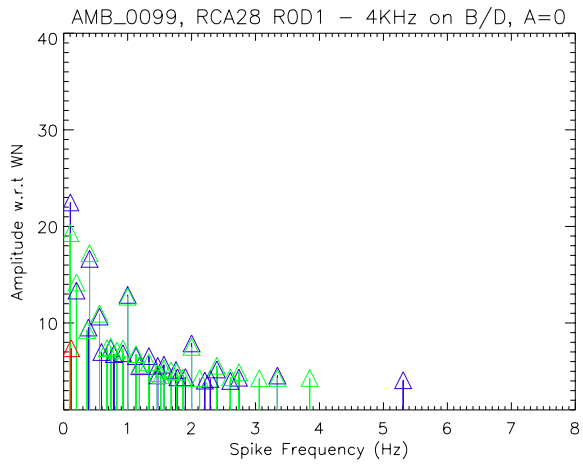
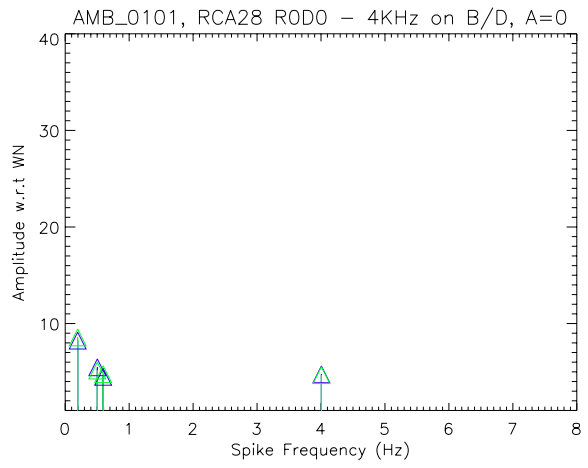
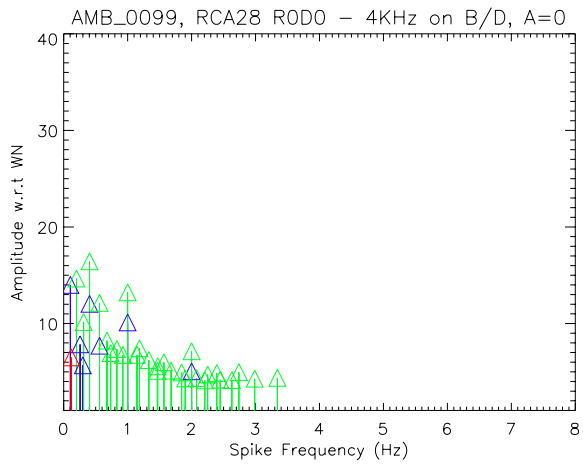




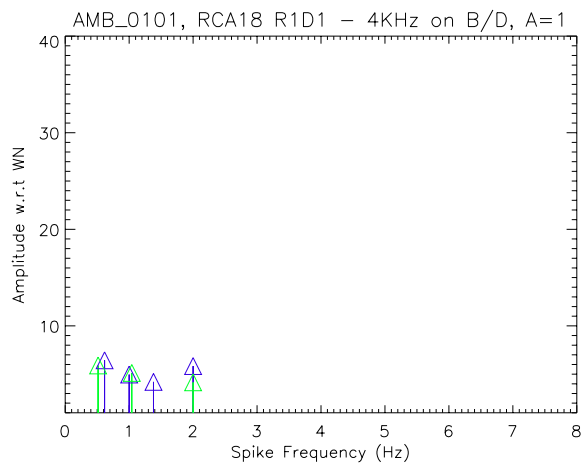
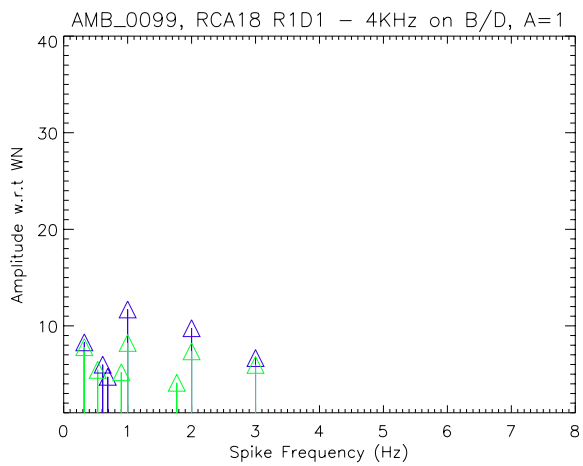
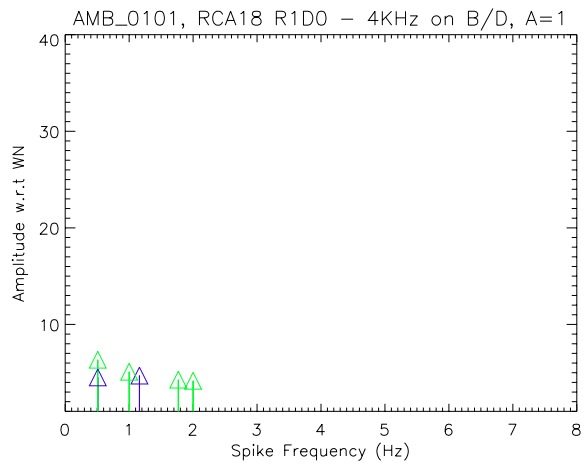
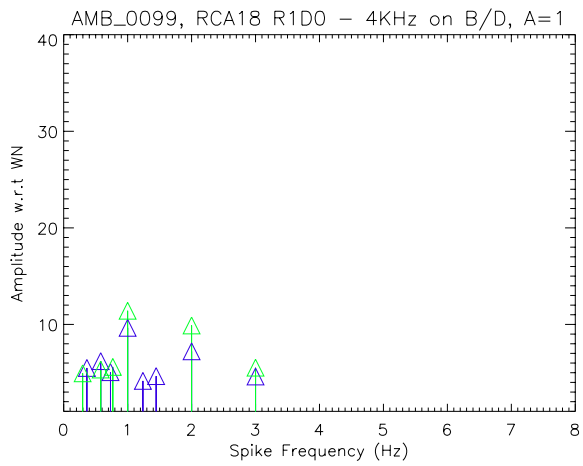
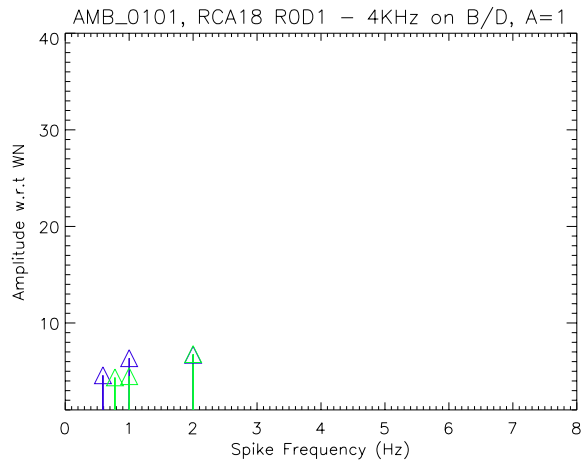
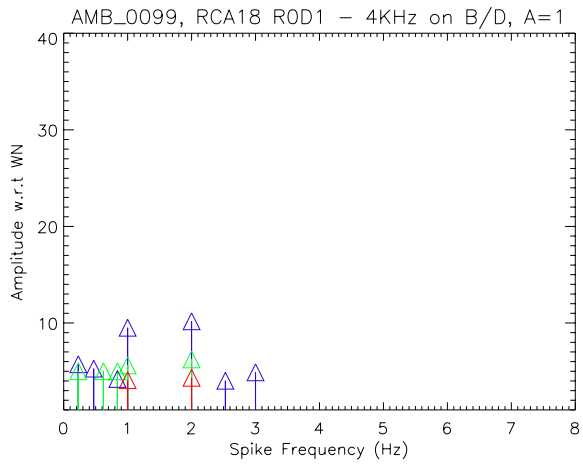
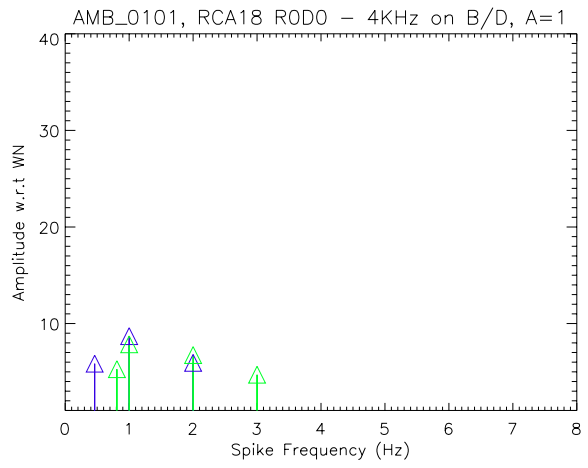
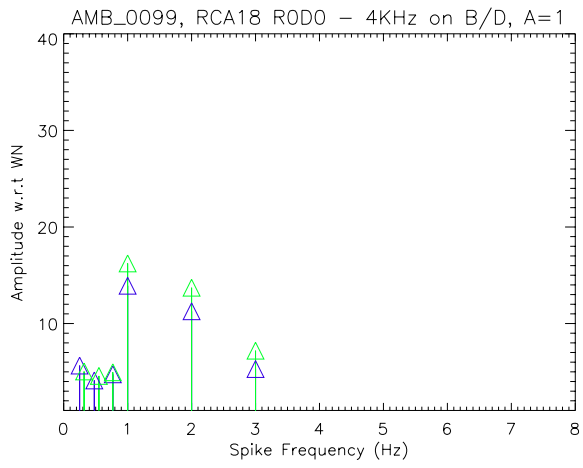


