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Report on the B23 bread-board Prototype Integration @ESO for optical warm tests

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4 Acronyms

FH	Feed Horn
OMT	Ortho Mode Transducer
LNA	Low Noise Amplifiers





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6 Introduction and scope

The scope of the breadboard B23 prototype is to setup the optical chain (OMT+FH+Filters+Lens) to perform beam measurements to provide a full assessment of the extended frequency range technical capabilities to demonstrate the feasibility of the development of B23 cartridge for ALMA.

On November 2015 the breadboard was integrated and setup to perform warm beam tests with the beam scanner at ESO.

The pre-integration @ INAF and the integration @ESO was under the responsibility of INAF/IASF-bologna.

The iALMA-TEC-ICD-IAB-001-H [AD1] interface control document reports all the information about the entire prototype system, including design solutions and configurations.

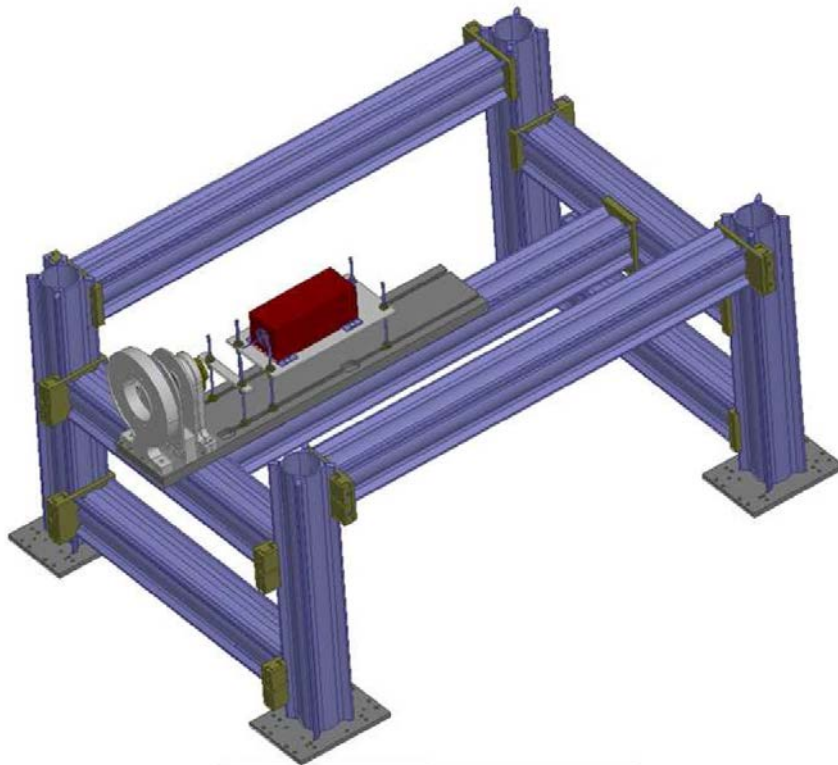


Figure 1. Overview of the system as specified in the ICD

7 Units Acceptance Reports

Units were received at INAF/IASF-bologna to check for integrations and to deliver it to ESO together with other parts hereafter listed:

- Feed horn + OMT (INAF)
- 15 K filter (ESO)
- 110 K filter (ESO)
- Lens (UCHILE)

7.1 Feed horn and Orthomode Transducer

We received the FH and OMT from INAF/OAA (Arcetri) already integrated together. Measured performances are reported in [RD1]. Electromagnetic design and drawings are reported in [RD2] and [RD3]

7.2 Filters

15K filters and 110K filters were received from ESO on September 2015. Only visual inspection was performed demonstrating that the units arrived as expected.



Figure 2. 15K filter as received at INAF/IASF-Bologna

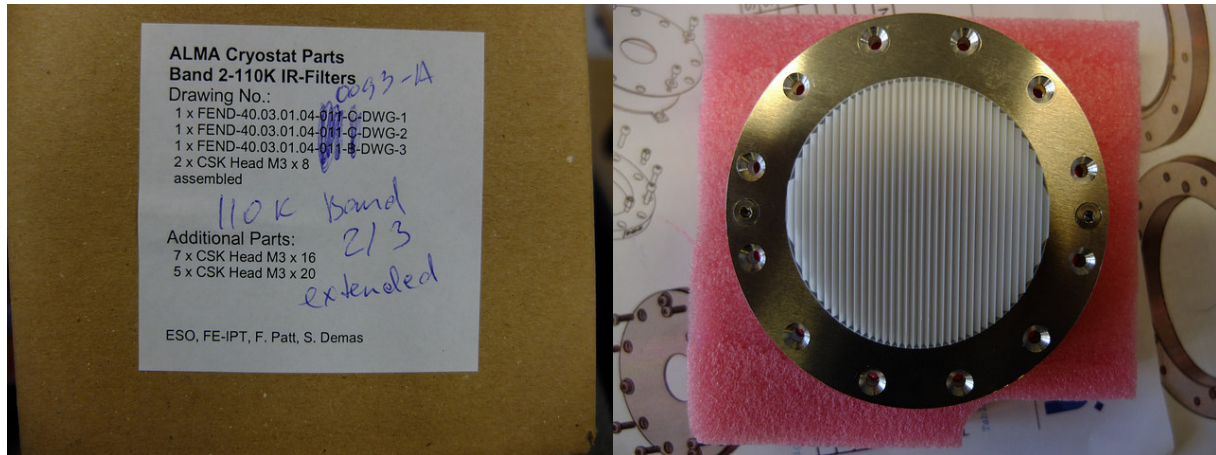


Figure 3. 110K filter as received at INAF/IASF-Bologna

7.3 Lens

The Lens unit (including holder) was received from University of Chile.

