

Search for acoustic (p-) modes and asteroseismology of the slowly pulsating B star HD 45284

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Science case:

The slowly pulsating B stars (SPBs) are massive main-sequence gravity-mode oscillators of spectral types between B3 and B9. The gravity modes detected in them have periods of the order of days and are excited through the kappa-mechanism active in the partial ionisation zones of iron-group elements near 200 000 K. The red edge of the SPB strip is not yet confirmed observationally and one open question that we will also address here is whether oscillations occur in A0-type stars. Our main goal, however, is to investigate whether low-amplitude acoustic oscillation modes are also present in SPBs besides the known presence of gravity modes with amplitudes of several hundreds of a magnitude. If acoustic modes would be detected and identified, we would have very strict constraints on their stellar structure because the gravity and acoustic modes probe very different regions of the star (the core and outer layers, respectively). The acoustic modes are expected to have periods of the order 1-3 hours in such stars.

There is only one well-known SPB accessible for COROT: HD 45284. It is an extremely happy circumstance that this SPB happens to be the one with by far the shortest beat period known so far. We have therefore proposed this star as a COROT main target for 5-months monitoring but it was not selected for the Core Programme. Given its importance we apply for a short run concentrated on this particular star, of which we have already numerous Geneva photometric data. Its known frequencies are 1.23852, 1.12753, 1.50605 c/d, implying beat periods of less than 10 days (all other known SPBs have beat periods of the order of several months). This means that COROT measurements during 30 days are also suited to study the gravity modes in this star and will largely suffice to discover any additional short-period acoustic modes should they be excited. The star has been monitored from the ground, and its frequencies, amplitudes and phases are stable over years. Moreover, it is a relatively slow rotator. The final goal is of course to do a very in-depth seismic analysis of this star and perhaps also of the other targets we propose.

Type of observations:

SR, sismo CCDs, 30 days to cover three times the beat period of the main target

Main Target:

star	α	δ	SpT	V mag	vsini	remarks
CCDI						
HD 45284	06 26 13.17	-07 21 41.20	B8	7.37	60	known frequencies: 1.23852, 1.12753, 1.50605 c/d stable amplitudes & phases H α abs. (GAUDI)

Additional sismo targets:

star	α	δ	SpT	V mag	vsini	remarks
CCD1						
HD 45709	06 28 42.91	-06 58 12.13	B9	7.55	200	H α abs. (GAUDI)
HD 45380	06 26 44.85	-07 30 42.97	A0Vn	6.33	240	Variable Star Hipparcos Unsolved Catalogue 0.04551 c/d, 0.0098 mag
HD 45659	06 28 26.09	-06 32 52.39	B8	8.04		
HD 45585	06 28 04.40	-06 55 36.22	B5	8.82		
CCD2						
HD 45583	06 28 10.77	-04 53 56.51	B8	7.97	75	H α abs. (GAUDI)
HD 45517	06 27 47.69	-04 55 53.83	A0	7.58	10	H α abs. (GAUDI) in cluster
HD 45153	06 25 38.92	-04 49 56.27	B8	7.30	280	H α abs. (GAUDI) in cluster
HD 295102	06 27 59.00	-04 47 45.41	B8	8.71		in cluster
HD 45532	06 27 50.84	-05 09 17.50	A0	8.09		in cluster

5 relevant publications:

1. Waelkens, C., Aerts, C., Kestens, E., Grenon, M., Eyer, L., 1998, Study of an unbiased sample of B stars observed with HIPPARCOS: the discovery of a large amount of new Slowly Pulsating B Stars, *Astronomy & Astrophysics* **330**, 215 – 221
2. Aerts, C., De Cat, P., Peeters, E., Decin, L., De Ridder, J., Kolenberg, K., Meeus, G., Van Winckel, H., Cuypers, J., Waelkens, C., 1999, Selection of a sample of bright southern Slowly Pulsating B stars for long-term photometric and spectroscopic monitoring, *Astronomy & Astrophysics* **343**, 872 – 882
3. Mathias, P., Aerts, C., Briquet, M., De Cat, P., Cuypers, J., Van Winckel, H., Le Contel, J.-M., 2001, Spectroscopic monitoring of 10 new northern Slowly Pulsating B star candidates discovered from the HIPPARCOS mission, *Astronomy & Astrophysics* **379**, 905 – 916
4. De Cat, P., Aerts, C., 2002, A study of bright southern slowly pulsating B stars. II. The intrinsic frequencies, *Astronomy & Astrophysics* **393**, 965 – 981
5. Briquet, M., Aerts, C., Mathias, P., Scuflaire, R., Noels, A., 2003, Spectroscopic mode identification for the slowly pulsating B star HD 147394, *Astronomy & Astrophysics* **401**, 281 – 288

Needed ground-based observations plan:

All stars are relatively bright. Those with visual magnitude below 8 have been studied spectroscopically, data are available in the GAUDI data base. Should the proposal be selected we plan to perform pre-launch and after-launch photometric monitoring with the Leuven Mercator telescope on La Palma to monitor the long-period gravity modes in the targets; we have permanent access to this private telescope. Moreover, we have guaranteed access to the Euler telescope equipped with the CORALIE spectrograph at La Silla. This instrument will be used to gather additional high-resolution spectra for the targets fainter than 8th magnitude to exclude the binary nature of the stars from their cross-correlation profile and to derive vsini. Additional FEROS time will be applied for in order to perform precise abundance determinations for the stars fainter than 8th magnitude.