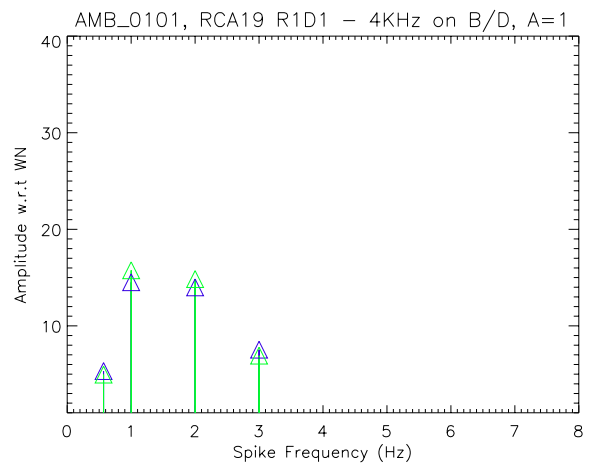
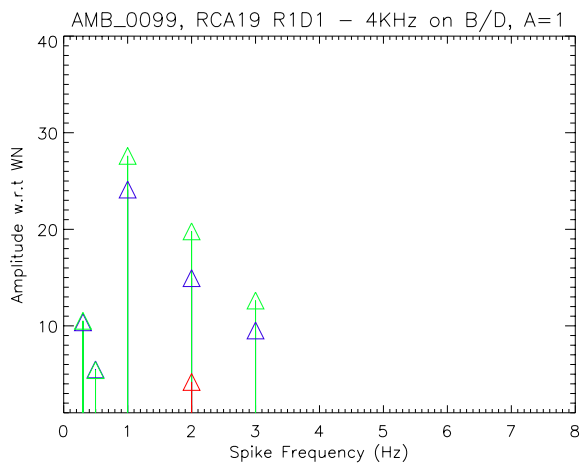
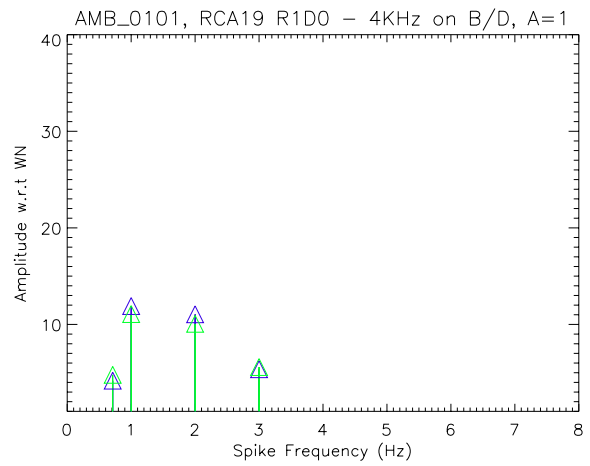
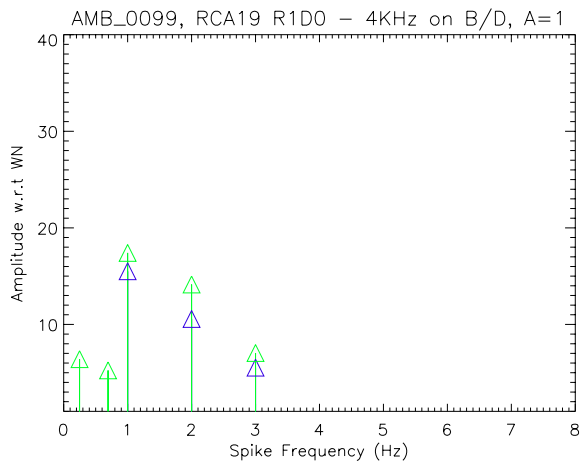
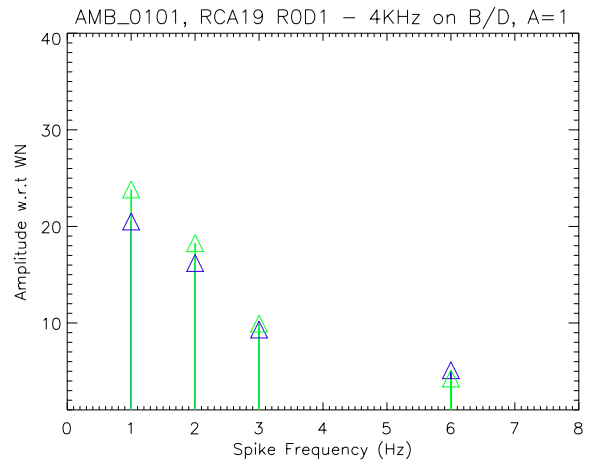
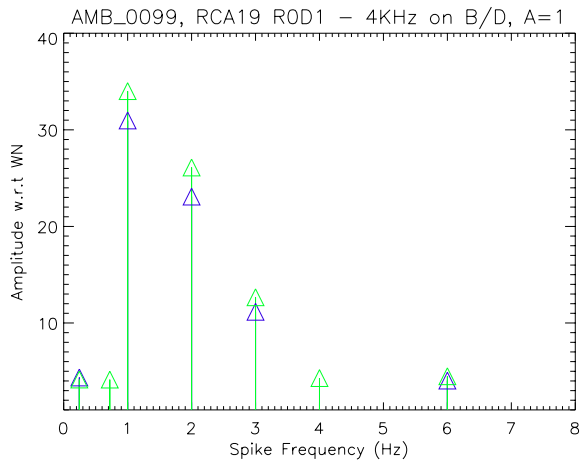
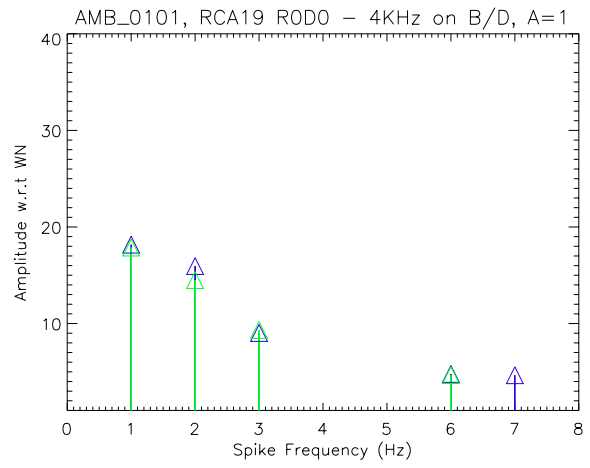
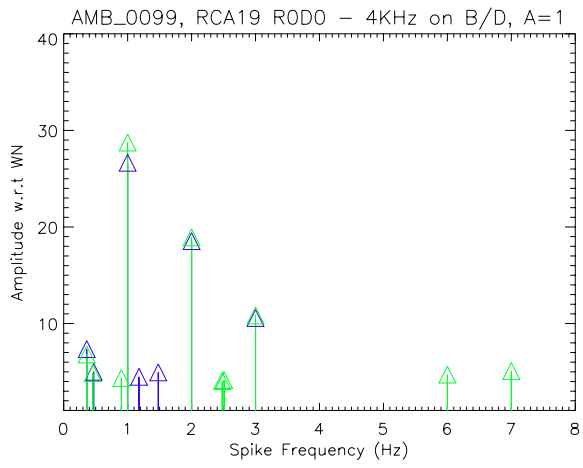


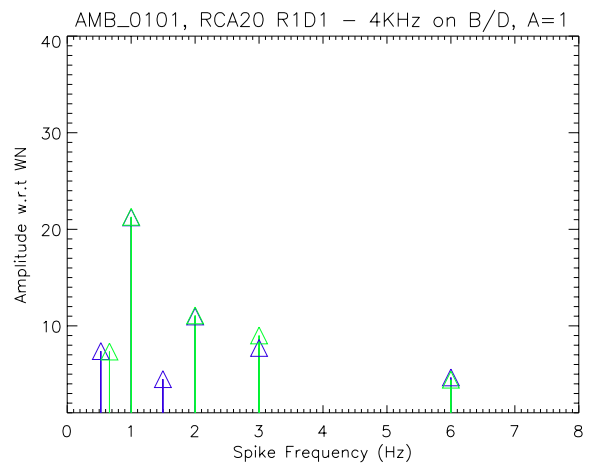
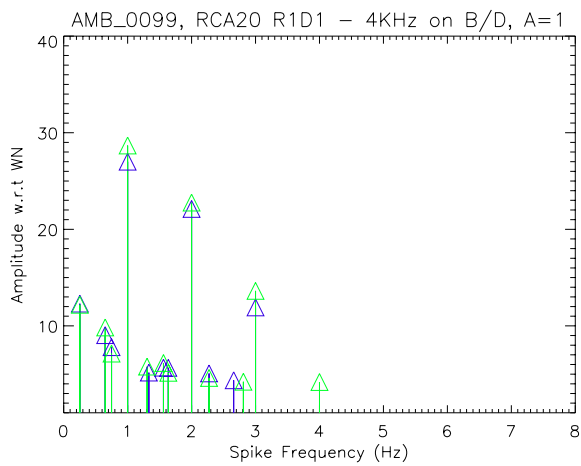
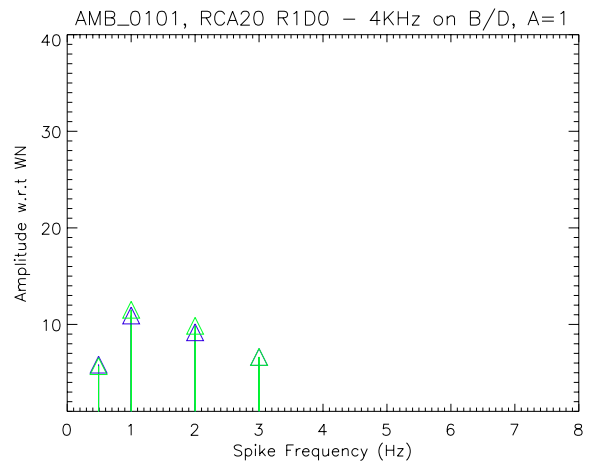
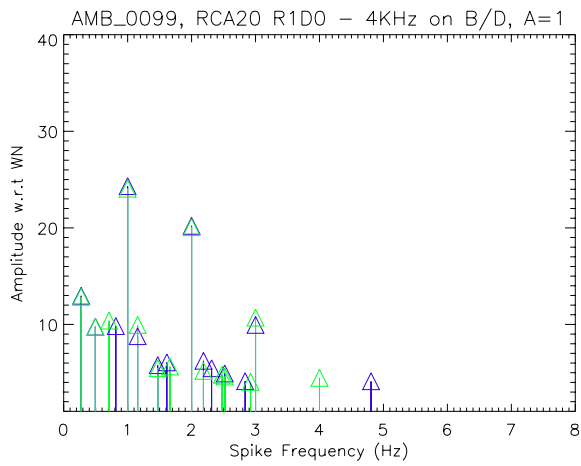
