Report on the third run of the ESO LP 185.D-0056 (HARPS@3.6m)

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EXECUTIVE SUMMARY.

The ESO Large Programme 185.D-0056 (HARPS@3.6m) continued in June and July 2011, with the first radial velocity survey of red giants. The log of the the observations, the problems encountered, some tips in the use of HARPS in the HAM mode, the situation of the publications, and a look to the future are given. The following actions/items are emphasized:

1. the observations were devoted to the red giants in the open cluster NGC 6633 using the HAM configuraton. A few other CoRoT targets belonging to other pointings were observed;
2. the first 10-nights run had excellent weather conditions, with just one night lost; the second 5-nights run was more disturbed, with only 2 good nights;
3. different filling programmes were run at the beginning and end of night.
4. we had no technical problems and in particular the switch between HAM and EGGS worked properly and rapidly.

1. Introduction

The ground–based spectroscopic monitoring of the CoRoT targets continued in June and July 2011. Two sites have been involved: European Southern Observatory (La Silla, Chile; HARPS@3.6m) and Observatoire de Haute Provence (France; SOPHIE@1.9m).

The next HARPS runs are scheduled from December 17, 2011 to 27, 2011 and from January 7 to 12, 2012. Thierry Morel (Liege University) and Monica Rainer (Brera Observatory) will be the observers. No other observations with other instruments are scheduled, the OHP proposal has not been accepted. We will evaluate the possibility to take complementary spectra from the MERCATOR telescope (HERMES instrument; Canary Islands).

2. Status of publications

Table 1 lists the status of the analyses of the spectroscopic timeseries, and the new attributions as well. New entries with respect to the previous report are highlighted in red. After publication of the results in a refereed journal, the reduced spectra have been made available to the community through the ESO archive (ESO rule for Large Programmes).

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. Moreover, in the second round of papers at least one of the scientists in the ground-based activities will be included in the first positions, to reward the great and long effort made to support CoRoT photometry with high-resolution spectroscopy.

3. The spectroscopic data of stars observed in June and July 2011

The CoRoT observations ran from April 5 to June 30 (LRc07) and from July 6 to early October 2011 (LRc08) in the Center direction. The asteroseismic targets were the same for both runs, i.e., HD 170053 (K2 III, V=7.3), HD 170031 (K5, V=8.2), HD 170231 (K2, V=8.7), HD 170174 (K2, V=8.3), and HD 170200 (B8, V=5.7). All these stars are in the field of the open cluster NGC 6633.

The fact that four stars out of five are red giants (HD 170053, HD 170031, HD 170231, and HD 170174) imposed a change in the observational strategy with respect to previous runs. The sharp lines of these slow rotators are more suitable for the study of the radial velocity variations than of the line profile ones. Therefore, we used HARPS in the HAM (high resolution) configuration, instead of the EGGS (high efficiency) one. The corresponding increase in the exposure times imposed a limit to the number of targets. After a quick look to the CoRoT N0 photometric data (courtesy from Reza Samadi),

we omitted the less promising target HD 170174 from the continuous monitoring.

We had the same problems in the observations scheduled at OHP. We agreed with P. Mathias to observe HD 170031 and HD 170053 in the high–resolution mode with SOPHIE, since otherwise the OHP time series would be dense enough. We observed HD 170031 and HD 170053 from both sites and we could obtain accurate radial velocity curves. The end of night in OHP coincided with the beginning of night in La Silla and the telescopes could point to the same star for 45 minutes. This allowed us to calculate the exact amount of the systematic difference (a few $\mathrm{m\,s^{-1}}$) between the two spectrographs and consequently to improve the quality of the radial-velocity curves.

A few other CoRoT targets were observed at ESO. They are HD 172046 (upon request from P. De Cat), HD 169392AB (from R. Garcia), and HD 169556 (from G. Verner).

