Report on the third and last run of the ESO LP 182.D-0356 (HARPS@3.6m)

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EXECUTIVE SUMMARY.

The ESO Large Programme 182.D-0356 ended with the two runs of December 2009 with the HARPS instrument at the 3.6m ESO telescope. The log of these observations, the problems encountered and solved in the spectra reduction, some tips, the situation of the publications, and a look to the future are given. The following actions/items are emphasized:

1. All the 15 nights were characterized by excellent weather. The targets related to the CoRoT run LRa03 were observed. The observers made an excellent work and the survey of the CoRoT field was performed exactly how expected;
2. Long timeseries are available for LPV analysis on the hybrid δ Sct-γ Dor star HD 44195 and on the SPB star HD 43317. Other stars have been observed less frequently, but always as requested by the respective PIs ;
3. The spectra have been fully reduced. The problem of the continuous oscillations produced by the HARPS pipeline has been definitely solved.

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1. Introduction

The ground–based spectroscopic monitoring of the CoRoT targets continued in December 2009. Two sites were involved: European Southern Observatory (La Silla, Chile; HARPS@3.6m) and Mercator telescope (Canary Islands; HERMES@MERCATOR). There will be neither OHP and NOT (proposals not accepted) nor FOCES (decommissioned instrument) runs.

Unfortunately, the weather was horrible in the period from December 14 to 24, 2009, in the Canary Islands and no useful spectrum (actually, photon ...) could be taken in the equivalent time of 6 additional nights scheduled at the HERMES instrument.

As in the previous cases, the goals of this seventh (the third of the HARPS series) internal report are to circulate useful information about the ESO observations within the team and to keep the record of the observations.

The proposal for a new Large Programme lasting 6 ESO Periods (i.e., three years) was accepted (LP185.D-0056: *Extending the ground-based observations of CoRoT asteroseismic targets*). It has been submitted answering the P85 call in September 2009. The last runs of this LP will be in the ESO P90, i.e., December 2012-January 2013. The next HARPS runs are scheduled from June 12 to 22, 2010 and from July 1 to 6, 2009. Juan Carlos Suarez (IAA, Granada) and Katrien Uytterhoeven (CEA, Saclay) will be the observers. Spectroscopic observations are also scheduled with SOPHIE@OHP (from June 21 to July 3, P.I. P. Mathias) and with HERMES@MERCATOR.

2. Plan of the analyses and publications

Table 1 lists the stars observed in our Large Programmes and belonging to the CoRoT seismo programme. References to the papers already published are given. Table 1 also lists the pending studies, separated into "Papers in preparation" (analysis is finished, results have to be put together) and "Analyses in progress" (no result yet communicated by the responsibles). We also transferred to the ESO archive the reduced FEROS spectra of each target after the publication of the refereed paper, according to the ESO rules on the data obtained in a Large Programme.

The current policy about co-autorship is to include the PIs of the Large Programmes (i.e., P. Amado, P. Mathias, E. Poretti), the observers of the specific star and, if the ESO data are used, M. Rainer, who reduced the ESO spectra for the whole team. The contribution of other instruments (HERCULES, FIES, HERMES, NARVAL, FRESCO,...) should be evaluated case by case. I still remind you of my suggestion: at least one of the above persons will be included in the first positions in the second round of papers, to reward the effort made to support CoRoT photometry with full-reduced ground-based spectroscopy.

Table 1. Targets observed in the framework of the ESO ground–based complementary observations. The responsibles of the analysis of the spectroscopic data are also listed.