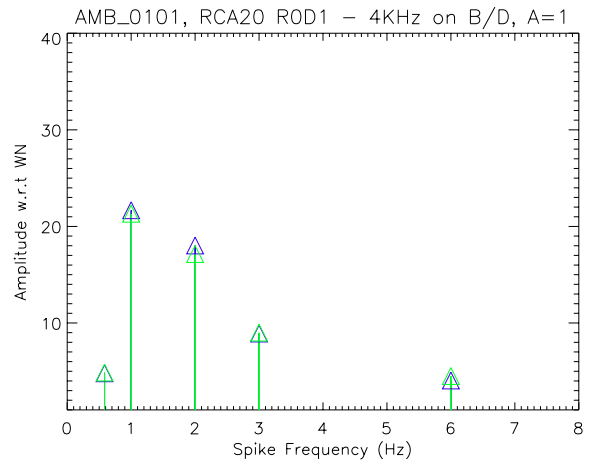
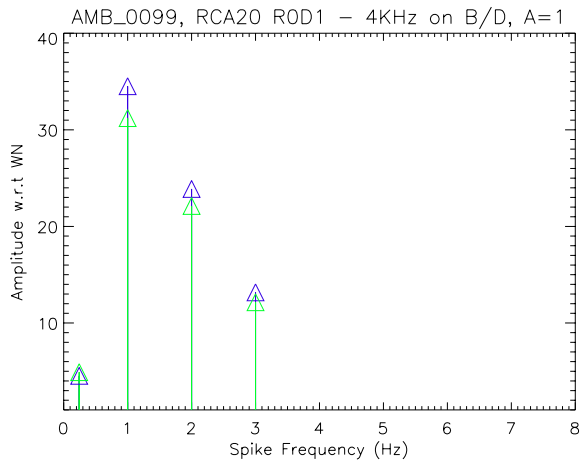
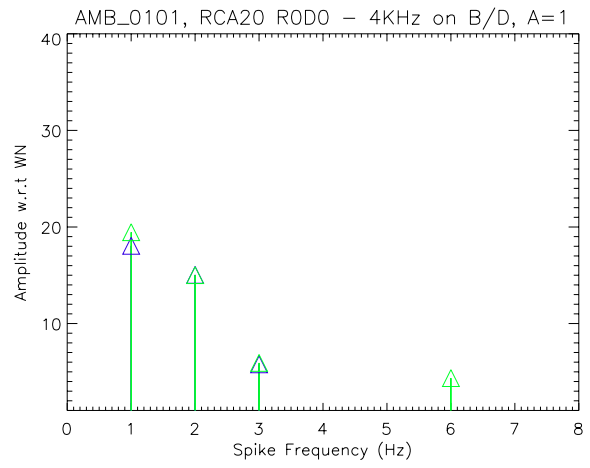
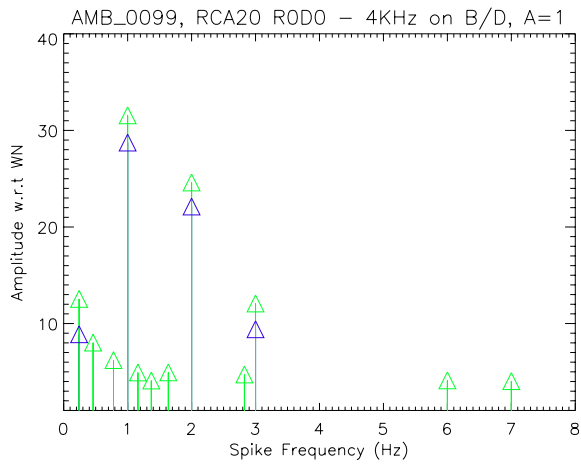


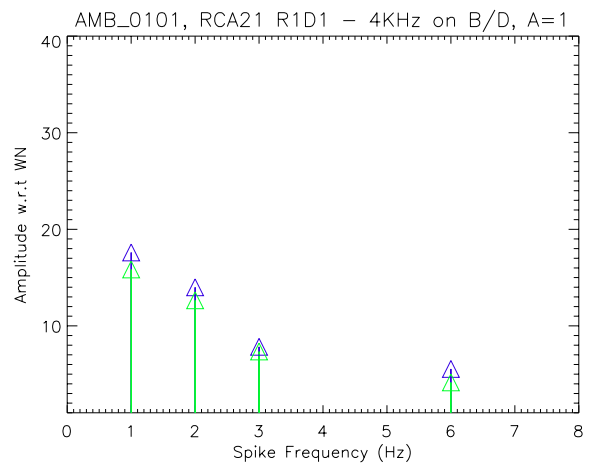
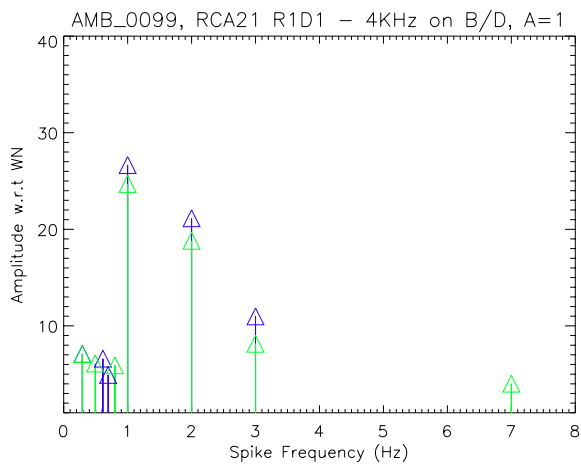
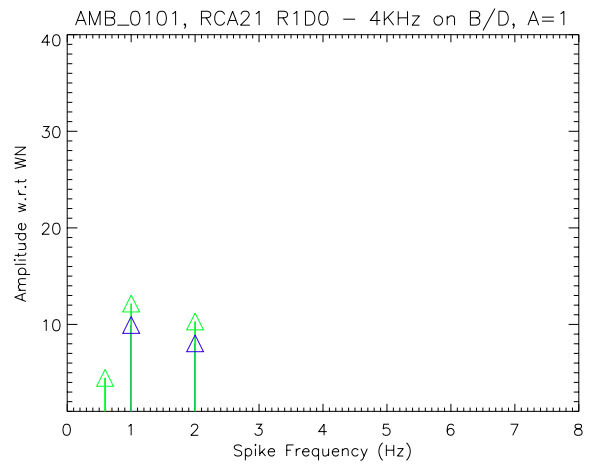
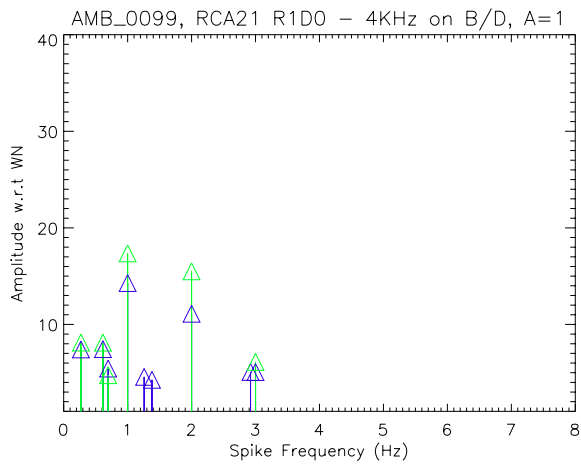
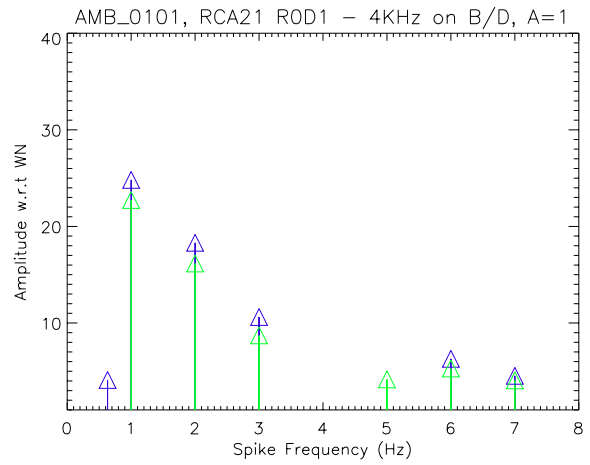
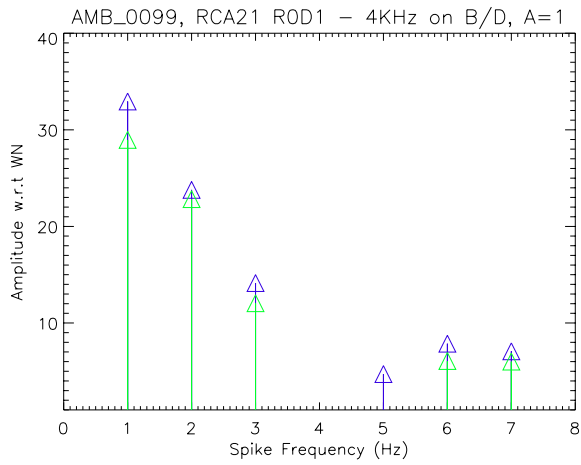
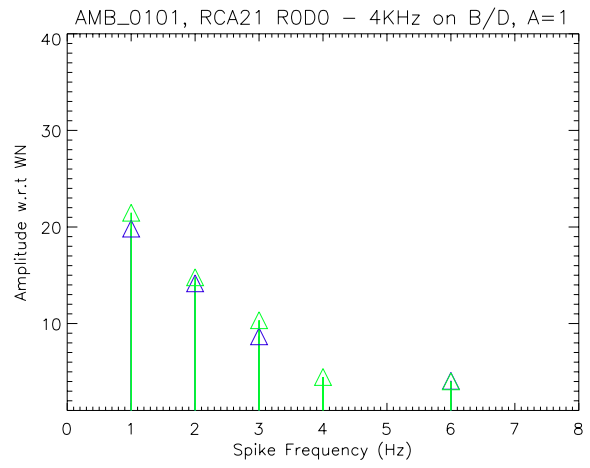
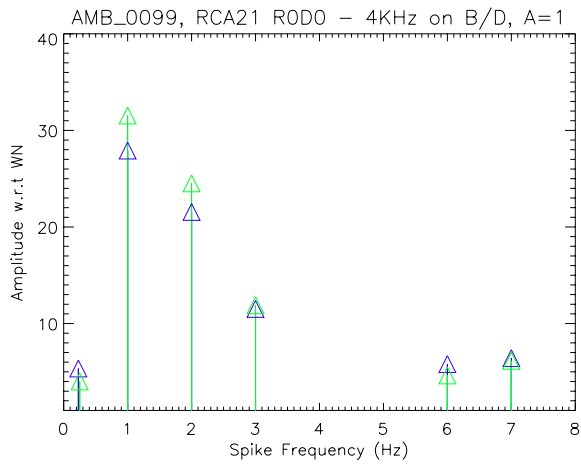


