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

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## EXECUTIVE SUMMARY.

The ESO Large Programme 185.D-0056 started with the HARPS instrument at the 3.6m ESO telescope in June and July 2010. The log of the these observations, the problems encountered, some tips, the situation of the publications, and a look to the future are given. The following actions/items are emphasized:

1. The observations in the 15 nights were disturbed by clouds, humidity, and wind. The  $\delta$  Sct star HD 170699, the Be star HD 171219, the  $\beta$  Cep HD 170580 were observed to study line profile variations. Spectra were also obtained for the B-star HD 170783 and for the CP star HD 170973. All these stars are belonging to the LRc05 and LRc06 CoRoT pointings. Moreover, we observed the bright red giant HR 7349 (LRc01).
2. Different filling programmes were run at the beginning and end of night. They were also used as backup programmes when strong wind from North hampered the pointing of the CoRoT field.
3. For the first time we had serious technical problems. HARPS did not work properly in the the EGGS configuration and we were forced to observe in the HAM configuration in one full night. Moreover, another full night was lost due to guiding problems.

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## 1. Introduction

The ground-based spectroscopic monitoring of the CoRoT targets continued in June and July 2010. Two sites have been involved: European Southern Observatory (La Silla, Chile; HARPS@3.6m) and Observatoire de Haute Provence (France; SOPHIE@1.9m). As in the previous cases, the goals of this eighth (the fourth 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 December 22, 2010 to January 1, 2011 and from January 7 to 12, 2011. **Interested observers are kindly requested to inform E. Poretti. Note**

that the two runs are separated by 6 days only and therefore the observations could be conducted by just one observer. In such a case, we will ask ESO to give full support to the observer for the whole period. In Period 86 HARPS will be offered in the polarimetric mode too. We submitted a request (a short proposal) to the OPC to use the instrument in such mode. We have been informed that “ *the OPC judged that the intended polarimetric observations represent too large a deviation from the original goals and observational strategy of the Large Programme to allow them to be approved on the basis of a mere change request. The OPC recommended that, in future periods, you request additional time for such observations via full formal proposals to be submitted by the corresponding deadlines*”.

To complement the HARPS observations of the next CoRoT pointing there will be a SOPHIE@ OHP run from December 10 to 20 (P.I.: P. Mathias). 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. **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). New papers with respect to the previous report are highlighted in red.

**I suggest that 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 2010

The CoRoT observations performed by CoRoT from April to September 2010 in the Center direction were splitted into two Long Runs (LRc05 and LRc06), each spanning 80 days. The asteroseismic targets are: HD 170699 ( $\delta$  Sct,  $V=7.0$ ), HD 170580

( $\beta$  Cep,  $V=6.7$ ), HD 170973 (CP star,  $V=6.4$ ), HD 170783 (B star,  $V=7.7$ ), and HD 171219 (Be star,  $V=7.6$ ).

The Red Giant HD 171264 ( $V=8.1$ ) was too faint and not very appealing. We replaced it with the bright Red Giant HR 7349=HD 181907 ( $V=5.8$ ) observed by CoRoT in the LRC01 (Carrier et al. 2010, A&A 509, A73).

These stars were also observed with SOPHIE@OHP (June 21-28, 2010) and HERMES@Mercator.

#### 4. The ESO observations

The observers were Juan Carlos Suarez (IAA, 12-22 June, 2010) and Katrien Uytterhoeven (CEA, 1-6 July, 2010). Tables 2 and 3 report the logs of both runs. The setup of the HARPS instrument is summarized in the Appendix of the previous report. 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. **We definitely solved the instrumental problem affecting the HARPS spectra collected in 2009. The corrected spectra were distributed to the respective PIs (see Tab. 1) in March.**

Observers are requested to carefully check the value of the `TEL.TARGET.RADVEL` keyword in the Observing Blocks. It must be “-99999.9” or “-99999” for the cold stars. In such a case the HARPS pipeline calculates a very accurate value of the star’s radial velocity. 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.

##### 4.1. Observing cycle

Exposure times have been set to 700 sec for HD 170699, to 400 sec for HD 170973, to 500 sec for HD 170580, 210 sec for HR 7349, and to 1200 sec for HD 171219. However, these exposure times were often modified accordingly to the weather conditions (clouds, poor seeing, ...). The observing sequence was

HR 7349 - HD 170699 - HD 171219 - HD 170699 - slot - ...

In the “slot” we put HD 170973 at the beginning and end of night and, in alternance, HD 170580 and HD 170783 during the night.

HD 135240 was observed at the beginning of the night to better define the blaze function (exposure time: 150 sec).