3.1. Saving the log of the night and the RV measurements

At the end of night it is possible to save two log-files, i.e., the log of all spectra (spectra_harps) and the list of the radial velocities measured by the pipeline (rv_harps).
To do it, digit

`cd /diska/home/harusr`

in the pipeline computer (whaldrs2). It is advisable to create a subdirectory with your name:

`mkdir yourname`
`cd yourname`

then digit the two commands:

list_spectra_harps yyyy-mm-dd > yyyy-mm-dd_log.vdb
list_rv_harps yyyy-mm-dd > yyyy.mm.dd_rv.vdb

After that, you can ftp the two text files everywhere you like. If you want to see the data of your targets, both raw and reduced, first open a window in the whaldrs2 computer. To do that, in the screen of the HARPS pipeline click with the left button of the mouse outside any window: a small window will then appear; click with the left button of the mouse on `harusr on whaldrs2` and the window of the desired computer will appear. The raw and reduced spectra are in

`/data/raw/yyyy-mm--dd`
`/data/reduced/yyyy-mm-dd`

3.2. The HAM observing blocks

An example of observing block requiring the HAM mode is reported in the Appendix. The Thorium lamp must be put on the second fiber. As in the case of the observation of cold stars in the EGGS mode, Observers are requested to carefully check the value of the `TEL.TARGET.RADVEL` keyword. It must be "−99999". In such a case the HARPS pipeline calculates a very accurate value of the star's radial velocity. Still better, it is recommened to substitute the "−99999" value with the value calculated by the pipeline from the first spectra of the star. We remind that for stars with spectral type earlier than F0, there is no template in the HARPS library and the RV value is not reliable. Often the pipeline crashes. In such a case, but only for hot stars, put "99999" in the `TEL.TARGET.RADVEL` keyword. See also the report of the third run of the LP 182.D-0356.

3.3. Observing cycle

Exposure times have been set to 450 sec for HD 170053 (V=7.3), to 900 sec for HD 170031 (V=8.2), and to 1200 sec for HD 170231 (V=8.7). We achived the goal to get errors not larger than 1 $\mathrm{m\,sec^{-1}}$ (i.e., SNR=150 at 600 nm) on the radial velocity values. To study the line profile variations of HD 170200 (V=5.7) the exposure time was set to 300 sec to get SNR=200 in the blue. All the spectra of these stars were taken in the HAM mode. The exposure times were often modified accordingly to the weather conditions (clouds, poor seeing, ...).

The red giants HD 170053, HD 170031, and HD 170231 were observed in sequence and the observers tried to allocate three spectra per night of HD 170200. As a result, we got 10-11 cycles of the three red giants per night. The other CoRoT targets HD 172046, HD 169566, and HD 169392AB were observed in EGGS mode. This implies that for the first time the observers switched from EGGS to HAM modes during the night. The procedure took 1-2 minutes and worked fine all times but one (15 min lost). As a result, the observers performed 10-11 cycles of the three red giants per (good) night and also completed the survey of other targets as requested.

The calibration star HD 135240 was observed at the beginning of the night both in HAM end EGGS mode to better define the blaze function (HAM exposure time: 300 sec).

3.4. Length of the nights

The observations spanned about 12^h in June and about 11^h30^m in July. At the declination of the CoRoT field (from $+6°$ to $-3°$), the HARPS observations could be performed from -4^h20^m to $+4^h20^m$. At these extreme hour angles the airmass is 2.8, i.e., the critical telescope pointing limit. In the case of the LRc07 pointing ($+6°$), the CoRoT field could be observed for about 8^h in both runs.

3.5. Weather statistics

The observations in the 10-nights run were exceptionally good for the month of June. In the first run we lost 12.25 hours (out of 120) due to bad weather (11.25 hours during the visibility of the CoRoT targets, 1.0 hour during the filling programme).

In the second run we lost three full nights i.e., 34.5 hours (out of 57.5) due to bad weather (24 hours during the visibility of the CoRoT targets, 10.5 hours during the filling programmes).

4. Backup and filling programmes

Other targets have been observed at the beginning and at the end of nights (*filling programme*), strictly following the ESO rules in the submission of these additional targets. We remind that both backup and filling programmes have to be submitted by the PI 10 days before the observations and then approved by the ESO staff. The stars belonging to other accepted proposals are rejected. This occurred for several stars of the backup and filling programmes proposed for the June-July runs.