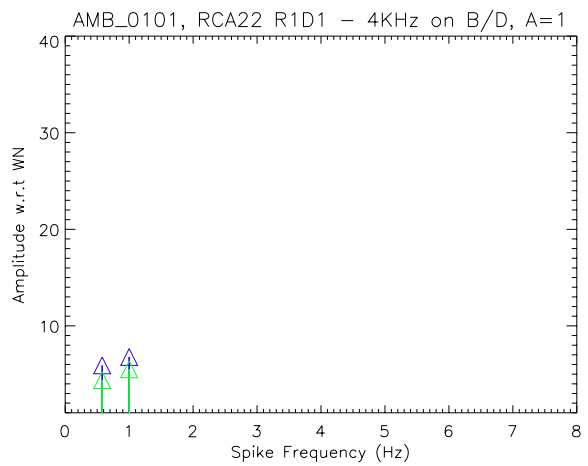
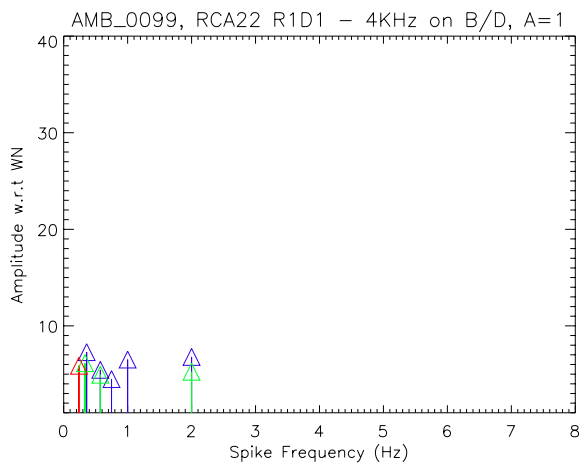
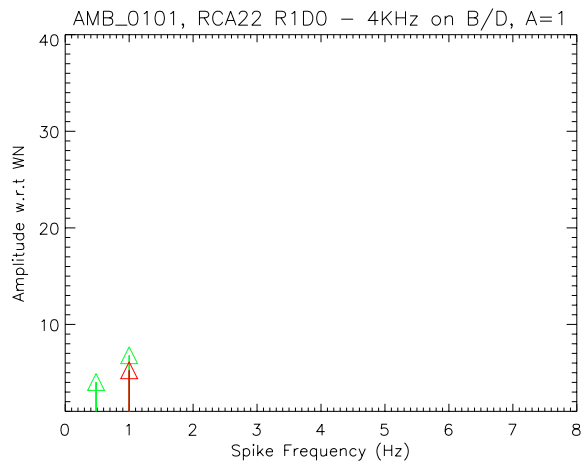
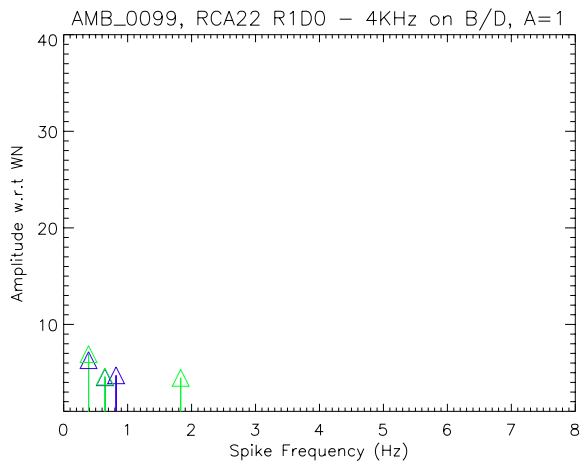
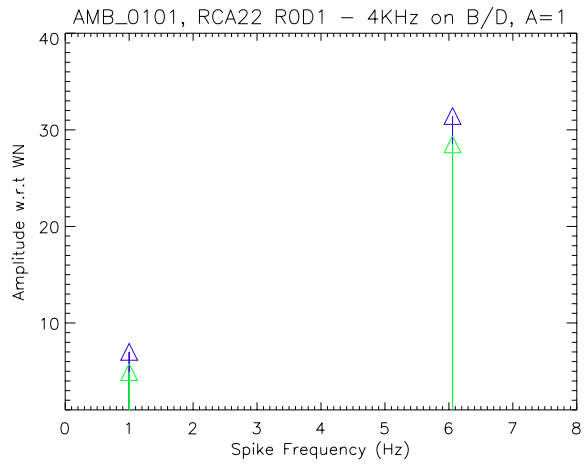
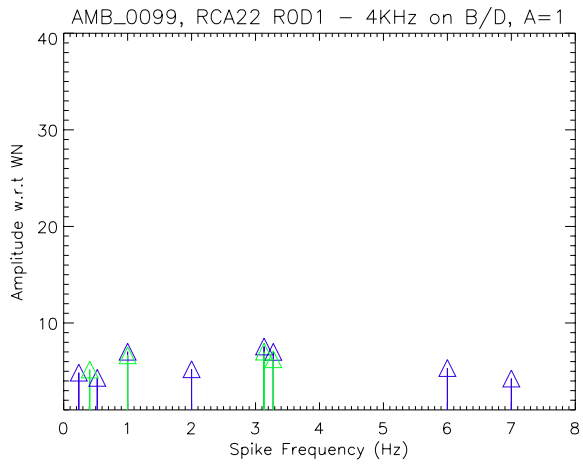
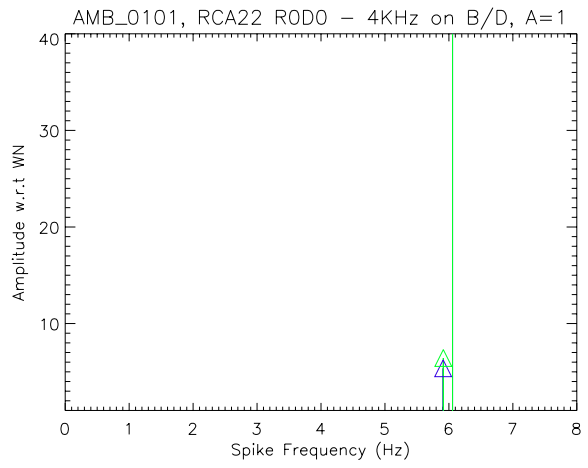
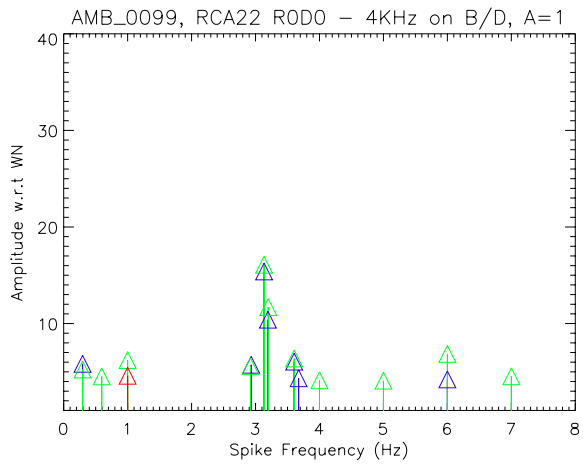


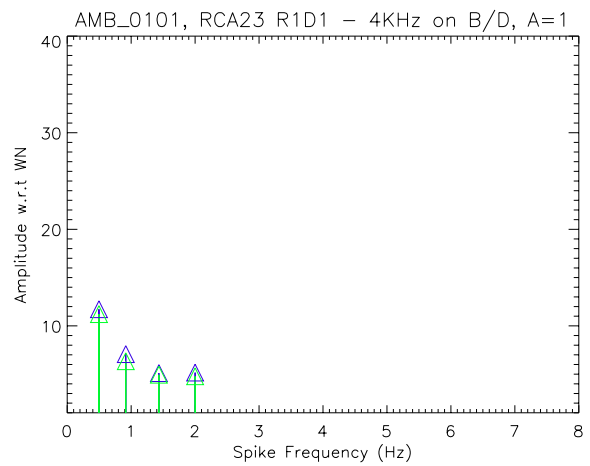
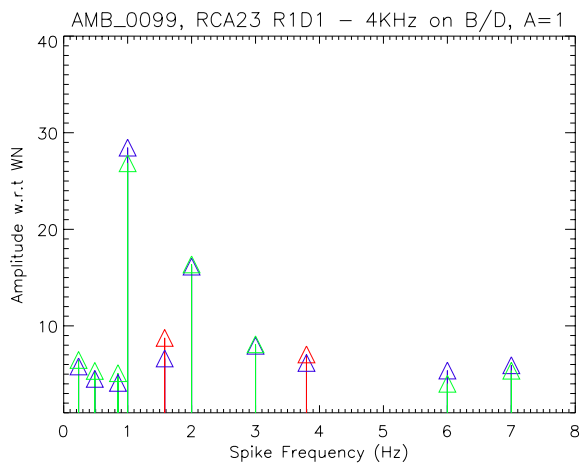
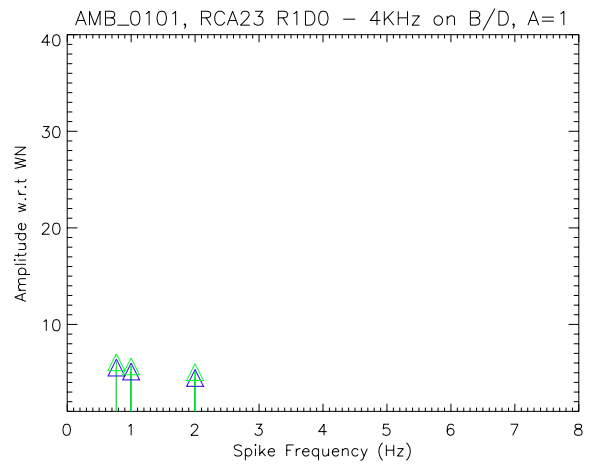
