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

E. Poretti, M. Rainer, and T. Semaan

Seismology Ground-Based Observation Working Group

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EXECUTIVE SUMMARY.

After the completion of the ESO Large Programme 178.D-0361 with the FEROS instrument at the 2.2m ESO/MPI telescope, the ground–based spectroscopic observations related to the new ESO Large Programme 182.D-0356 are started with the HARPS instrument at the 3.6m ESO telescope in December 2008 and January 2009. The log of the these observations, some tips, the situation of the data analysis of the FEROS spectra 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 LRa2 were observed. The observers made an excellent work and the survey of the CoRoT field has been performed exactly how expected;
2. The spectra have been fully reduced. Long timeseries are available for LPV analysis on the Be stars HD 51452 and HD 51193, and on the δ Sct star HD 50870. The short–period variable SX Phe has been observed at the beginning of the December nights as a filling program;
3. Several papers based on the FEROS observations have been submitted.

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1. Introduction

The ground–based spectroscopic monitoring of the CoRoT targets continued in December 2008 and January 2009. Three sites have been involved: European Southern Observatory (La Silla, Chile; HARPS@3.6m), Observatoire de Haute Provence (France; SOPHIE@1.9m), Calar Alto (Spain; FOCES@2.2m). As in the previous cases, the goals of this fifth (the first 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 next HARPS runs are scheduled from June 20 to 30, 2009 and from July 14 to 19, 2009. Interested observers are kindly requested to inform E. Poretti. The selection, also considering OHP and CAHA runs, has to be done before April 20th. The OHP runs are scheduled from 4 to 10 July and from 28 July to 3 August. The CAHA run (the last one, because the FOCES instrument will be not available after the end of October) is scheduled from June 12 to 16 (a second proposal asking for nights in July has been submitted). We can also count on 4 nights from June 30 to July 4 with the FIES instrument mounted at the NOT.

2. The previous spectroscopic observations and the related papers

Table 1 updates the list of the observed targets and the (chair)persons at work on the specific stars. After the First CoRoT International Symposium (Paris, February 2–5, 2009), many papers have been prepared and submitted for the A&A special feature. Two different strategies have been used to present the CoRoT results: the ground–based and space observations are analyzed either together (papers on HD 50844, HD 50846, HD 50209, HD 51146+HD50747, and HD 181231), or separately (papers on HD 49330 and HD 180642). The first paper on HD 49434 (Uytterhoeven et al., 2008) discussed only the preparatory photometry and spectroscopy; the new spectroscopic data and the CoRoT timeseries are the subjects of ongoing analyses.

The co-authorship policy has not been discussed in details, but we have probably found a satisfactory solution in the practice. The current procedure 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. Since the targets are selected on the basis of the instrumental performances, my feeling is that the PIs should be included even if not all the instruments have been used for the specific observations. The contribution of other instruments (HERCULES, FIES, NARVAL, FRESCO,...) should be evaluated case by case.

3. The spectroscopic data of stars observed in December 2008 and January 2009

Three targets have been selected for the spectroscopic observations with HARPS: the δ Sct variable HD 50870 and the two Be stars HD 51452 and HD 51193≡V746 Mon. The two Be stars were also observed at OHP, but we had only two full clear nights and partial observations on other few nights. We collected 52 and 53 spectra on HD 51193 and HD 51452, respectively. The new δ Sct star HD 49294 (discovered by CoRoT) was observed at CAHA. We had very bad weather in Calar Alto, too. We got three nights with useful data (67 spectra) in December and one in January (19 spectra), which in turn means around 25% and 10% of the awarded time.

4. The ESO observations

The weather in this first HARPS run was excellent, with 100% of good weather and no time lost due to technical reasons. The observers were Monica Rainer (INAF-Brera Observatory, 14–24 December, 2008) and Thierry Semaan (Meudon Observatory, 2-7 January, 2009). Table 2 reports the logs of both runs. The setup of the HARPS instrument is summarized in the Observing Block listed in the Appendix at the end of this report. Note in particular the Fast Readout Mode. There is no Atmospheric Dispersion Corrector.

The spectra collected at ESO have been fully reduced by M. Rainer. No public pipeline is available for HARPS and therefore the FEROS approach has been modified to be adapted to the HARPS spectra. For each star observed with HARPS we provide both the calibrated and normalized merged spectra. The spectra have been made available to the responsibles and, upon request, they could be sent to all interested CoIs.