In addition to HR 6139 (P.I. L. Mantegazza, 5 spectra on 3 nights) and HD 91024 (P.I. C. Aerts, 19 spectra on 9 nights), we observed:

γ Dor and SPB stars (P.I. P. De Cat) – HD 163899 (1 spectrum), HD 91201 (1), HD 73654 (1), HD 112409 (1), HD 155854 (1), HD 224288 (1), HD 138521 (1), HD 133803 (1), HD 85693

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

Star	CoRoT run – ESO LP	Investigators Spectroscopic data	Papers
	Published results		
HD 49434	LRa01 - LP 178.D-0361	Uytterhoeven et al. 2008, A&A, 489, 1213	
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	
HD 46149	SRa02 - LP 182.D-0356	Degroote et al. 2010, A&A, 519, A38	
HD 49434 - Paper II	LRa01 - LP 178.D-0361	Chapellier et al. 2010, A&A, 2011, 525, A23	
HD 51756	LRa02 - LP182.D-0356	Papics et al., 2011, A&A, 528, A123	
CoRoT 101155310	LRc01 - LP 182.D-0356	Poretti et al. 2011, A&A, 528, A147	
	Papers in preparation		
HD 181555	LRc01 - LP 178.D-0361	L. Mantegazza	Michel et al.
HD 171586	LRc02 - LP 178.D-0361	T. Luftinger	Luftinger et al.
HD 172189 - Paper III	LRc02 - LP 178.D-0361	S. Martín	Martín et al.
HD 50870	LRa02 - LP 182.D-0356, LP 185.D-0056	L. Mantegazza	Mantegazza et al.
HD 51193	LRa02 - LP 182.D-0356	J. Gutierrez-Soto	
HD 174966	SRc01 - LP 182.D-0356	L. Mantegazza	Garcia-Hernandez et al.
HD 50230	LRa01 - LP 182.D-0356	P. Degroote	Degroote et al.
	Analyses in progress - Line profile variations		
HD 49434 - Paper III	LRa01 - LP 178.D-0361	K. Uytterhoeven	Uytterhoeven et al.
HD 171834	LRc02 - LP 178.D-0361, LP 182.D-0356	K. Uytterhoeven	
HD 51452	LRa02 - LP 182.D-0356	M. Floquet	
HD 174532	SRc02 - LP 182.D-0356	L. Mantegazza	Fox et al.
HD 170580	LRc05 - LP 182.D-0356, LP185.D-0056	A. Thoul	
HD 44195	LRa03 - LP 182.D-0356	E. Poretti	Poretti et al.
HD 43317	LRa03, LRa02 - LP 182.D-0356	P. Papics	
HD 170699	LRc05, LRc06 - LP 185.D-0056	L. Mantegazza	
HD 170973	LRc05, LRc06 - LP 185.D-0056	Th. Luftinger	
HD 170783	LRc05, LRc06 - LP 185.D-0056	M. Briquet	
HD 171219	LRc05 - LP 185.D-0056	C. Neiner	
HD 41641	LRa05 - LP 185.D-0056	L. Mantegazza	
HD 43285	LRa04 - LP 185.D-0056	C. Neiner	
HD 43338	LRa04 - LP 185.D-0056	Ph. Mathias	
HD 42597	LRa05 - LP 185.D-0056	P. Degroote	
HD 170031, HD 170231	LRc07, LRc08 - LP 185.D-0056	T. Morel, E. Poretti (RV)	
HD170053	LRc07, LRc08 - LP 185.D-0056	T. Morel, E. Poretti (RV)	
HD 170200	LRc07, LRc08 - LP 185.D-0056	P. Degroote	
	Analyses in progress - Binarity and/or physical parameters		
HD 51844, HD 49310	LRa02, SRa01 - LP 182.D-0356	M. Hareter	
Red giants	All LPs, not still observed by CoRoT	T. Morel	
GSC00144-03031	LRa04 - LP 185.D-0056	E. Poretti	Poretti et al.
HD 50890	IRa01 - LP 185.D-0056	Th. Morel	Barban et al.
HD 49566	SRa01 - LP 185.D-0056	Th. Morel	Hekker et al.
HD 43587	LRa03 - LP 185.D-0056	P. Boumier	Boumier et al.
HD 42299	LRa04 - LP 185.D-0056		
HD 42787	LRa04 - LP 185.D-0056	H. Bruntt	
HD 42089	LRa05 - LP 185.D-0056	H. Bruntt	
HD 42618	LRa04, LRa05 - LP 185.D-0056	M. Hall	I. Roxburgh et al.
HD 170174	LRc07, LRc08 - LP 185.D-0056	T. Morel	
HD 172046	LRc02 - LP 185.D-0056	P. De Cat	
HD 169392AB	LRc03 - LP 185.D-0056	H. Bruntt	Garcia et al.
HD 169556	LRc03 - LP 185.D-0056	H. Bruntt	Verner et al.