Only visual inspection was performed, demonstrating that the units was as expected without any damage. The lens profile was not measured at INAF.



Figure 4. Lens and holder as received @INAF/IASF-Bologna

7.4 Baseplate and supports

Baseplate and support were manufactured in INAF, at IASF-Bologna and IAPS-Rome. According with [AD1], the following item were provided by INAF:

- Baseplate Case-Holder
- base
- S1 Lens support frame
- S2 110K filter support frame
- S3 15K filter support frame

- S2-S3 spacer
- S4 Feed horn support frame
- Base
- S5 cryo chain support frame
- S6 down converter support frame

7.4.1 Baseplate Case-holder

The case-holder is constituted by standard commercial structure from Newport (<http://www.newport.com/>), as described in [AD1].

7.4.2 Base

The manufacturing of the base was started at INAF/IASF-BO, and completed at INAF/IAPS Rome. Figure 5 reports the check of the holes positions that was performed on the base.

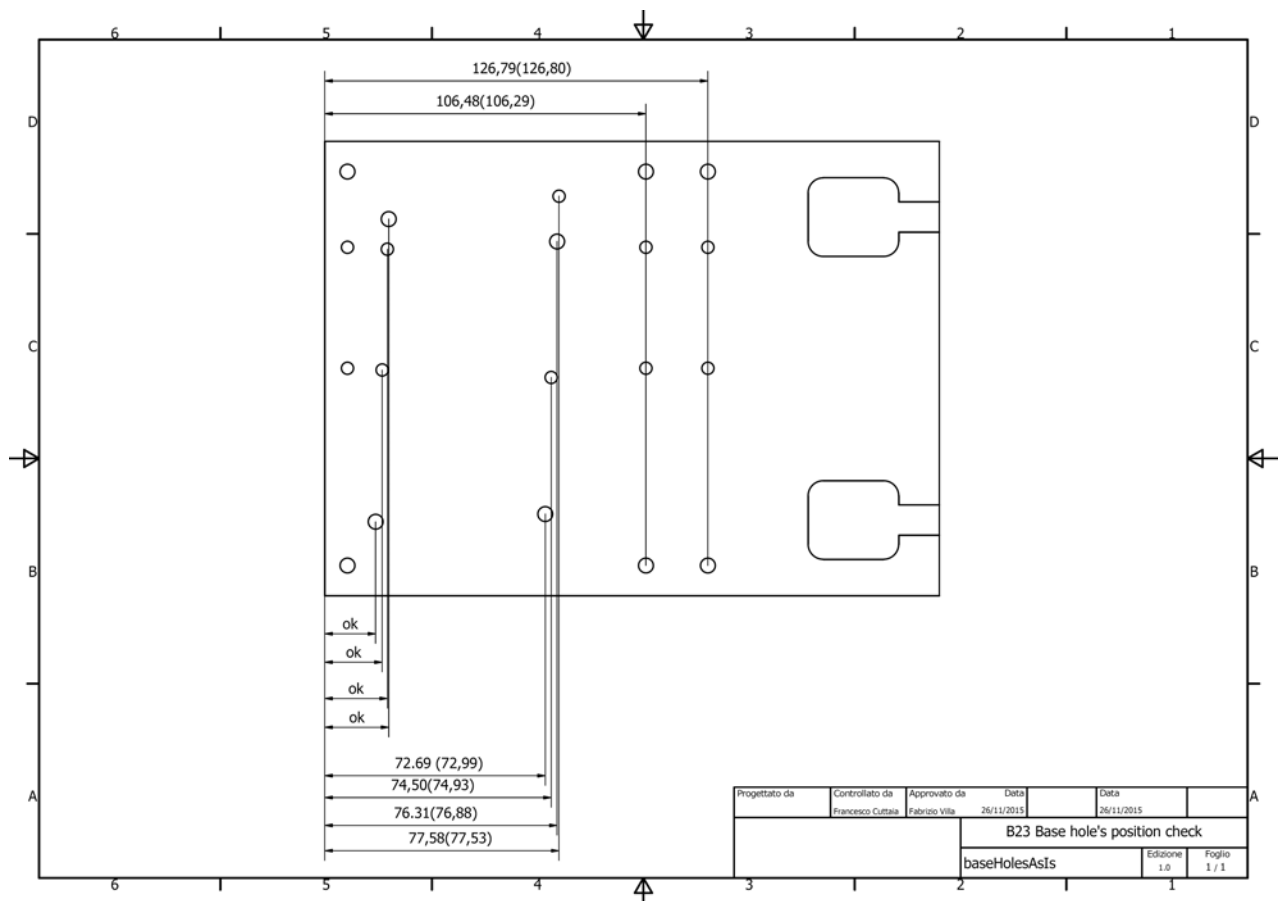


Figure 5. Check of the holes positions on the base

7.4.3 Filter's supports

Filter's support, namely S2 and S3 together with the spacer was manufactured by INAF/IAPS.