We remind that the instrument must be set in the EGGS mode (i.e., lower resolution mode). Since August 20$^{\rm th}$, 2008 the EGGS reference fiber is damaged and does not transmit light. Therefore, no sky spectrum is acquired. An error message appears during some of the standard calibrations at the beginning of the night, owing to the fact that the system tries to acquire a calibration lamp using the damaged fiber. There is no reason to worry about it because these calibrations will not be used anyway in the reduction. In the EGGS configuration the use of the second fiber was limited to the sky subtraction, therefore it does not affect the precision in the radial velocity measurements. The remaining fiber (the science fiber) is performing as expected. The EGGS resolution is R=80,000, as measured on the spectra we obtained.

The HARPS on-line pipeline has been modified by ESO staff to process smoothly all the data coming from the new configuration. The results are given as monodimensional merged and calibrated spectra. We do not use these spectra, but we reduced again the data to have both unmerged and merged calibrated and normalized spectra.

4.1. Observing cycle

Exposure times have been set to 1200 sec for HD 50870, and to 600 sec for HD 51452 and HD 51193. The observing sequence was

```
HD 50870 - HD 51452 - HD 50870  - HD 51193 -
HD 50870 - ...
```

The above sequence lasted 70 min, thus ensuring 7–8 cycles per night. Both observers have been very clever in following the cycle and adapting it to the particular circumstances, as in case of observations at large airmass. Moving from one target to the next requires about 2 min. Overheads for focusing are confirmed to be around 7 min. HD 34816 was observed at the beginning of the night to better define the blaze function (exposure time: 30 sec).

4.2. Length of the nights

The nights were about 8^h50^m long. At the declination value of the CoRoT field (-3°), the HARPS observations could be performed from -4^h25^m to $+4^h25^m$. 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 in December and for 8^h35^m in January. The night of 19-20 December started at UT 00^h08^m≡ST 01^h21^m and ended at UT 08^h52^m≡ST 10^h06^m. The night of 6-7 January started at UT 00^h23^m≡ST 02^h51^m and ended at UT 09^h05^m≡ST 11^h34^m.

4.3. Weather statistics

We had no interruption of the observations due to bad weather or technical reasons. Therefore, we used the 100% of the awarded time.

4.4. Signal–to–noise ratio evaluation

The SNRs listed in Tab. 2 are the median values of the SNRs in the region 5805–5825 Å. They have been computed during our reduction taking into account photon noise, readout noise and flat field correction. At the telescope, the HARPS pipeline provides an estimate of the SNR at three different wavelengths or the observer can estimated it by plotting the SNR values in the different orders and taking the maximum values. In both cases our measured SNRs are about 0.8 times smaller than the values obtained from the reduction process at the telescope.

5. Backup and filling programs

Sunsets and sunrises almost perfectly bracketed the CoRoT observations in the December and January nights. Therefore, a very limited filling program was added to the nights of the first 10–d run only. SX Phe (P.I. E. Poretti) was observed for 60–70 min at the beginning of each night. In January, after the standard calibrations and the spectrum of the blaze star, it was immediately possible to point the CoRoT field. The backup programme 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 1. Targets observed in the framework of the ESO ground–based complementary observations (LP 178.D-0361 with the FEROS intrument at the 2.2m ESO/MPI telescope). The responsible(s) of the analysis of the spectroscopic data are also listed.

Star	Type	Investigators Spectroscopic data	Papers
		Initial Run	
HD 50747, HD 51106	Am, SB2	Dolez	Submitted to A&A (Dolez et al.)
HD 50844	δ Sct	Mantegazza	Submitted to A&A (Poretti et al.)
HD 50846	Be, EB	Fremat and Desmet	To be submitted to MNRAS (Desmet et al.)
HD 292790	F8	Poretti	Just one spectrum
		Long run center direction (LRc1)	
HD 180642	β Cep	Briquet and Uytterhoeven	Submitted to A&A (Briquet et al.)
HD 181555	δ Sct	Mantegazza, Rainer and Zima	
HD 181231	Be	Neiner	Submitted to A&A (Neiner et al.)
		Long run anticenter direction (LRa1)	
HD 49434	γ Dor	Uytterhoeven (Dec. 2006-Jan. 2007)	Uytterhoeven et al., 2008, A&A 489, 1213
HD 49434	γ Dor	Mathias (Dec. 2007-Jan. 2008)	
HD 50209	Be	Floquet and Hubert	Submitted to A&A (Diago et al.)
HD 49330	Be	Hubert	Submitted to A&A (Floquet et al.)
		Long run center direction (LRc2)	
HD 172189	δ Sct, EB, SB2	Martín	
HD 171834	γ Dor	Mathias	
HD 171586	Ap	Weiss	