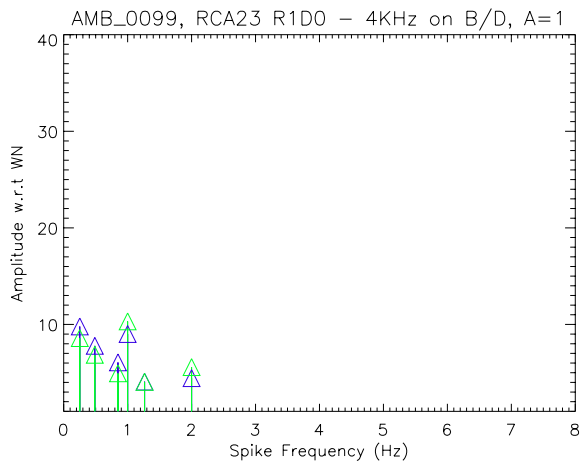
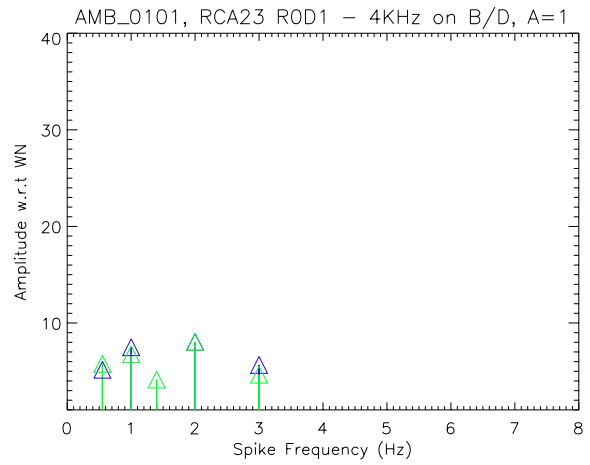
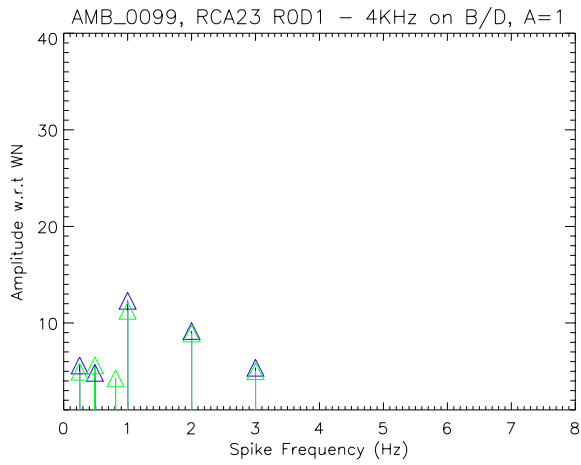
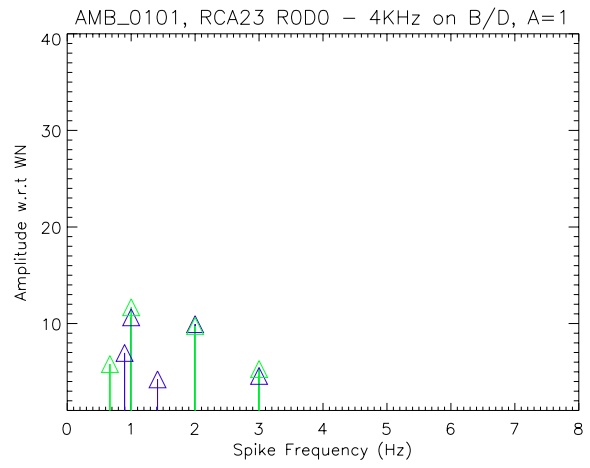
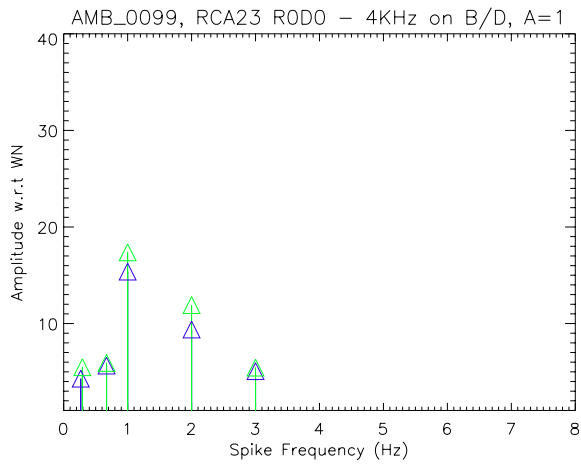


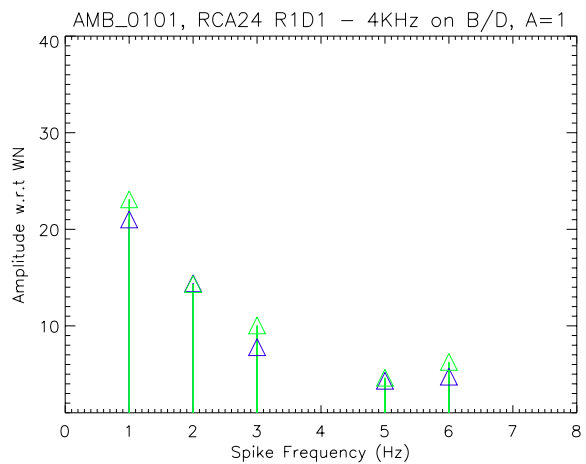
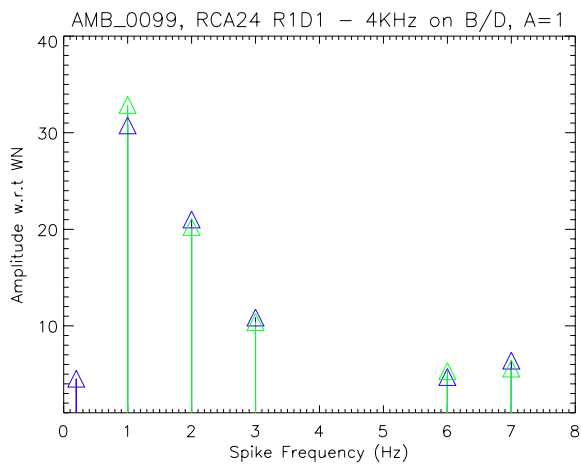
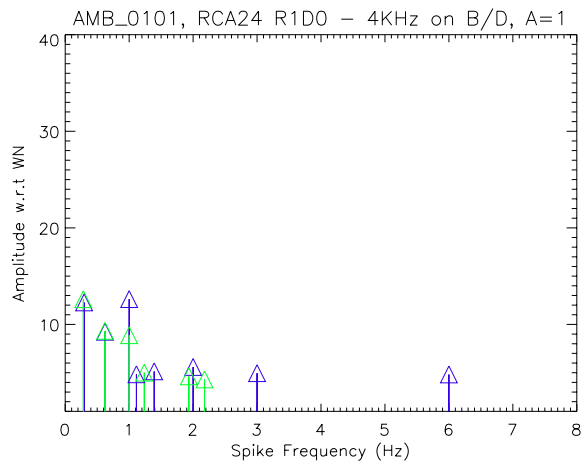
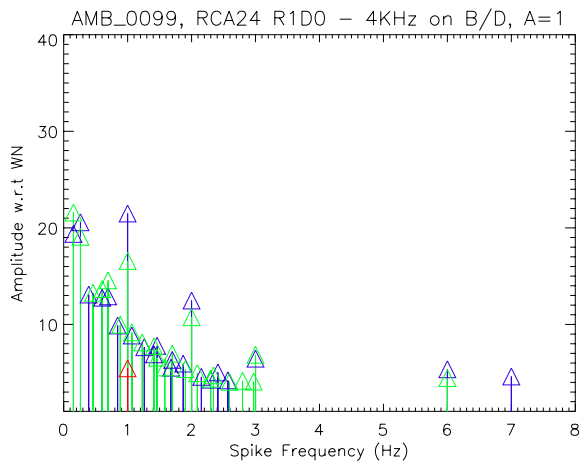
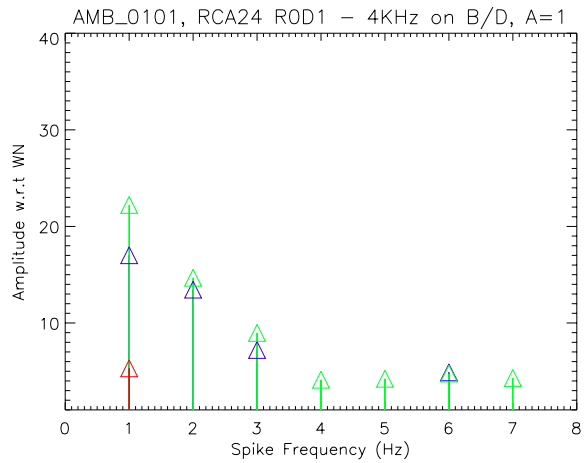
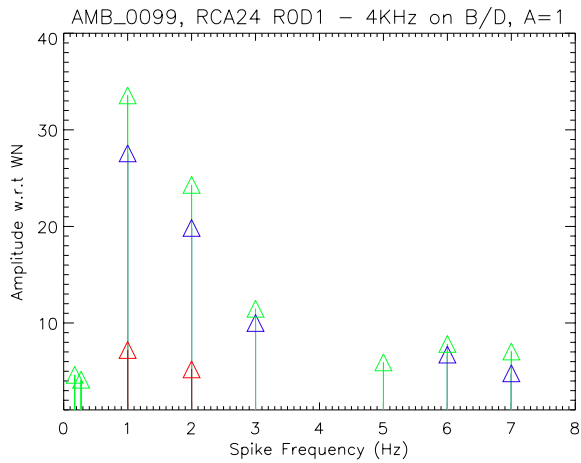
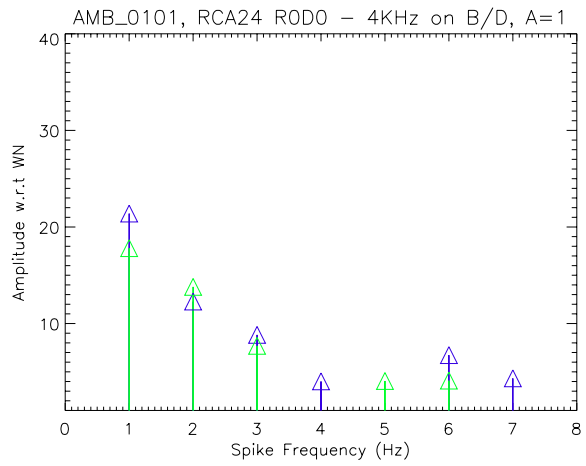