Star	Type	Investigators Spectroscopic data	Papers
	Published results		
HD 50747, HD 51106	IR01 - LP 178.D-0361		Dolez et al., 2009, A&A, 506, 159
HD 50844	IR01 - LP 178.D-0361		Poretti et al., 2009, A&A, 506, 85
HD 50846	IR01 - LP 178.D-0361		Desmet et al., 2010, MNRAS, 401, 418
HD 181231	LRc01 - LP 178.D-0361		Neiner et al., 2009, A&A, 506, 143
HD 180642	LRc01 - LP 178.D-0361		Briquet et al., 2009, A&A, 506, 269
HD 50209	LRa01 - LP 178.D-0361		Diago et al., 2009, A&A, 506, 125
HD 49330	LRa01 - LP 178.D-0361		Floquet et al., 2009, A&A, 506, 103
	Papers in preparation		
HD 181555	LRc01 - LP 178.D-0361	L. Mantegazza	Michel et al.
HD 49434 - Paper II	LRa01 - LP 178.D-0361	K. Uytterhoeven	Chapellier et al.
HD 171586	LRc02 - LP 178.D-0361	T. Luftinger	Luftinger et al.
HD 46149	SRa02 - LP 182.D-0356	P. Degroote	Degroote et al.
	Analyses in progress		
HD 49434 - Paper III	LRa01 - LP 178.D-0361	K. Uytterhoeven	Uytterhoeven et al.
HD 172189 - Paper III	LRc02 - LP 178.D-0361	S. Martín	Martín et al.
HD 171834	LRc02 - LP 178.D-0361, LP 182.D-0356	K. Uytterhoeven	
HD 50870	LRa02 - LP 182.D-0356	L. Mantegazza	Mantegazza et al.
HD 51452	LRa02 - LP 182.D-0356	M. Floquet	
HD 51193	LRa02 - LP 182.D-0356	M. Floquet	
HD 174966	SRc01 - LP 182.D-0356	L. Mantegazza	Garcia-Hernandez et al.
HD 174532	SRc02 - LP 182.D-0356	L. Mantegazza	
HD 170580	LRc05 - LP 182.D-0356	C. Aerts	
HD 44195	LRa03 - LP 182.D-0356	E. Poretti	
HD 43317, HD 51756	LRa03, LRa02 - LP 182.D-0356	P. Papics	
HD 51844, HD 49310	LRa02, SRa01 - LP 182.D-0356	M. Hareter	
Red giants	All LPs, not still observed by CoRoT	T. Morel	

3. The ESO observations

The ESO observations performed in December 2009 were related to the LRa03 field. Five stars were observed in the seismo field with CoRoT: HD 44195 (7.56, F0; hybrid γ Dor-δ Sct); HD 43317 (6.6, B3 IV; SPB); HD 43587 (5.71, G0 V; solar-like); HD 43823 (7.38, F2); HD 43913 (7.88, A0). All these stars except for HD 43587 were observed with HARPS. We also monitored other stars belonging to previous CoRoT Runs: HD 51756 (7.2, B0.5, LRa02), HD 46149 (7.6, O8.5, SRa02), HD 49310 (9.1, A0, SRa01), HD 51844 (8.6, F0, LRa02), and HD 50230 (9.0, B3, LRa01). Moreover, we also took one spectrum of the red giants HIP 28485≡HD 40726 (V=7.0), HIP 29526≡HD 42911 (V=7.4), and HIP 29575≡HD 43023 (V=5.8). These stars are suitable targets for a next CoRoT Long Run.

The observing sequence was

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HD 44195 - HD 44195 - HD 43317
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The other stars were observed with the cadence suggested by the respective PIs. In particular, HD 51756 replaced HD 43317 in the sequence once in the night, around meridian.

Exposure times have been set to 700 sec for HD 44195, to 300 sec for HD 43317, and to 500 sec for HD 51756. However, these exposure times were often modified accordingly to the weather conditions (clouds, poor seeing, ...).

The observers were Monica Rainer (INAF-Brera Observatory, 8-18 December, 2009) and Markus Hareter (Vienna University, 25-30 December, 2009). Table 2 reports the logs of both runs. The setup of the HARPS instrument is summarized in the Appendix of the first report of the LP182.D-0356 (Poretti et al., March 2009). We just remind that the instrument must be set in the EGGS mode (i.e., lower resolution mode), corresponding to R=80,000, as measured on the spectra we obtained. As a tip for future observers, it seems that in some cases the HARPS pipeline does not run properly. In particular, it crashes if we request to calculate the radial velocity for a hot star (too few lines). Therefore, when preparing future OBs, the value in the "Target Radial Velocity" keyword has to be set to "99999" for hot stars, so that the pipeline will not calculate the radial velocity value. In case of additional troubles for cool stars, try to solve the problem changing the default value it from "-99999.9" to "-99999" (i.e., without any decimal), or viceversa.

3.1. Instrumental problem in the spectra reduction

In the previous report we described the history of the discovery of spurious "oscillations" in the spectra reduced with the

HARPS pipeline. The cause was individuated in a misalignement of a filter on the path of the flat-fiels lamp. The good news are that the ESO staff (and namely the HARPS instrument scientist, Gaspare Lo Curto) re-ran the complete reduction of the HARPS spectra collected in December 2008, January, June and July 2009. The new spectra were made available to us in early Febraury 2010, and after some positive checks they were distributed to the PIs of the different stars.