6. Appendix

Here we list the Observing Block of HD 50870 as saved from the P2PP software. The EGGS configuration with the science fiber only is defined by the `ACQUISITION.TEMPLATE.NAME` keyword. Consecutive exposures can be taken changing the `SEQ.NEXPO` keyword. For other objects, the lines `name, ra, dec, TARGET.NAME, DET1.WIN1.UIT1` must be changed. Note that the exposure time is in the `DET1.WIN1.UIT1` keyword.

```
IMPEX.VERSION "2.0"
type                    "0"
STTimeIntervals         ""
calibrationReq          ""
InstrumentComments      ""
userComments            ""
userPriority            "1"
LineNumber              "0"
name                    "HD50870"


comments                ""
objectClass             " Unknown           "
ra                      " 06:54:56.761"
dec                     "-03:20:21.890"
epoch                   "2000.0"
equinox                 "2000"
propDec                 "0.000000"
propRA                  "0.000000"
diffRA                  "0.000000"
diffDec                 "0.000000"
LineNumber              "0"
TARGET.NAME             "HD50870"
air_mass                        "5.0"
fractional_lunar_illumination "1.0"
sky_transparency                "Photometric"
moon_angular_distance           "30"
seeing                          "2.0"
StrehlRatio                     "0.0"
CONSTRAINT.SET.NAME             "No Name"


longDescription             ""
IPVersion                   "142.22"
instrument                  "HARPS"
LineNumber                  "0"
OBSERVATION.DESCRIPTION.NAME "HD50870"


ACQUISITION.TEMPLATE.NAME "HARPS_eggs_acq_objA"
TEL.TARG.RADVEL     "-99999.9"
DPR.TYPE            "STAR,DARK,F0"



TEMPLATE.NAME "HARPS_eggs_obs_all"
DET1.READ.SPEED    "416kHz,1,high"
DET1.WIN1.UIT1     "1200"
SEQ.NEXPO          "1"
DPR.CATG           "SCIENCE"
```

Table 2. Log of the observing runs (December 2008–January 2009) at ESO with the HARPS@3.6m instrument. The number of spectra and the measured SNR range are indicated for every star on each night.

Night	HD 50870	HD 51452	HD 51193	Seeing	Notes
	V=8.9	V=8.1	V=8.1		
Exp. Time	1200 sec	600 sec	600 sec		
December 14-15	13	7	8	0.″7–1.″4	
	[104-140]	[106-140]	[84-137]		
December 15-16	14	7	6	0.″7–1.″7	
	[120-167]	[121-165]	[117-151]		
December 16-17	13	6	7	0.″6–1.″4	
	[117-163]	[127-161]	[114-150]		
December 17-18	13	7	6	0.″8–1.″1	
	[110-165]	[127-164]	[131-154]		
December 18-19	13	7	7	0.″8–1.″5	
	[106-161]	[135-161]	[104-153]		
December 19-20	13	7	7	0.″6–1.″6	
	[124-174]	[147-172]	[120-160]		
December 20-21	14	6	7	0.″5–1.″2	
	[110-165]	[131-168]	[116-152]		
December 21-22	14	7	7	0.″6–1.″1	
	[107-166]	[125-167]	[133-154]		
December 22-23	15	7	6	0.″7–1.″3	
	[113-170]	[108-173]	[141-158]		
December 23-24	14	7	7	0.″6–1.″4	
	[90-170]	[134-166]	[97-157]		
January 2-3	14	7	7	1.″0–2.″0	Low SNR at beginning of night
	[87-135]	[98-144]	[83-129]		Better seeing (0.″8–1.″0) at end of night
January 3-4	15	8	7	0.″6–1.″3	
	[107-170]	[94-175]	[110-159]		
January 4-5	14	7	8	1.″0–1.″3	
	[95-161]	[93-156]	[83-145]		
January 5-6	15	8	7	0.″8–1.″5	
	[92-163]	[92-162]	[115-153]		
January 6-7	15	7	8	0.″8–1.″3	
	[114-174]	[128-179]	[107-158]		
Total	**209**	**105**	**105**		