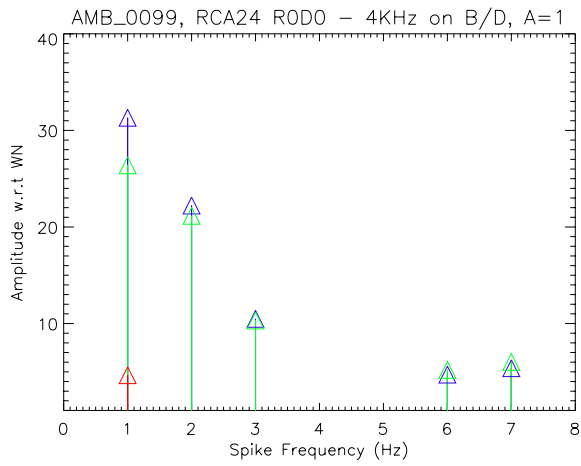


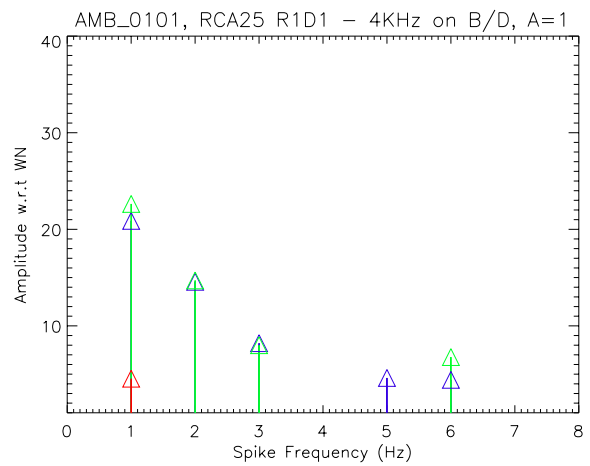
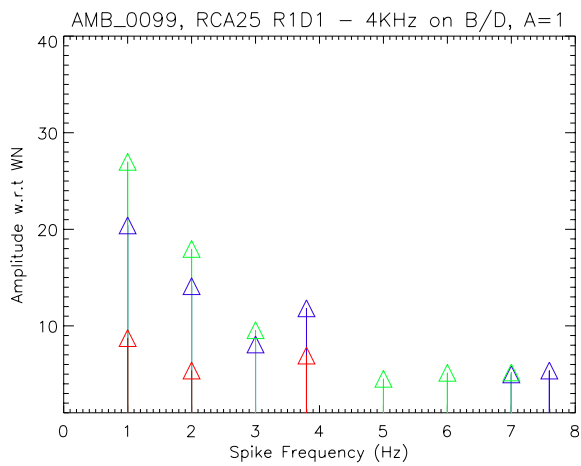
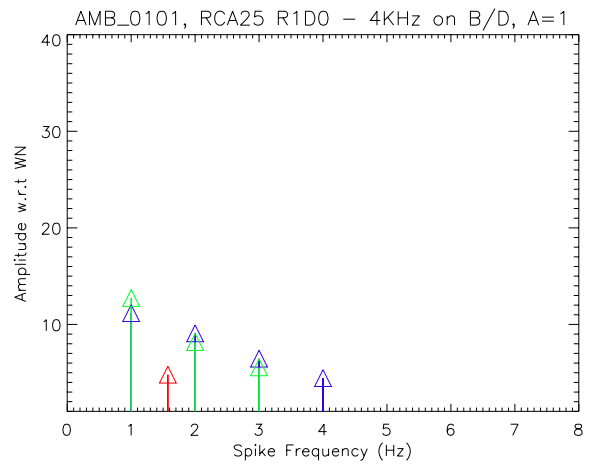
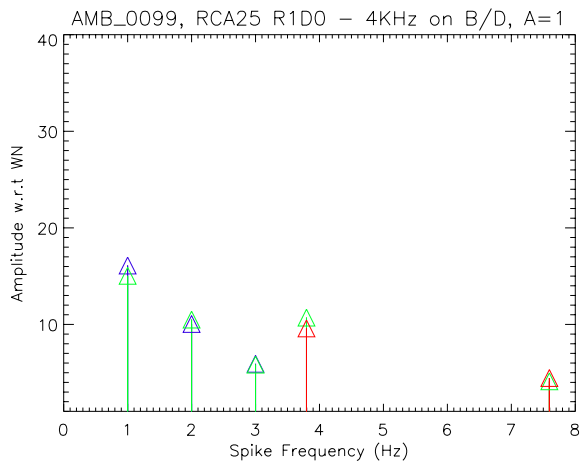
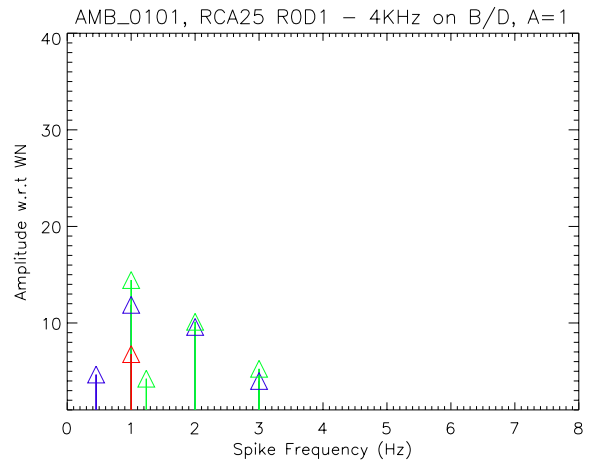
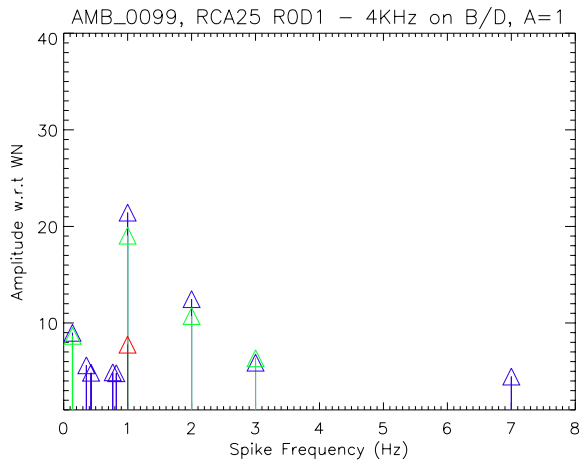
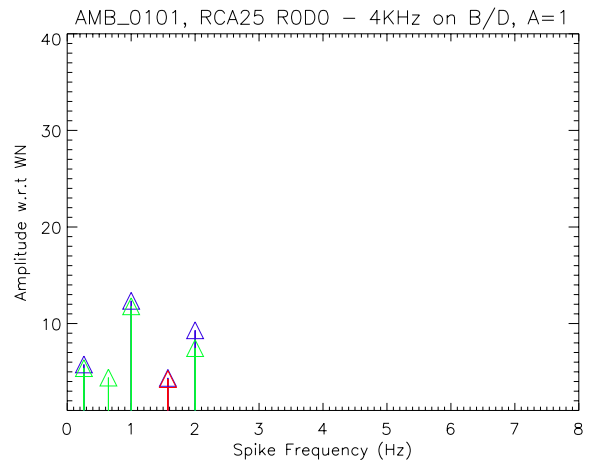
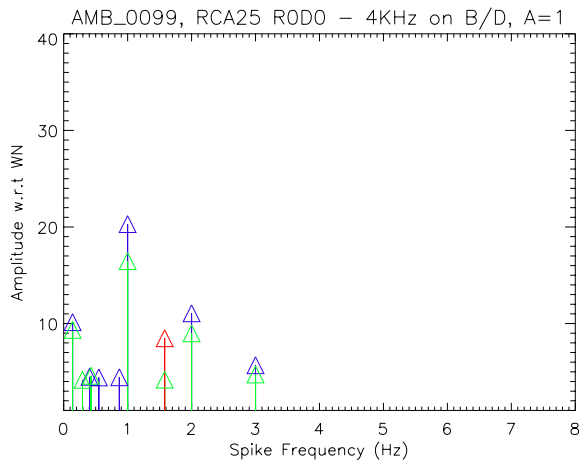




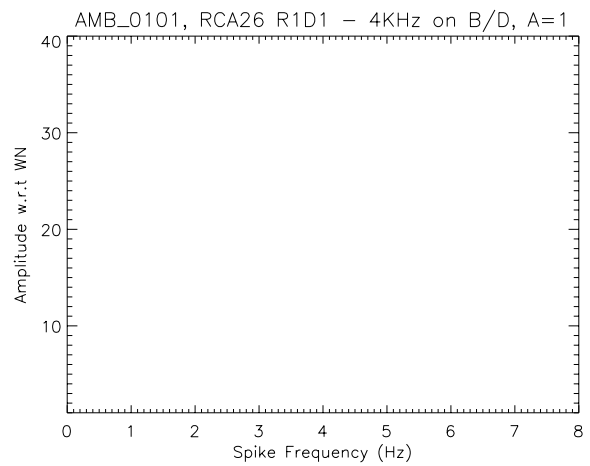
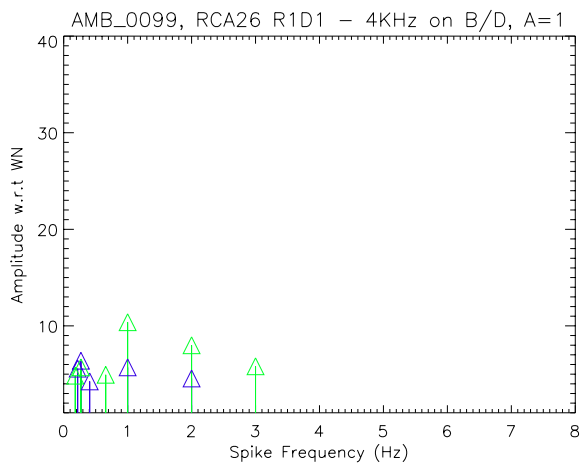