##### 4.2. Length of the nights

The observations spanned about  $12^h30^m$  in June and about  $11^h30^m$  in July. At the declination of the CoRoT field (from  $+6^\circ$  to  $-3^\circ$ ), 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. The CoRoT field could be observed for about  $9^h$  in both runs. The night of 23-24 June started at UT  $22^h25^m \equiv$  ST  $11^h51^m$  and ended at UT  $10^h56^m \equiv$  ST  $24^h23^m$ . The night of 1-2 July started at UT  $23^h03^m \equiv$  ST  $12^h59^m$  and ended at UT  $10^h32^m \equiv$  ST  $24^h30^m$ .

##### 4.3. Weather statistics

The observations were often disturbed by clouds, humidity, and strong wind. In the first run we lost 33.5 hours (out of 125) due to bad weather (26.5 hours during the visibility of the CoRoT targets, 7.0 hours during the filling programme). In particular, two full nights were lost (15-16 and 18-19 June). Moreover,  $2^h$  and  $9^h$  of the CoRoT time could not be used due to strong wind from North on the 12-13 and 17-18 June, respectively.

In the second run we lost 20.5 hours (out of 57.5) due to bad weather (16 hours during the visibility of the CoRoT targets, 4.5 hours during the filling programme). Moreover,  $5^h$  and  $1^h$  of the CoRoT time could not be used due to strong wind from North on the nights of 4-5 and 5-6 July, respectively.

##### 4.4. Technical reasons

For the first time we had to face severe technical problems. They were of different nature (a slight drift in the EGGs fiber, problems in closing the EGGs shutter and in the calibration procedure). In the first run we lost 20 hours, 9 during the CoRoT time, 11 of the filling programme. We used the HAM configuration in one full night (14-15 June) to bypass the EGGs malfunction. **The step in wavelength of the HAM spectra has been made the same of the EGGs ones.** We lost 1 full night for the guiding problems (19-20 June), common to both HAM and EGGs configurations.

After some maintenance and repair procedures, the ESO staff solved the problem and in the second run we lost  $15^m$  in the twilight of the night of 1-2 July only.

##### 4.5. Overall statistics

In the first run we lost 53.5 hours due to bad weather and technical problems. The CoRoT field was monitored for 43.5 hours, the filler and backup stars for 28.0 hours (11 hours of the CoRoT time had to be given to the backup programme due to the wind from North).

In the second run we lost 20.5 hours due to bad weather and technical problems. The CoRoT field was monitored for 24.0 hours, the filler and backup stars for 13.0 hours (7 hours of the CoRoT time had to be given to the backup programme due to the wind from North).

We had a bonus of  $4^h40^m$  in the extra-night of June 30-July 1 ( $3^h50^m$  for the CoRoT field,  $50^m$  for the filler programme).

##### 4.6. Signal-to-noise ratio evaluation

The SNRs listed in Table 3 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. We confirm that the values provided by the HARPS pipeline at the telescope are in general overestimated by a factor of 1.25.

#### 5. Backup and filling programmes

The strong wind blowing from the North forced the observers to move to the *backup programme* during 4 (partial) nights (17-18 and 12-13 June, 4-5 and 5-6 July). The backup programme was composed of a list of  $\gamma$  Dor, SPB, Be stars to be observed once.

Other targets have been observed at the beginning and at the end of nights (*filling programme*), strictly following the

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

| Star                         | CoRoT run - ESO LP                   | Investigators<br>Spectroscopic data | Papers                                   |
|------------------------------|--------------------------------------|-------------------------------------|--|
| <i>Published results*</i>    |                                      |                                     |  |
| 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, in press      |
| HD 49434 - Paper II          | LRa01 - LP 178.D-0361                |                                     | Chapellier et al. 2010, accepted         |
| <i>Papers in preparation</i> |                                      |                                     |  |
| HD 181555                    | LRc01 - LP 178.D-0361                | L. Mantegazza                       | Michel et al.                            |
| HD 171586                    | LRc02 - LP 178.D-0361                | T. Luftinger                        | Luftinger et al.                         |
| <i>Analyses in progress</i>  |                                      |                                     |  |
| 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                | J. Gutierrez-Soto                   |  |
| 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, LP185.D-0056  | 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                            |  |
| HR 7349                      | LRc01 - LP185.D-0056                 | F. Carrier                          |  |
| 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         | C. Aerts                            |  |
| HD 171219                    | LRc05 - LP 185.D-0056                | C. Neiner                           |  |