Table 3. General description of the nights

Night	Seeing DIMM	Lost time: Bad weather	Lost time: Technical Reasons	Notes
June 23-24	0.″5–1.″0			
June 24-25	0.″5–1.″2			
June 25-26	0.″7–1.″5			Thin clouds
June 26-27	0.″5–1.″5			
June 27-28	$\sim$1.″2			Simultaneous observations with OHP
June 28-29	$<$ 0.″8			
June 29-30	0.″4–0.″8		15^{min}	EGGS-HAM switch
June 30-July 1	$\sim$0.″9	5^h30^{min}		Clouds first part of night
July 1-2	$\sim$1.″0			
July 2-3	1.″5–2.″5	6^h45^{min}		Strong wind
July 15-16		12^h30^{min}		Wind, rain
July 16-17		12^h30^{min}		Snow, ice
July 17-18	2.″0			
July 18-19		12^h30^{min}		Clouds
July 19-20	1.″0		20^{min}	Pipeline stall

Table 2. Number of spectra collected in the OHP and ESO runs from May to July 2011

		10-n run	5-n run	Total
ESO observations LRc07 and LRc08				
HD	170031	92	19	111
HD	170231	81	19	100
HD	170053	84	18	102
HD	170174	1	–	1
HD	170200	26	5	31
ESO observations other runs				
HD	172046	4	1	1
HD	169392A	1	–	1
HD	169392B	1	–	1
HD	169556	–	1	1
OHP observations				
HD	170031			76
HD	170053			175

(1), HD 90872 (1), HD 113357 (1), HD 79416 (1), HD 149989 (1), HD 110606 (1), HD 126516 (1), HD 152565 (1), HD 86659 (1), and HD 188032 (2 spectra).

B-A-F stars (P.I. M. Hareter) – EE Cha (2 spectra), EF Cha (2), HD 144277 (4), υ Sco (3), μ^1 Sco (3), ζ^1 Sco (3). Moreover, 13 additional spectra of HD 144277 were taken on the night July 2-3, when the strong wind hampered the pointing in the direction of the CoRoT field.

δ Sct stars (P.I. E. Poretti) - Gravity darkening effect: 35 spectra of WZ Scl and 38 spectra of ρ Pav at end of 9 nights of the first run (all except the first). $v \sin i$ determinations: 1 spectrum of 32 stars at end of two nights of the second run.

5. Appendix

Here we list the Observing Block of HD 170031 as saved from the P2PP software. The HAM 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                        "O"
STTimeIntervals             ""
calibrationReq              ""
InstrumentComments          ""
userComments                "HD170031 K5 V=8.19"
userPriority                "1"
LineNumber                  "0"
name                        "AO-HD170031-HAM"


comments                    ""
objectClass                 " Unknown              "
ra                          " 18:27:07.390"
dec                         " 06:04:11.413"
epoch                       "2000.0"
equinox                     "2000"
propDec                     "0.000000"
propRA                      "0.000000"
diffRA                      "0.000000"
diffDec                     "0.000000"
LineNumber                  "0"
TARGET.NAME                 "HD170031"


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                     "150.28"
instrument                    "HARPS"
LineNumber                    "0"
OBSERVATION.DESCRIPTION.NAME "HD170031"


ACQUISITION.TEMPLATE.NAME "HARPS_ech_acq_thosimult"
TEL.TARG.RADVEL          "-99999"
INS.OPTI6.NAME           "THAR2"
DPR.TYPE                 "STAR,WAVE,K5"



TEMPLATE.NAME "HARPS_ech_obs_all"
DET1.READ.SPEED   "416kHz,1,high"
DET1.WIN1.UIT1    "900"
SEQ.NEXPO         "1"
DPR.CATG          "SCIENCE"
```