7.4.4 Horn support (S4)

Horn support was manufactured by INAF/IAPS.

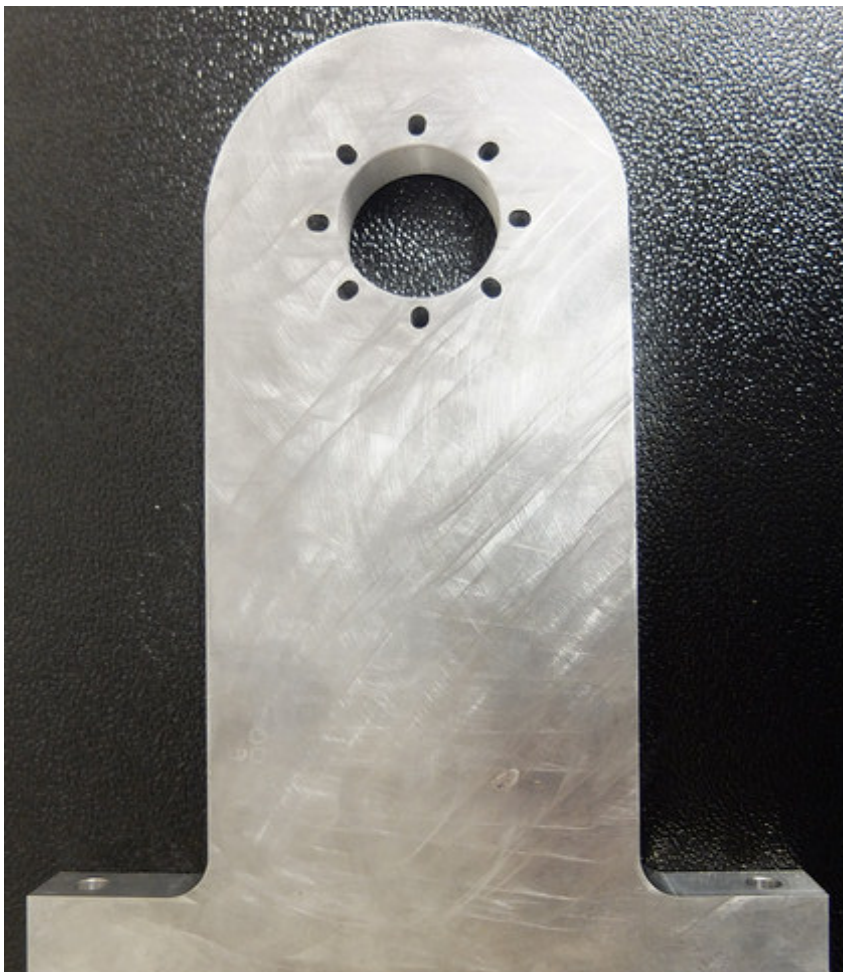


Figure 6. Horn support S4

As seen in Figure 7 the support was received with small damages probably occurred during transportation. The damages were repaired with a file especially on the bottom face where the support is mounted on the base.

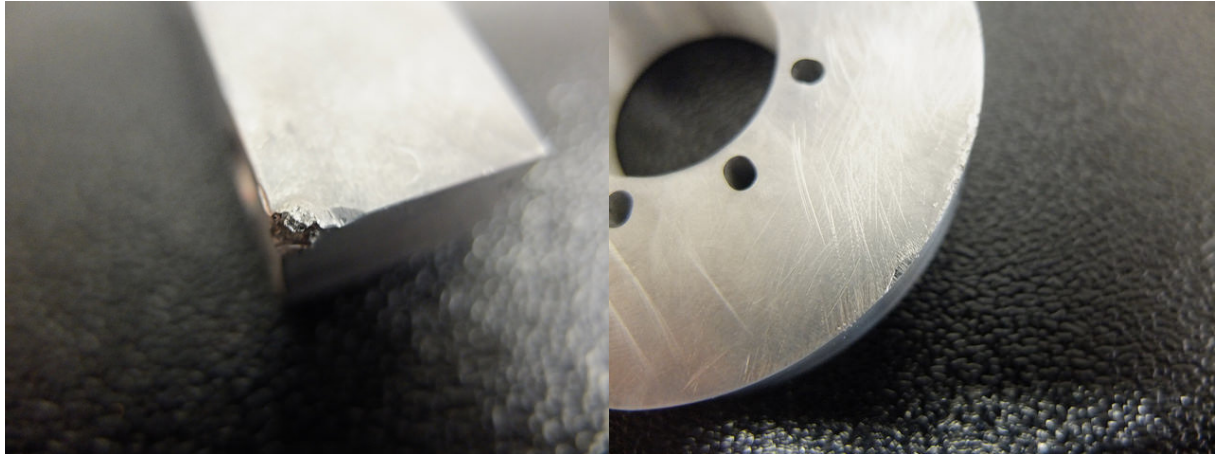


Figure 7. Damages of the S4

8 Pre-Integration @ INAF/IASF-Bologna

All the units were pre-integrated @ INAF/IASF with the aim to identify criticalities and to identify all the tools and screws and the sequence for the integration process for all the system.