\* Reduced spectra now available in the ESO archive at

<http://archive.eso.org/cms/eso-data/data-packages/178-d-0361/hd-49434-feros-spectroscopic-time-series-data-release-v1-0/>  
<http://archive.eso.org/cms/eso-data/data-packages/178-d-0361/hd-50844-feros-spectroscopic-time-series-data-release-v1-0/>  
<http://archive.eso.org/cms/eso-data/data-packages/178-d-0361/hd-49330-feros-spectroscopic-time-series-data-release-v1-0/>  
<http://archive.eso.org/cms/eso-data/data-packages/178-d-0361/hd-51106-hd-50747-feros-spectroscopic-time-series-data-release-v1-0/>  
<http://archive.eso.org/cms/eso-data/data-packages/178-d-0361/hd-180642-feros-spectroscopic-time-series-data-release-v1-0/>  
<http://archive.eso.org/cms/eso-data/data-packages/178-d-0361/hd-181231-feros-spectroscopic-time-series-data-release-v1-0/>  
<http://archive.eso.org/cms/eso-data/data-packages/178-d-0361/hd-50209-feros-spectroscopic-time-series-data-release-v1-0/>

ESO rules in the submission of these additional targets. In addition to  $\epsilon$  Lup (P.I. K. Uytterhoeven, 9 spectra, SNR between 170 and 335), HD 137949 (P.I. F. Leone, 10 spectra, SNR 110-250), HD 91024 (P.I. C. Aerts, 16 spectra, SNR 110-260), we observed:

*Be stars* (P.I. A.M. Hubert) – 1 spectrum of Mis 379, Mis 270, MQ TrA,  $\mu$  Lup, HD 146596, V846 Ara,  $\mu$  Cen, HD 156398, HD 146501 (SNR=120),  $\theta$  Cir, V946 Cen, HD 151113, HD 147302, HD 155851, V817 Cen,  $\mu^2$  Cru, HD 124834, CO Cir,  $\gamma$  Cir, CK Cir, HD 216113 (SNR=90). SNR values are in the range

165-230, if not differently noted. Two spectra of CV Cir (SNR 120 and 200).

$\gamma$  Dor and SPB stars (P.I. P. De Cat) – HD 112409 (2 spectra), HD 85693 (2), HD 110606 (2), HD 90872 (2), HD 138521 (1, SNR=105), HD 152635 (2), HD 197451 (1 EGGs; 2 HAM, SNR 70 and 140), HD 201985 (1 EGGs, SNR=85; 1 HAM, SNR=65), HD 224288 (1), HD 206481 (2, SNR 110 and 175), HD 214291 (6), HD 205879 (1), HD 10167 (1), HD 11462 (1), HD 109799 (1), HD 113357 (2), HD 152565 (2), HD 155854 (1), HD 121190 (1), HD 131058 (1), HD 132200 (1), HD 137785 (1),

**Table 2.** General description of the nights

| Night          | Seeing<br>DIMM | Lost time                         |                                   | Notes  |
|----------------|----------------|-----------------------------------|-----------------------------------|--|
|                |                | Bad weather                       | Technical Reasons                 |  |
| June 12-13     | 1''9–2''6      | 2 <sup>h</sup> 15 <sup>min</sup>  | 1 <sup>h</sup> 15 <sup>min</sup>  | EGGS fiber lost. Clouds, strong wind.                  |
| June 13-14     | 1''8–2''0      | 6 <sup>h</sup> 20 <sup>min</sup>  | 2 <sup>h</sup>                    | Dome control. Clouds.                                  |
| June 14-15     | <1''5          |                                   | 3 <sup>h</sup> 30 <sup>min</sup>  | EGGS shutter, observations in HAM mode.                |
| June 15-16     |                | 12 <sup>h</sup> 30 <sup>min</sup> |                                   | Clouds all the night.                                  |
| June 16-17     | 1''2           |                                   | 45 <sup>min</sup>                 | EGGS calibration problem.                              |
| June 17-18     | 1''4–1''8      |                                   |                                   | Strong wind from North, backup programme.              |
| June 18-19     |                | 12 <sup>h</sup> 30 <sup>min</sup> |                                   | Fog, high humidity (100%).                             |
| June 19-20     |                |                                   | 12 <sup>h</sup> 30 <sup>min</sup> | Guiding problems, both HAM and EGGS.                   |
| June 20-21     | 1''0           |                                   |                                   | No problems.   |
| June 21-22     | 1''3–1''9      |                                   |                                   | Thin cirrus.   |
| June 30-July 1 | 0''85          |                                   |                                   | Extra half-night                                       |
| July 1-2       | 0''5–0''9      |                                   | 15 <sup>min</sup>                 | Telescope control stuck. Seeing 1''0–1''2 end-of-night |
| July 2-3       | 1''3–2''4      | 1 <sup>h</sup> 10 <sup>min</sup>  |                                   | Strong wind.   |
| July 3-4       | 2''0–3''0      | 9 <sup>h</sup> 45 <sup>min</sup>  |                                   | Strong wind.   |
| July 4-5       | >2''0          | 4 <sup>h</sup> 15 <sup>min</sup>  |                                   | Strong wind.   |
| July 5-6       | >2''0          | 5 <sup>h</sup> 15 <sup>min</sup>  |                                   | Strong wind (4''5 end-of-night), backup programme.     |

HD 149989 (1), HD 153580 (1), HD 79416 (2), HD 84809 (1), HD 86659 (1). SNR values are in the range 130-240, if not differently noted.