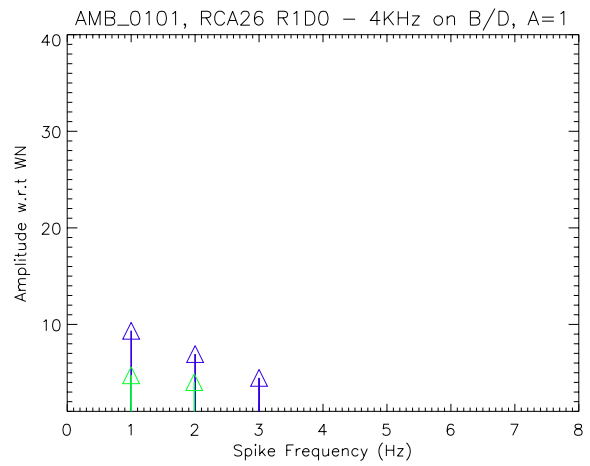
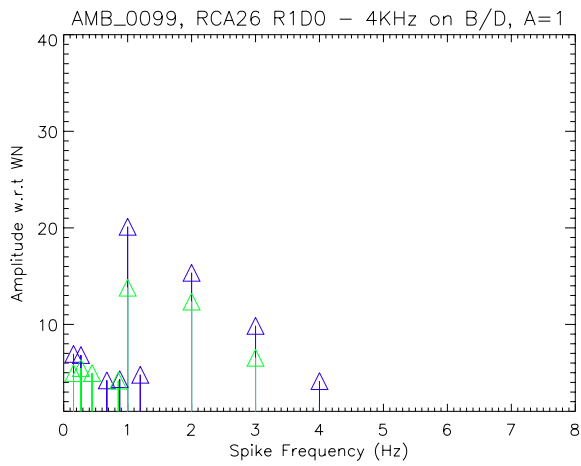
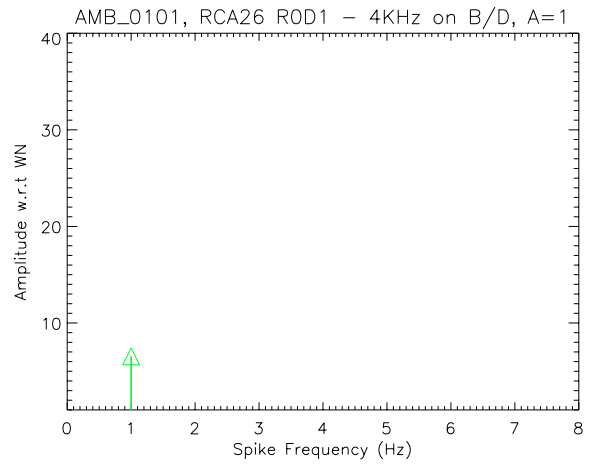
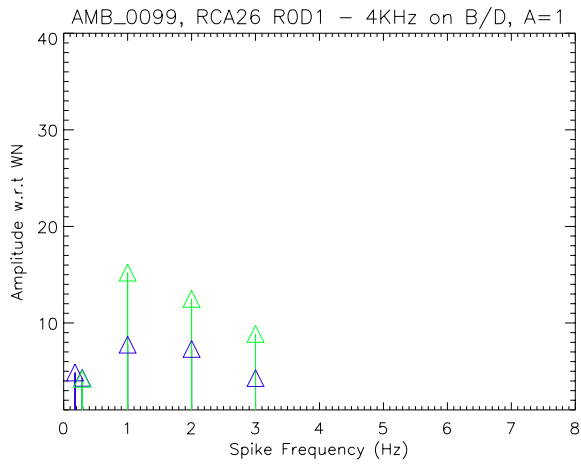
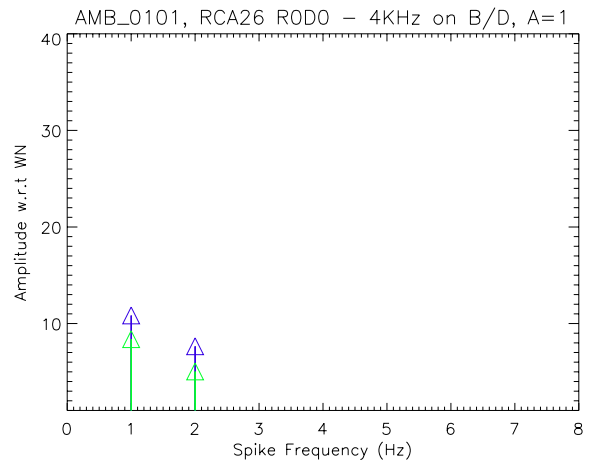
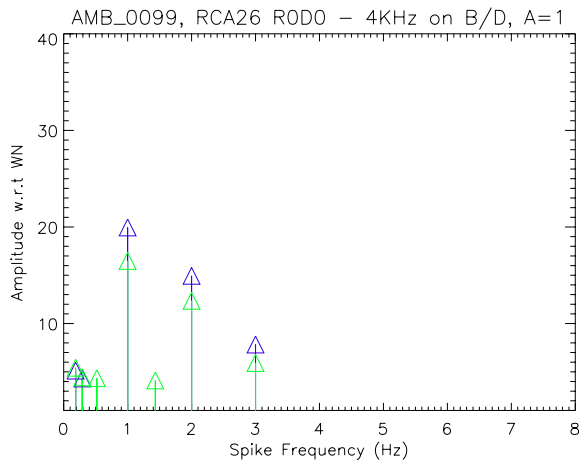


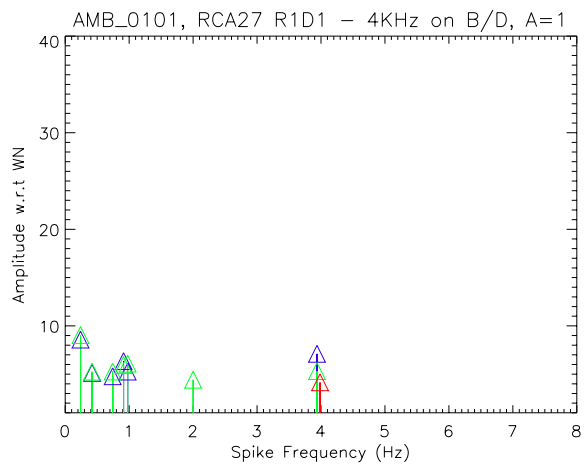
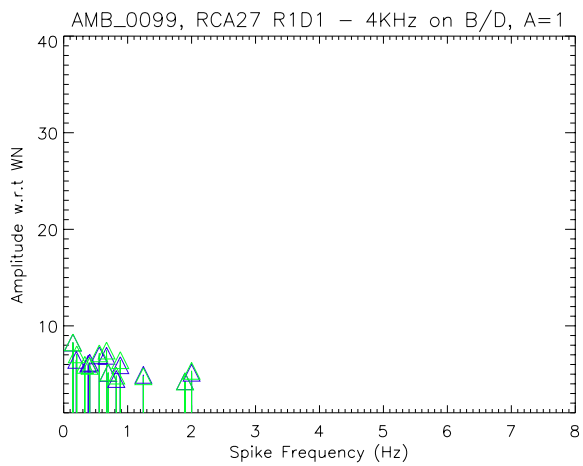
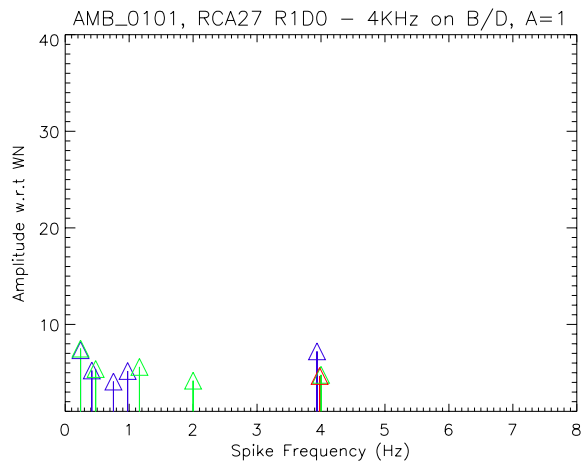
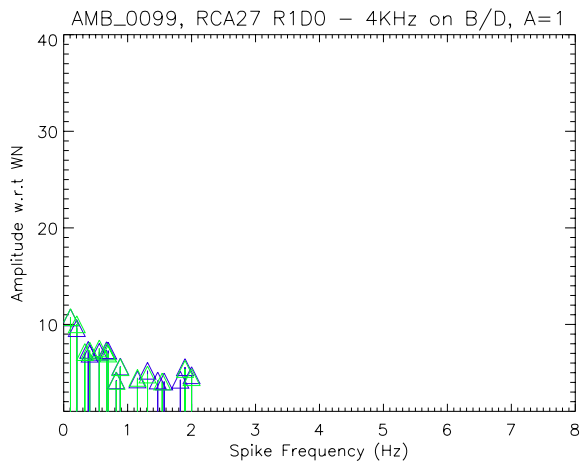
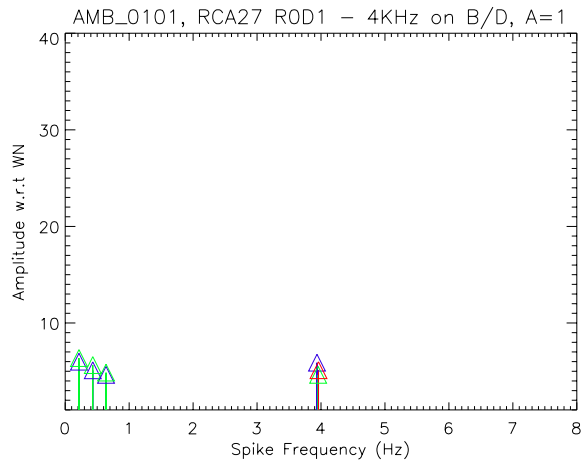
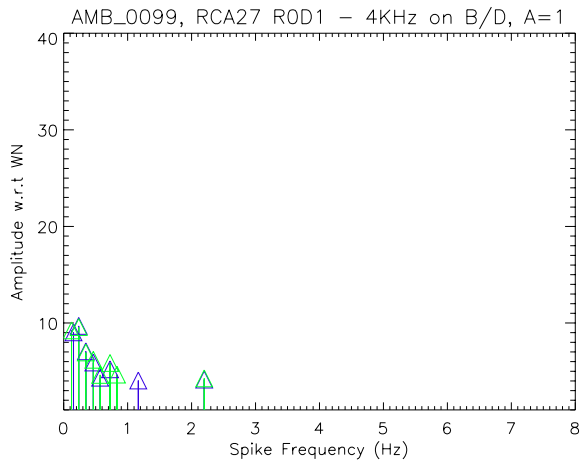