Unit	Support	Notes	Actions	Stauts
INAF Feed+OMT	S4	Missing alignment pin	To manufacture the pin	Done
Lens	S1	-	N/A	N/A
110 K filter	S2	Interference between the filter and the support	To verify dimensions; to inform ESO	Plastic spacer manufactured
15 K filter	S3	-	N/A	N/A

Concerning the interference between the 110 filter and the support S4 (see Figure 8), the ICDs and manufacturing drawings were checked. After that it was found that the interference was due to an inconsistency between the filter manufacturing drawings and the interface control drawings of the filter itself. In particular the support frame hole has diameter 50 mm as whilst the plastic part of the filter has diameter 60 mm together with the total thickness of the filter (10.65 mm) that is to large compared with the thickness of the clamp (2 mm in its smaller dimension)

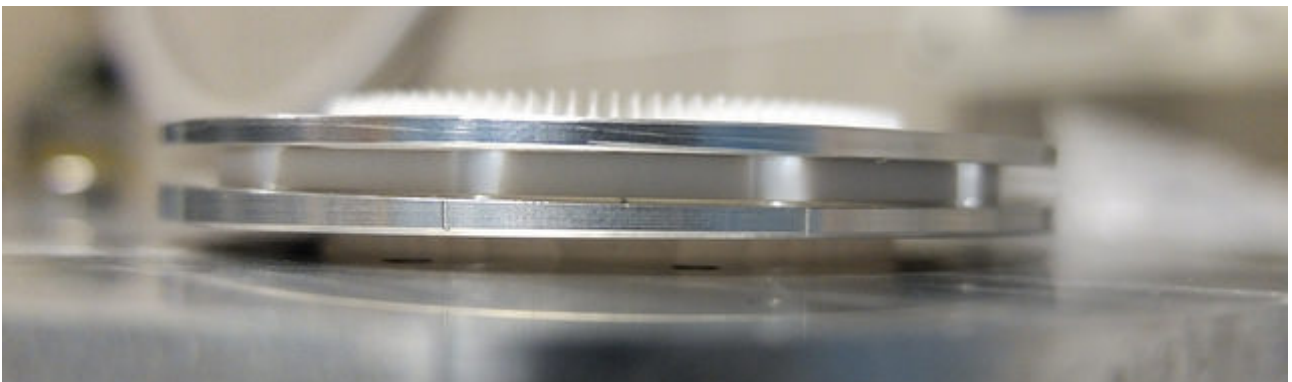


Figure 8. Picture showing the mechanical interference of the 110K filter with the support due to the filter diameter.

To permit the filter mounting, a dedicated spacer was manufactured in plastic. In this way, the filter can be mount on the support but the filter location is not nominal.

8.1 Integration procedure

An integration procedure was set and hereafter reported as reference.

WTP integration procedure on case holder:

The BASE is supposed already installed and positioned on the case holder.

step	action
1	Mount the 15 K filter on S3 (S3 should be alone and not integrated)
	In the case of INAF feed+OMT the filter will NOT be installed
2	Mount S2 + spacer on the BASE, using pins 10 mm long on the left side and 16mm long on the right side (as seen from front)
3	Mount S3 on the S2+spacer unit. 4 screws M6 and 4 nylon washers
4	Attach the INAF horn + OMT on S4 using 7 screws M3x20 + 1 3.5 diameter pin H8
5	Attach the S4 support to the BASE using 2 screws M6 x 25 mm taking care of the fact that the support + horn + OMT is not balanced
6	Mount the 110 K filter on the S2 support with the plastic spacer ring to avoid interference
7	Mount the lens on S1, using 12 M4x25 mm screws. The right position of the frame is with the sign on the right of the support as seen by front (see Figure 9).



Figure 9. Lens mounted on S1. See the reference sign on the re right of the support as seen from the front.

9 Delivery of material to ESO

All the material needed was carried to ESO by INAF/IASF bologna on 2nd November 2015. The packing list is hereafter reported:

Packing List 02/11/2015

Materiale Newport (Laser Optronic Srl)

N.	Tipo	
✓ 3	Mod. X95-1	
✓ 8	Mod X95-0.64	
✓ 4	Mod X-95-EP	Box 9
✓ 4	Mod M-PBN16	Box 9
✓ 14	Mod CX95A	Box 9
✓ 2	M-CXL95-120	Box 9

Materiale a microonde (D.S.P.M. Telecomunicazioi):

N.	Tipo	
✓ 2	MI-WAVE 580W/387 (WR10 waveguide termination)	Box 1
✓ 1	MI-WAVE 115W/387 (WR10 waveguide isolator)	Box 1
✓ 1	MI-WAVE 690W-2.44/387 (WR10 waveguide straight section)	Box 1

