

Asteroseismology of the B supergiant HD 47240 and of massive OB stars in its environment

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Science case:

It is well known that very massive OB stars exhibit microvariability with (quasi-)periodicities of the order of hours to days. For several bright OB stars evidence was found that this variability results from multiperiodic oscillations. The study of oscillations in such objects is difficult due to the strong stellar wind caused by the radiative force. However, it is of utmost importance to monitor oscillations in such stars because it will allow us to perform seismic modelling for the most massive stars in the galaxy. Current evolutionary tracks are most uncertain for these stars, while they are the ones that enrich the galaxy with heavy elements through their supernova explosions.

The current proposal concerns the early B-type supergiant HD 47240. We discovered this star to be periodically variable with a period of 1.73 days from HIPPARCOS data. We have meanwhile derived the star's effective temperature, luminosity and mass loss with a high precision from high-resolution spectra. This star is therefore a perfect massive star to perform seismology and, given the importance of massive stars seismology, it was proposed, but not accepted, as a main target for COROT. Given that O star and B-supergiant seismology are not included in the COROT Core Programme (so far) we submit an additional programme in this topic.

We have selected additional bright O main-sequence stars and early-B supergiants in the vicinity of HD 47240 and visible in one COROT short run. We will use them to calibrate the whole very massive stellar model sequence from the stellar birth up to the pre-supernova stage. We have also added a β Cep candidate because of the limited number of such stars in the Core Programme of COROT (due to a limited choice near the current primary candidate stars) in order to understand the possible link between β Cep-type oscillations in B giant stars situated at the top of the instability strip and the microvariability of O stars and B supergiants. Moreover, we have also added one B3 and two late B stars.

Type of observations: SR, 30 days in order to cover the beat periods of the modes as well as possible.

Main Target:

star	α	δ	SpT	V mag	vsini	remarks
CCD1						
HD 47240	06 37 52.70	+04 57 24.01	B1Ib	6.18	100	$T_{\text{eff}}=20000\text{K}$, $\log g=2.5$ (Aerts et al., in preparation) 0.57800 c/d, 0.015 mag (HIPPARCOS)

Additional sismo targets:

star	α	δ	SpT	V mag	vsini	remarks
CCD1						
HD 47382	06 38 28.64	+04 36 25.87	B0III	7.16	60	$\Delta RV=30$ km/s (Simbad) profile var. in 2 GAUDI spectra H α abs. (GAUDI)
HD 46885	06 36 00.11	+04 29 52.91	B9III	6.56	35	asymmetric profiles in GAUDI spectrum H α abs. (GAUDI)
HD 47431	06 38 49.41	+04 42 02.19	B8III _n	6.56	100	H α abs. (GAUDI)
HD 261307	06 38 47.45	+05 04 23.09	B	9.34		
CCD2						
HD 47107	6 37 14.37	+05 48 22.07	B1.5Ia	8.00		normal mass-loss rate from IUE spectrum star in cluster
HD 47129 Plaskett's star	06 37 24.04	+06 08 07.38	O8.5I+O7I P _{orb} =14.4d	6.06	75 (& 350)	T _{eff} = 35000K, log L/L _⊙ =5.80 strong stellar wind (from GAUDI+IUE) P=2.8 days in H α ; origin?
HD 46966	06 36 25.89	+06 04 59.48	O8V	6.87	60	$\Delta RV=2$ km/s (Simbad) H α abs. (GAUDI) low mass-loss rate T _{eff} =38000K, log L/L _⊙ =5.27
HD 47314	06 38 18.70	+05 59 21.80	B8Ib	8.47		
HD 46846	06 35 53.36	+05 50 32.69	B3V	8.89		

5 relevant publications:

1. Rauw, G., Morrison, N. D., Vreux, J.-M., Gosset, E., Mulliss, C. L., 2001, The spectral variability of HD 192639 and its implications for the star's wind structure, *Astronomy & Astrophysics* **366**, 585 – 597
2. Lamers, H., Bastiaense, M., Aerts, C., Spoon, H., 1998, Periods, period changes and mode identification in Luminous Blue Variables, *Astronomy & Astrophysics* **336**, 605 – 621
3. Aerts, C., 2000, A group of interesting periodically variable B-type supergiants, in: *3rd MONS workshop: MONS Science preparation and Target Selection*, 24–26/1/2000, Århus University, Denmark, p. 131 – 134
4. Aerts, C., Lamers, H.J.G.L.M., 2003, Maximum mass-loss rates of line-driven winds of massive stars, *Astronomy & Astrophysics* **403**, 625 – 635
5. Aerts, C., Thoul, A., Dąszynska, J., Scudlaire, R., Waelkens, C., Dupret, M.-A., Niemczura, E., Noels, A., 2003, Asteroseismology of HD 129929: Core Overshooting and Nonrigid Rotation, *Science*, Vol. 300, Issue 5627, 1926 – 1928

Ground-based observations plan:

Most of the target stars are bright and have been studied spectroscopically, data are available either in the GAUDI or in the INES/IUE 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 for all the proposed targets; we have permanent access to this private Leuven 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 whenever needed (e.g. for precise abundance determination and detailed wind characteristics). We will apply for UVES at VLT for the most interesting massive stars, in order to monitor in detail their UV line-profile variability.