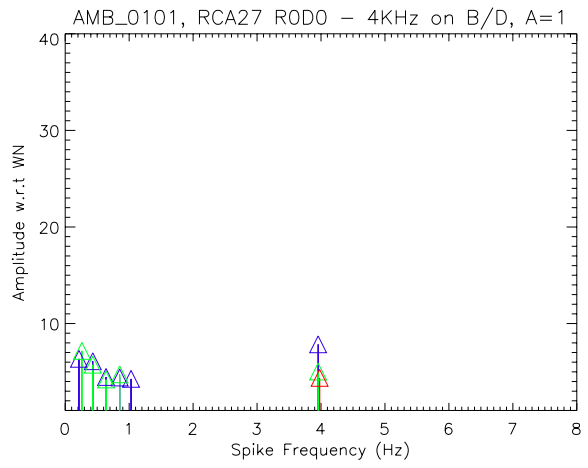
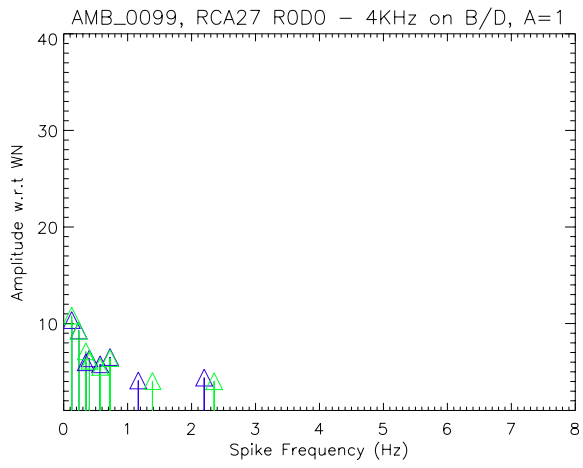


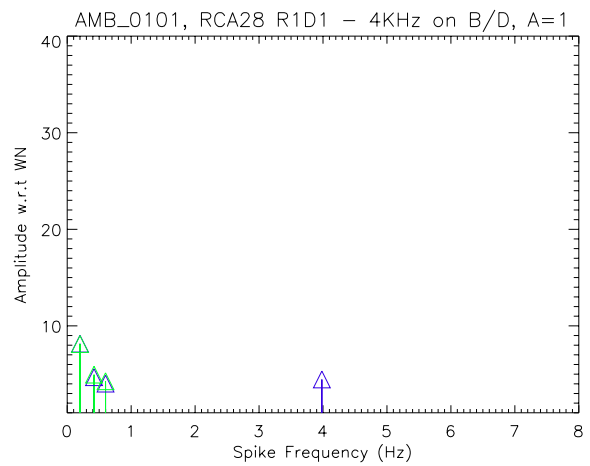
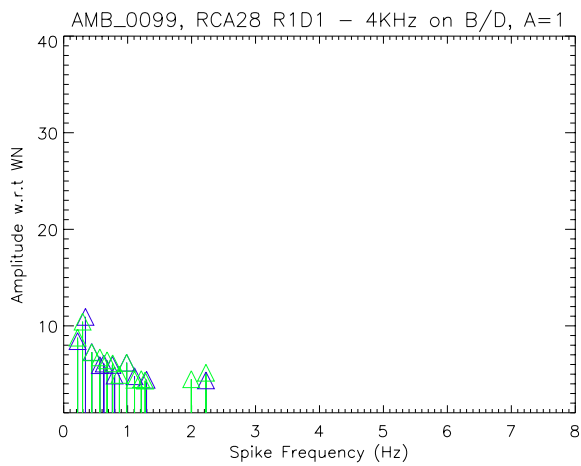
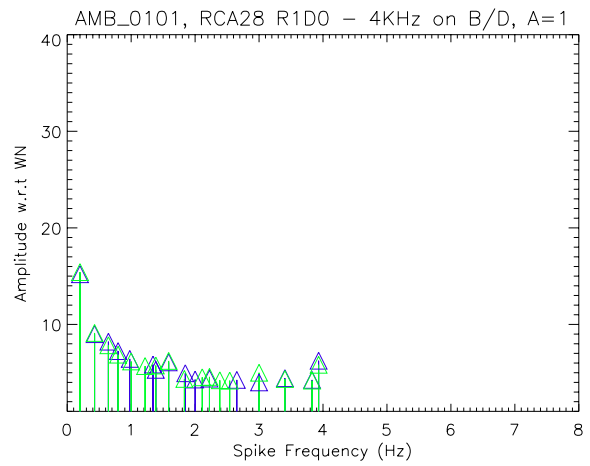
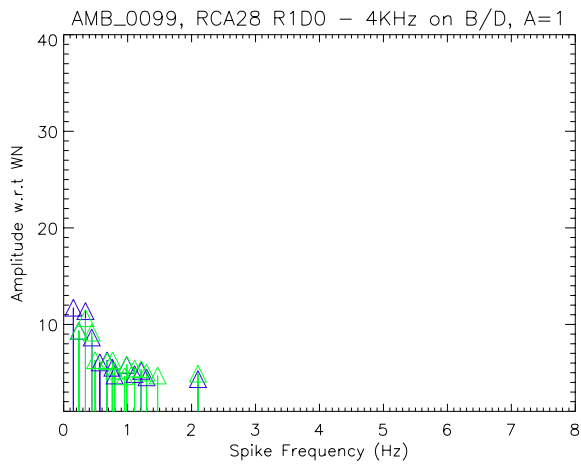
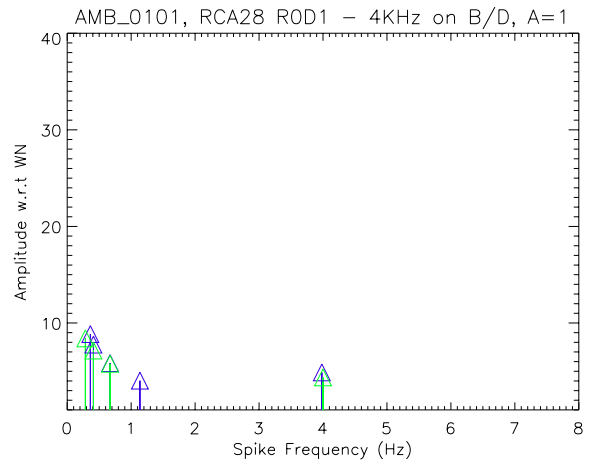
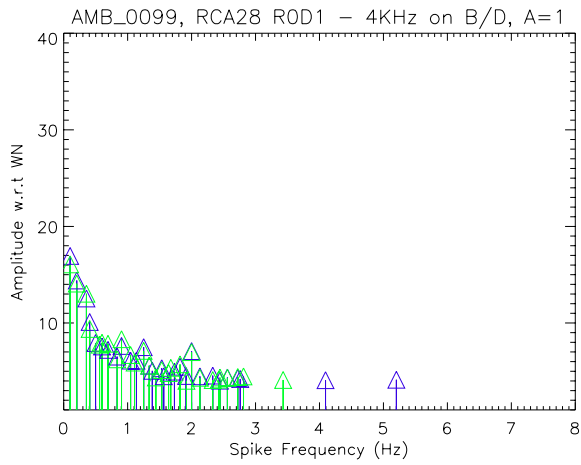
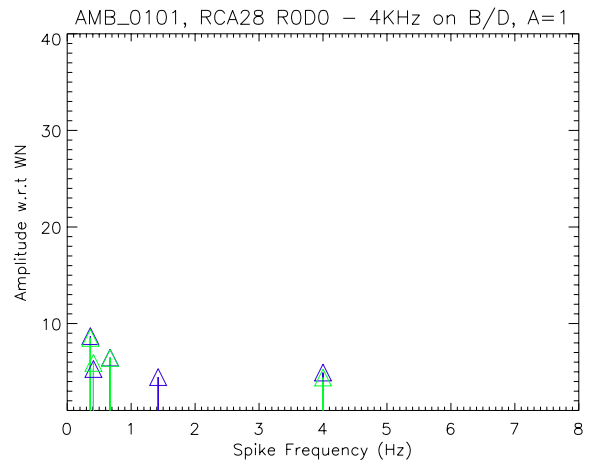
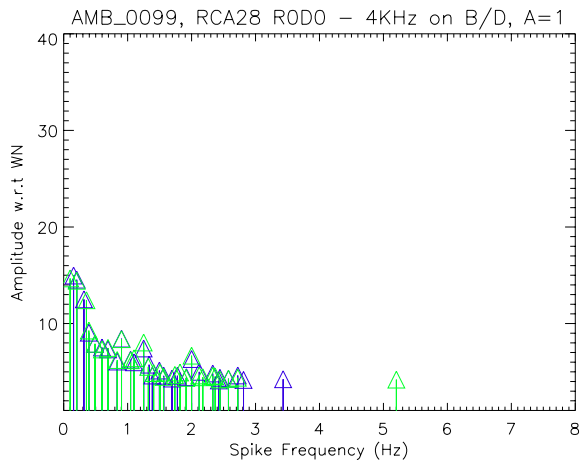












**SFT in Cannes vs WFT in Milan**  
**(300 sec)**