Materiale iALMA INAF

N.	Tipo	
✓ 1	B23 OMT	Box 1
✓ 1	B23 Feed Horn	Box 1
✓ 1	Warm Base Plate	
✓ 1	Support S1	Box 6
✓ 1	Support S2	Box 6
✓ 1	Support S3	Box 6
✓ 1	Support S4	Box 6
✓ 1	Spacer S2-S3	Box 6
✓ 1	Downconverter plate	Box 6
✓ 1	Isolator plate	Box 6
✓ 6	M6 bar	
✓ 2	Low Noise Amplifiers + wiring + screws + ...	Box 1

Materiale ESO

N.	Tipo	
✓ 1	15K Filter + holder + screws	Box 1
✓ 1	110K Filter + holder + screws	Box 1

Materiale Uchile

✓ 1	B23 Lens + holder	Box 1
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Materiale National Instrument

N.	Tipo	
✓ 1	Electronics for LNA bias NI PXIe-1071	Box 5
1		
1		
1		

Utensili

N.	Tipo	
1	Tools box	Box 2
✓ 2	Eccosorb	Box 8
1	Chiave dinamometrica	
✓ 1	Screws box	Box 3
✓ 1	Tappetino antistatico	
1	Multimeter Philips	Box 4
1	Etichettatrice	

10 Integration @ESO

On 3rd of November 2015 the integration of the system started @ESO RF laboratory.

Due to the actual available space on the optical bench at ESO, the layout of the Newport structure was modified as in Figure 10 using 60cm rails instead of 100 cm rails. Even if modified, the structure resulted strong enough to proceed with the integration.