*A-F stars* (P.I. M. Hareter) – HD 114839 (2 spectra, SNR 105 and 185), HD 209775 (2, SNR 125 and 190), BD+18°4914 (1 spectrum, SNR=80).

*CARMENES scientific case* (P.I. P. Amado) – The M-dwarf star Gl 570B has been monitored on two nights in the framework of the preparation of the scientific case of the spectrograph CARMENES, which will be mounted at the 2.2m telescope of Calar Alto. Gl 570B has been monitored for 2 hours (46 spectra,  $T_{\text{exp}}=120$  sec, SNR from 27 to 53) in the night of 12-13 June and for 85 min (52 spectra,  $T_{\text{exp}}=60$  sec, SNR from 50 to 60) in the night of 2-3 July. Notice that in the second night we got the same SNR of the first one with half exposure time. Indeed, the first night was very windy, with a poor seeing (about 2''), while the beginning of the second night was quite good (seeing around 1''3; see Table 2).

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.

**Table 3.** Log of the observing runs (June 2010–July 2010) 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. Spectra with low SNR have not been counted.

| Night                       | HD 170699<br>V=7.0 | HD 170580<br>V=6.7 | HD 170973<br>V=6.4 | HD 170783<br>V=7.7 | HD 171219<br>V=7.6 | HR 7349<br>V=5.8 |
|-----------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------------------|
| Exp. Time<br>(Default)      | 700 sec            | 500 sec            | 400 sec            | 1100 sec           | 1200 sec           | 210 sec          |
| June 12-13                  | 8<br>[123-190]     | 2<br>[135-220]     | –                  | 1<br>[107]         | –                  | 4<br>[150-230]   |
| June 13-14                  | 3<br>[120-152]     | –                  | 1<br>[145]         | –                  | 2<br>[125-141]     | 1<br>[133]       |
| June 14-15<br>(HAM spectra) | 11<br>[104-204]    | 1<br>[180]         | 1<br>[97]          | 2<br>[130-154]     | 6<br>[109-198]     | 6<br>[123-191]   |
| June 15-16                  | –                  | –                  | –                  | –                  | –                  | –                |
| June 16-17                  | 15<br>[113-233]    | 2<br>[182-230]     | 1<br>[202]         | 2<br>[164-201]     | 7<br>[143-223]     | 7<br>[193-288]   |
| June 17-18                  | 6<br>[172-225]     | 1<br>[202]         | 1<br>[185]         | –                  | 3<br>[161-182]     | 2<br>[212-222]   |
| June 18-19                  | –                  | –                  | –                  | –                  | –                  | –                |
| June 19-20                  | –                  | –                  | 2<br>[58-67]       | –                  | –                  | –                |
| June 20-21                  | 12<br>[103-173]    | 3<br>[120-152]     | 1<br>[160]         | 2<br>[121-140]     | 6<br>[97-166]      | 10<br>[109-206]  |
| June 21-22                  | 11<br>[110-181]    | 2<br>[136-153]     | 2<br>[83-150]      | 2<br>[155-168]     | 5<br>[105-177]     | 7<br>[104-187]   |
| Jun 30-Jul 1                | 6<br>[204-240]     | 1<br>[184]         | 1<br>[220]         | –                  | 2<br>[198-226]     | 19<br>[152-245]  |
| July 1-2                    | 22<br>[176-230]    | 5<br>[165-220]     | 2<br>[218-237]     | 4<br>[203-257]     | 11<br>[165-235]    | 22<br>[199-282]  |
| July 2-3                    | 15<br>[137-228]    | 2<br>[255-255]     | 2<br>[190-255]     | 2<br>[195-203]     | 7<br>[144-227]     | 14<br>[193-294]  |
| July 3-4                    | 1<br>[112]         | –                  | –                  | –                  | –                  | 8<br>[180-243]   |
| July 4-5                    | –                  | 1<br>[97]          | –                  | –                  | –                  | 6<br>[164-212]   |
| July 5-6                    | –                  | 2<br>[154-185]     | 2<br>[123-168]     | –                  | –                  | 10<br>[106-245]  |
| <b>Total ESO</b>            | <b>110</b>         | <b>22</b>          | <b>16</b>          | <b>15</b>          | <b>49</b>          | <b>116</b>       |
| <b>Total OHP</b>            | <b>31</b>          | <b>15</b>          | <b>10</b>          | <b>–</b>           | <b>13</b>          | <b>–</b>         |