3.2. Length of the nights

The nights were about 8^h50^m long. At the declination value of the CoRoT field ($+5°$), the HARPS observations could be performed from -4^h05^m to $+4^h05^m$. At these extreme hour angles the airmass is 2.8, i.e., the critical telescope pointing limit. The CoRoT field could be observed for 8^h00^m, but actually we stayed a bit longer time on the field since the red giants could be observed before the rising of HD 44105 and HD 43317. The night of 8-9 December started at UT 00^h21^m≡ST 00^h52^m and ended at UT 09^h01^m≡ST 9^h31^m.

HD 34816 was observed at the beginning of the night to better define the blaze function (exposure time 120 sec, SNR around 400).

3.3. Weather statistics and technical problems

We had no interruption of the observations due to bad weather. Very minor technical problems occurred. Twenty–minutes were lost at the beginning of the last night due to some difficulties in the switching between HAM and EGGS mode.

Therefore, we practically used the 100% of the awarded time.

3.4. Signal–to–noise ratio evaluation

The SNRs listed in Table 2 are the median values of the SNRs in the region 5802–5825 Å. They have been computed during our reduction taking into account photon noise, readout noise and flat field correction. The smallest SNR values are those of the spectra at the greatest airmasses. At the telescope, the HARPS pipeline provides an estimate of the SNR at three different wavelengths (4500, 5500 and 6500 Å). We still confirm that the SNR values given by the HARPS pipeline at 5500 Å are a little too optimistic, by a factor of 1.25. At the telescope the observer can also estimate the SNR in another way, i.e., by plotting the SNR values in the different orders and taking the maximum values.

4. Backup and filling programs

Sunsets and sunrises almost perfectly bracketed the CoRoT observations in the December nights. Therefore, the observers ran a very limited filling program. In the 10–d run a few spectra of the δ Sct stars X Cae and BR Hyi (P.I. L. Mantegazza) and of the γ Dor stars HD 11462, HD 33331, and HD 40494 (P.I. P. De Cat) were taken at the beginning of the night. In the 5-d run one spectrum of X Cae was taken at the beginning of the first night and only observations of CoRoT stars were performed afterwards.

The backup programme (complementary monitoring of γ Dor stars observed in the framework of multisite campaigns, P.I. P. De Cat) was not used. We remind that both backup and filling programs have to be submitted by the PI 10 days before the observations and then approved by the ESO staff.

Table 2. Log of the observing runs (December 2009) at ESO with the HARPS@3.6m instrument. The number of spectra and the SNR range (values obtained from the reduced spectra) are indicated for every star on each night. Spectra with low SNR have not been counted.

Night Exp. Time (Default)	HD 44195 V=7.6 700 sec	HD 43317 V=6.6 300 sec	HD 51756 V=7.2 500 sec	Other CoRoT targets	Seeing
December 8-9	25 [140-210]	12 [160-235]	1 [205]	HD 46149, HD49310, HIP 28485	0.″8–1.″6
December 9-10	27 [170-215]	14 [175-215]	1 [210]	HD 50230	0.″6–1.″0
December 10-11	27 [165-220]	14 [180-245]	1 [205]		<1.″0
December 11-12	20 [160-260]	10 [150-230]	1 [200]		
December 12-13	26 [150-220]	12 [165-235]	1 [180]	HD 51844, HIP 29575	<1.″0
December 13-14	25 [130-205]	13 [150-235]	1 [185]	HD 43823	<1.″0
December 14-15	26 [170-210]	13 [155-220]	1 [200]		<1.″0
December 15-16	26 [130-220]	13 [130-245]	1 [190]	HD 43913, HIP 29526	0.″5–1.″0
December 16-17	26 [130-210]	15 [130-230]	1 [215]		0.″6–1.″0
December 17-18	29 [170-210]	16 [175-215]	1 [180]	HD 50230, HIP 28485	0.″4–0.″8
December 25-26	24 [140-220]	11 [160-220]	1 [195]	HD 49310	0.″5–1.″5 >1.″5 for 1 hour
December 26-27	26 [170-230]	12 [190-225]	1 [190]	HD 51844	0.″5–0.″7
December 27-28	26 [160-235]	12 [145-215]	1 [205]	HD 49310	0.″7–1.″4
December 28-29	26 [140-220]	11 [150-220]	1 [190]	HD 46149, HD 51844	0.″7–1.″6
December 29-30	28 [170-230]	13 [175-210]	1 [185]	HD 51844	<0.″8
Total	**387**	**191**	**15**		