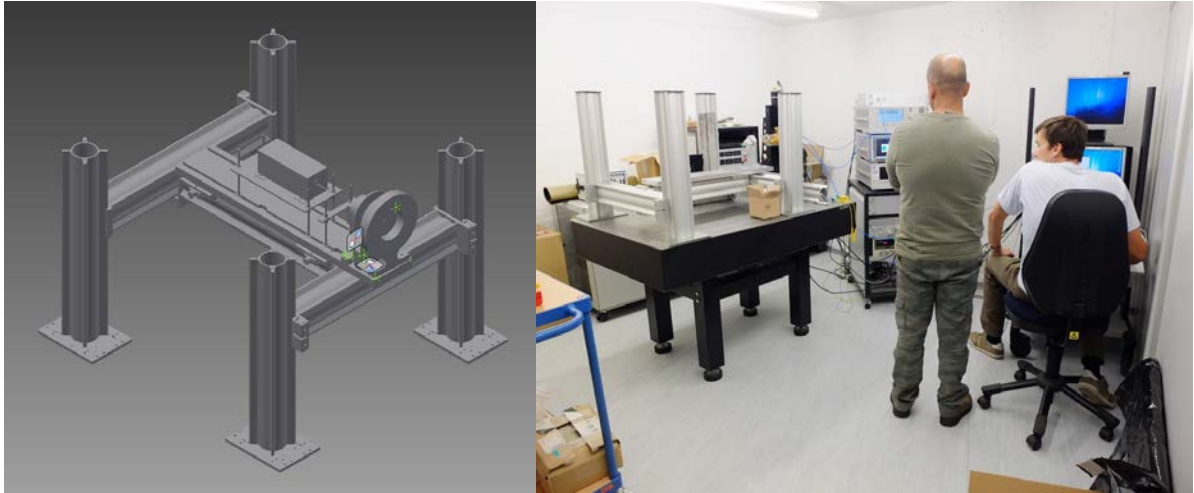


Figure 10. The layout of the Newport structure as mounted at ESO

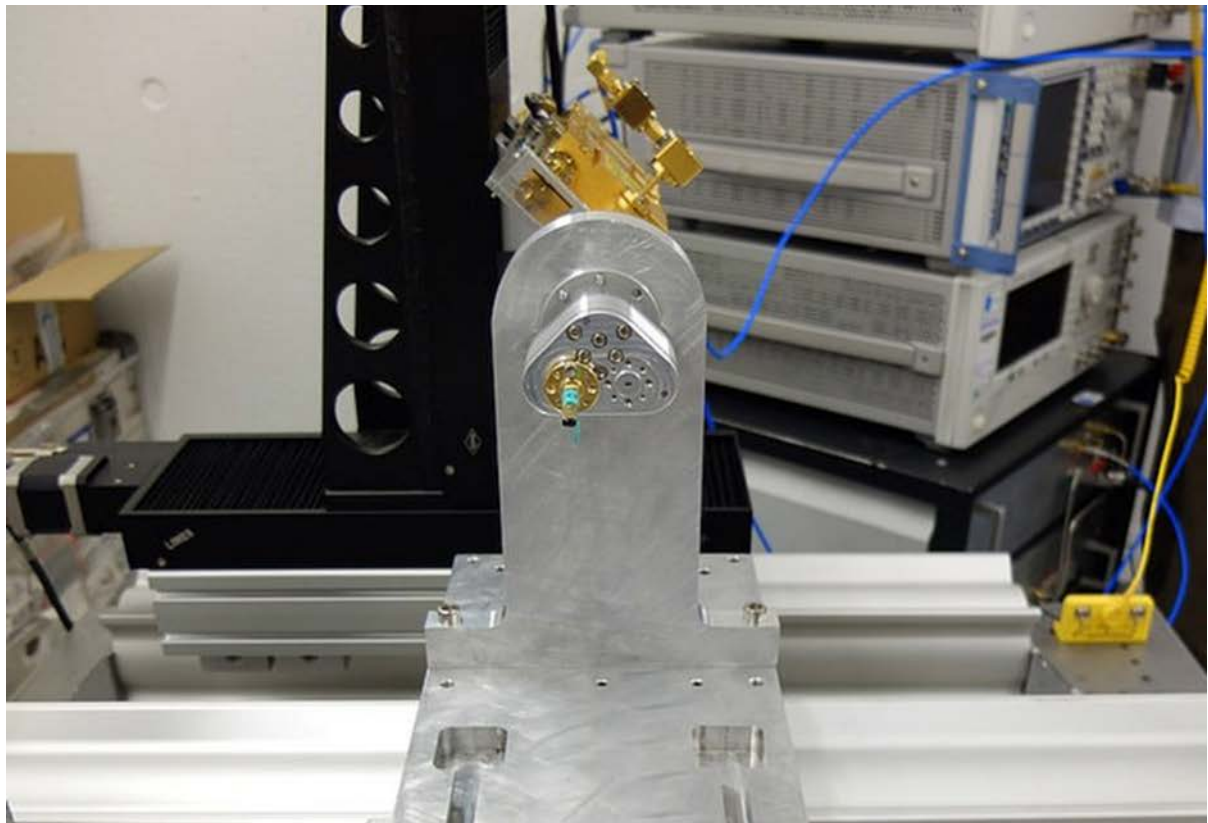


Figure 11. INAF feedhorn and OMT mounted on S4 and positioned in front of the beam scanner

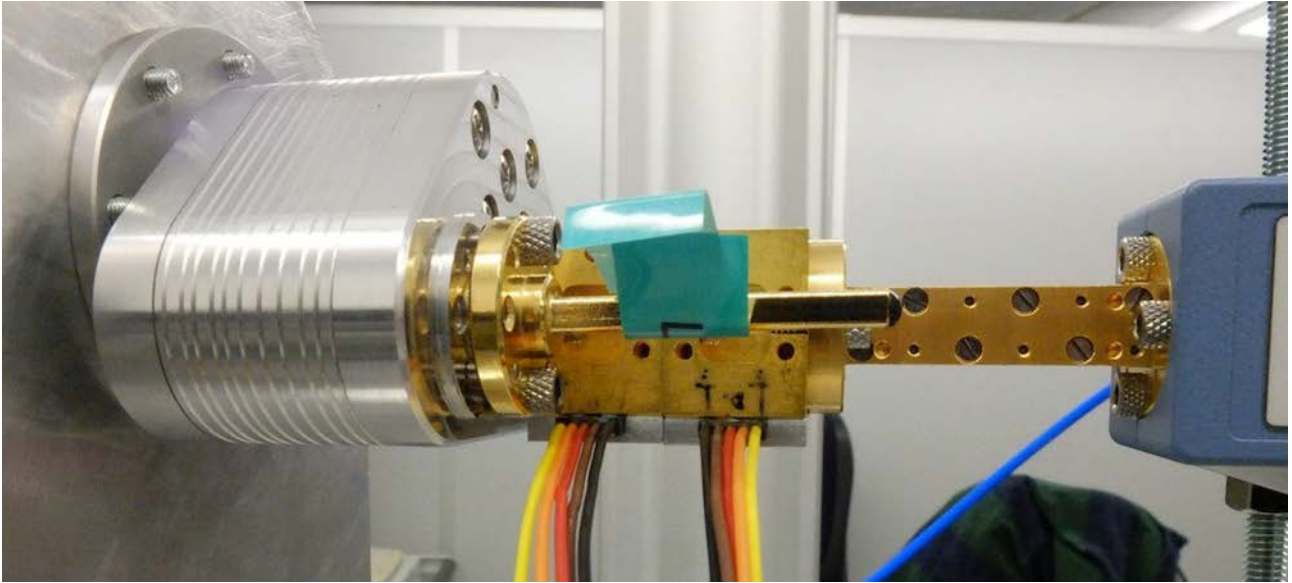


Figure 12. LNAs installed after the INAF OMT

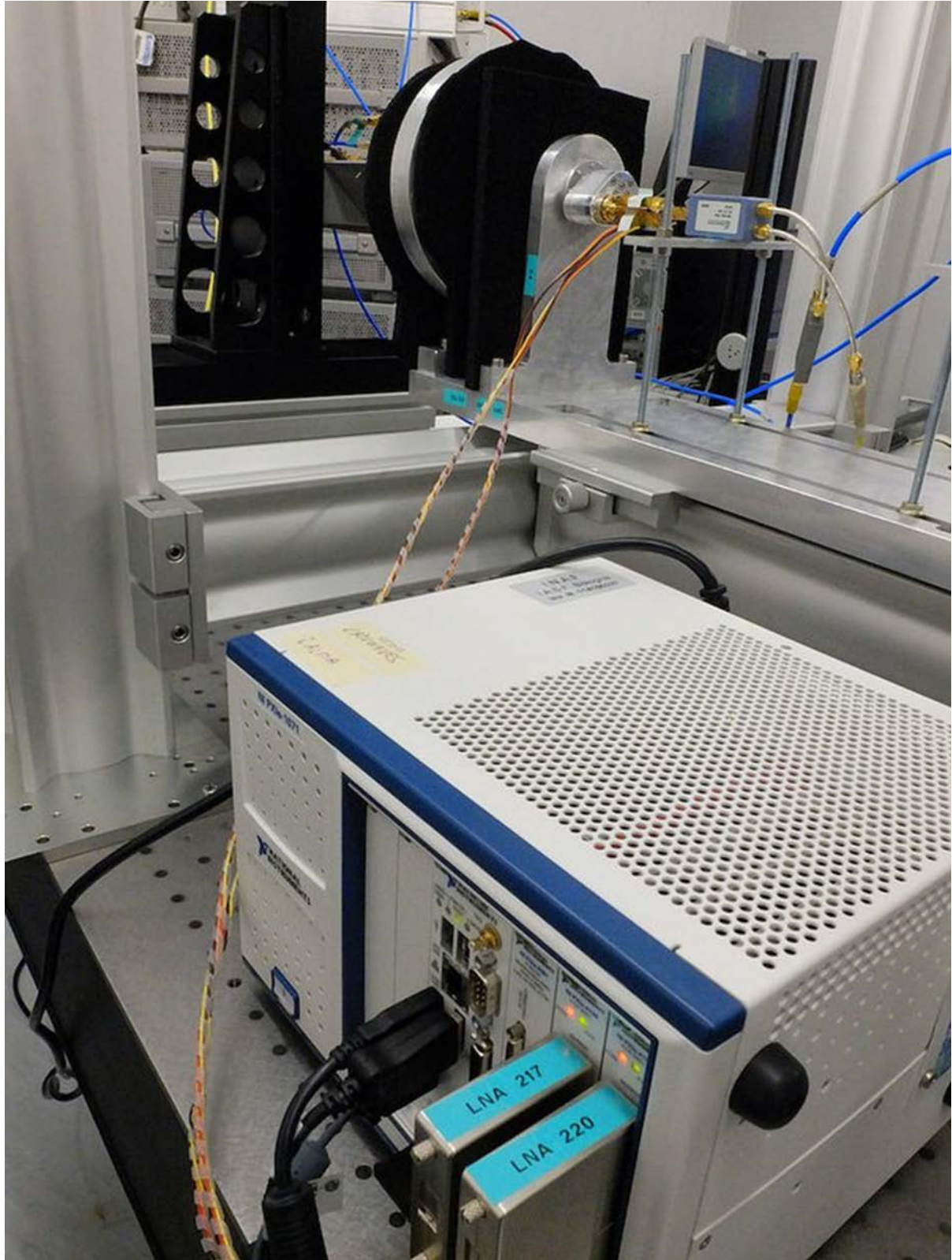


Figure 13. Electronics unit for LNA biases

The integration at ESO was completed in 2 days including the connection of the LNAs and relative bias electronics, the geed+OMT, the lens and the filters on supports. Moreover, the plate to support the downconversion unit was installed. As a check of the system (including beam scanner) a preliminary feed horn pattern + Lens was acquired whit the configuration as shown in Figure 14.

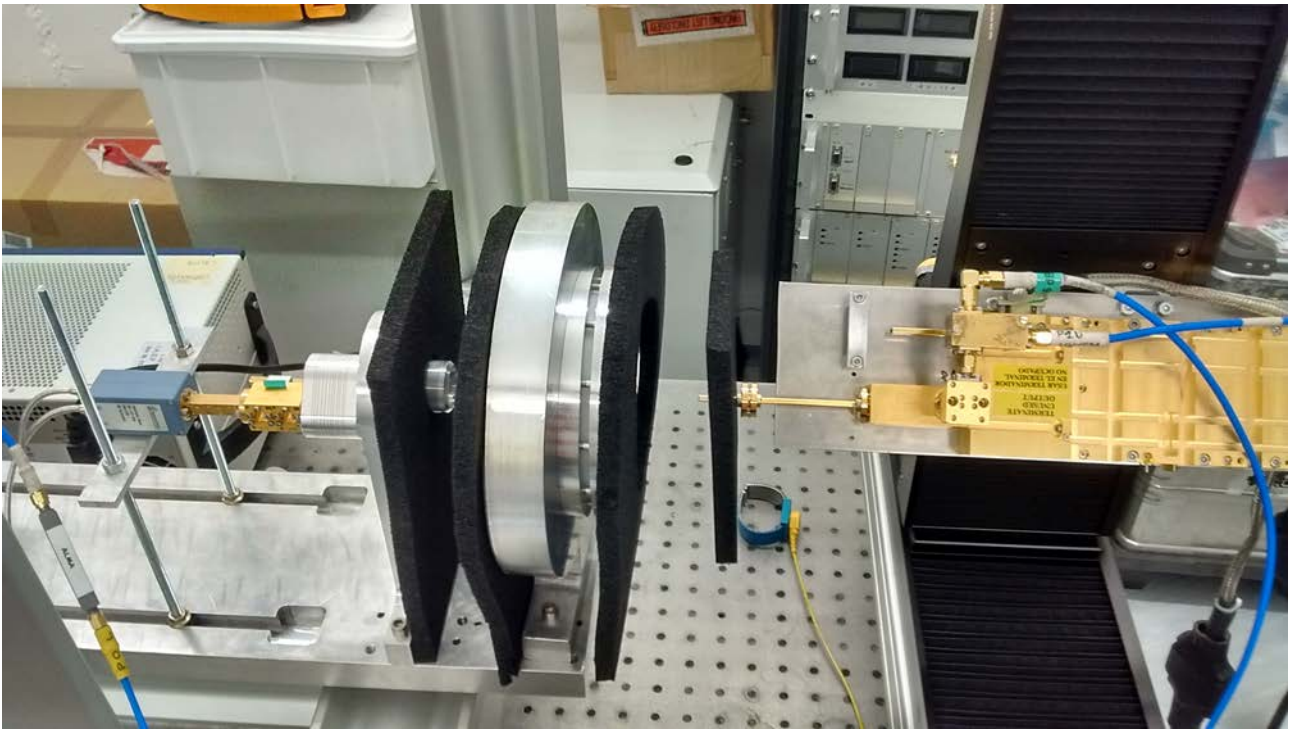


Figure 14. Configuration for the preliminary beam measurements to check the system

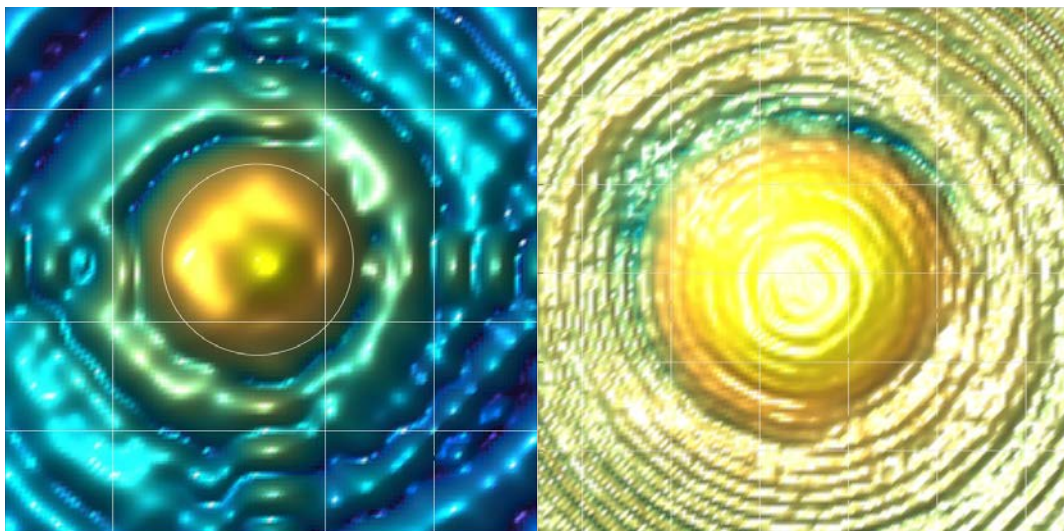


Figure 15. qualitative plots for the near filed (left) and far field patterns at 93GHz

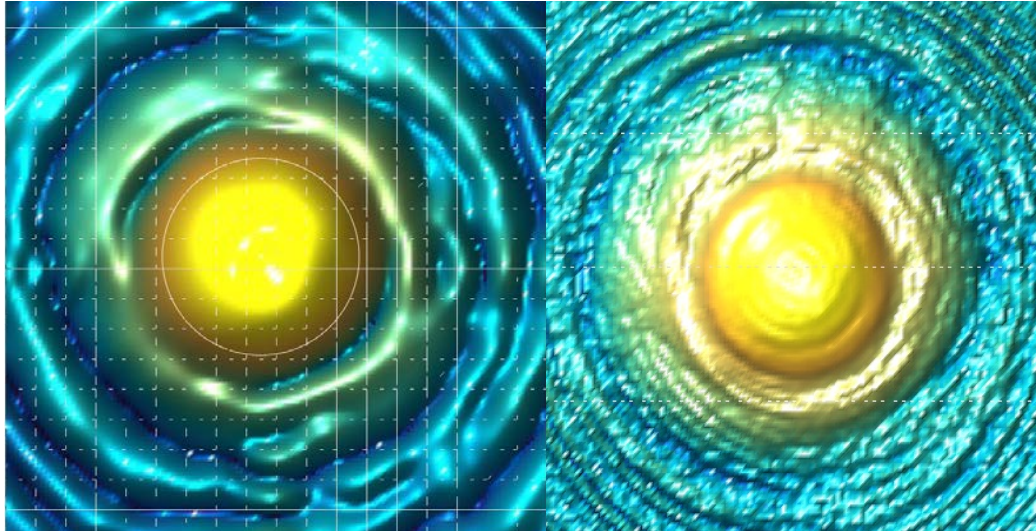


Figure 16. qualitative plots for the near field (left) and far field patterns at 110GHz

The qualitative results as shown in Figure 15 and Figure 16, demonstrated the capability to proceed with the next step of the activity, i.e. the optimization of the setup and the start of the test campaign.

END OF THE DOCUMENT