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First results of Mercator observations of variable A and F stars

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Abstract. We report on the first results from observations of 31 variable A and F stars, obtained with the new Mercator telescope (La Palma). Besides confirming the γ Dor nature of known bonafide and candidate γ Dor stars, we also present new candidate γ Dor stars. In addition, we found a new short-period variable star.

1. Introduction

The Mercator telescope is a new 1.2-m telescope located on the Roque de los Muchachos observatory on La Palma, Spain. The scientific observations started in spring 2001. Currently, the instrument attached to the telescope is "P7" which is a two channel (star + sky) photometer for quasi-simultaneous 7-band measurements in the Geneva photometric system. Since 2001, the telescope has been intensively used to observe variable B, A, and F main sequence stars. In this paper we present the data sets obtained for 31 A and F stars containing mainly (confirmed and candidate) γ Dor stars.

The obtained Mercator time series of the 31 A and F stars were subjected to an extensive frequency analysis, where objectivity was imposed by having each star independently analysed by two or three astronomers. The frequency analysis was done for all the Geneva passbands and colours with both the PDM (Stellingwerf 1978), and the Lomb-Scargle (Scargle 1982) method. Also a multi-frequency fit approach was used to find the best solution in the data (see Schoenaers & Cuypers, these proceedings).

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2. Sample and results

Confirmed and candidate γ Dor stars, and stars with colours similar to γ Dor stars were included in the observing program. A global overview of the preliminary results is given in Table 1. Because of strong aliasing in each of our ground-based data-sets, we complemented our frequency search with a (new) analysis of the space-based observations of the Hipparcos satellite in the H_p passband. In 23 stars out of 31 a well defined periodicity was found. Only one star was constant to our (tentatively estimated) limit of variability detection (0.005 mag in Geneva B). In 7 stars no significant period could be found in the Mercator data so far, or the candidate period is not compatible with the Hipparcos data or other ground-based observations.

3. γ Dor Stars

In the group of 23 periodic variables, 6 stars have a first period as in other ground based data, but the period could not (yet) be confirmed in the Hipparcos data. However, in at least two (other) stars (HD 2842 and HD 7169) a re-analysis of the Hipparcos data (technique described in Schoenaers & Cuypers, these proceedings) yielded the same two periods as found in the Mercator data. The first four frequencies found in HD 105458 are in perfect agreement with the results of Henry et al. (2001). In confirmed γ Dor stars, as HD 221866, multiperiodicity is easily found and also the phase behaviour as described by Aerts et al. (submitted) for the γ Dor stars HD 12901 and HD 48501 is confirmed: there is no discernible phase difference between the different filters. At the moment it is still premature to decide on the basis of these data which of the candidate stars will become bona fide γ Dor stars, but all variables with frequencies below $3\,\mathrm{d}^{-1}$ in Table 1 remain good candidates (if not already confirmed members). As an example we show in Fig. 1 phase diagrams of the star HD 74504.

4. A new short period variable

The star HD 104573 was not known as a periodic variable star until Koen & Eyer (2002) found the frequency $4.61406\,\mathrm{d}^{-1}$ in their re-analysis of the Hipparcos data. In the Mercator data a frequency $15.8709\,\mathrm{d}^{-1}$ is clearly present (see Fig. 2). The difference of the frequencies ($11.2568\,\mathrm{d}^{-1}$) corresponds to a period of 128 min. Since this is exactly equal to the rotational period of the Hipparcos satellite, the Hipparcos frequency is an alias. This is an example of how ground-based data can correct for an incorrect frequency in satellite data.

References

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Table 1. Overview of the results for the 31 studied A and F stars. For each target we give the HD number, the spectral type as given by Simbad (CDS, Strasbourg), the number N of Mercator observations, the total time-span T, and the frequencies found in the Mercator time series. We used the indication "*" "+" if the star is classified in the literature as a bonafide γ Dor star or δ Sct star, respectively. Italic frequencies indicate that we might have taken an alias frequency instead of a physical one because of a lack of extra information from the Hipparcos H_p photometry or elsewhere. Bracketed frequencies could not be found in another ground-based dataset nor in the Hipparcos dataset. Boldface frequencies could not be found in the Hipparcos dataset, but were also found in other ground-based datasets.

Star	SpT	N	T (d)	ν_1 (d^{-1})	ν_2 (d^{-1})	ν_3 (d^{-1})	ν_4 (d^{-1})
HD 277*	F0	214	513	1.1110	1.0809	1.3437	1.3869
HD 2842	F0V	153	513	1.7127	1.5374		
HD 7169	F2V	139	513	*1.8228*	*1.9248*		
HD 23874	F0	120	412	2.2566			
HD 32537*	F0V	119	412	(1.1680)			
HD 48271	F0	78	411	(0.9125)			
HD 62454*	F0	144	411	**1.5994**			
HD 69715	A5	80	377	(2.4796)			
HD 74504	F0	116	324	1.9059	1.8248		
HD 76506	F2	138	325	0.7692			
HD 83601+	A4V	92	325	(5.3689)			
HD 86358*	F3V	121	377	(4.7266)			
HD 94117	F2	148	115	6.2726			
HD 96452	A3	26	323	*2.5833*			
HD 98851+	F2	269	302	-			
HD 99900	A7IV	158	126	1.7382	1.8790		
HD 100215	Am	184	377	*0.3197*	1.4218		
HD 104573	A5	119	139	15.8709			
HD 105458*	F0III	299	299	***1.3205***	***1.9467***	***0.3936***	***1.2505***
HD 108100*	F2V	198	377	***1.3293***			
HD 113867	F0	177	343	(0.8885)			
HD 167858*	F2V	68	407	*0.7649*			
HD 171834	F3V	173	415	-			
HD 173977	F2	67	423	*1.1106*			
HD 175337	F5	35	404	1.2710	*0.3258*		
HD 195068	F0V	181	488	1.2505	*1.2984*		
HD 206043*	F2V	156	523	*2.3596*	***2.4323***		
HD 207223*	F3V	114	520	***0.3854***			
HD 211699	F0	123	480	0.9327	0.1936		
HD 218396*	A5V	119	516	**1.9805**	1.7325		
HD 221866*	F2V	166	513	0.8773	0.8385	0.8546	

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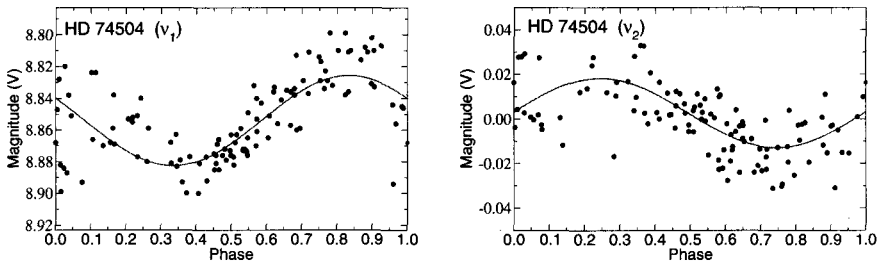

Figure 1. Phase diagrams in the Geneva V passband of the first frequency $\nu_1 = 1.9059\,\mathrm{d}^{-1}$, and the second frequency $\nu_2 = 1.8248\,\mathrm{d}^{-1}$ of the star HD 74504, obtained with Mercator observations.

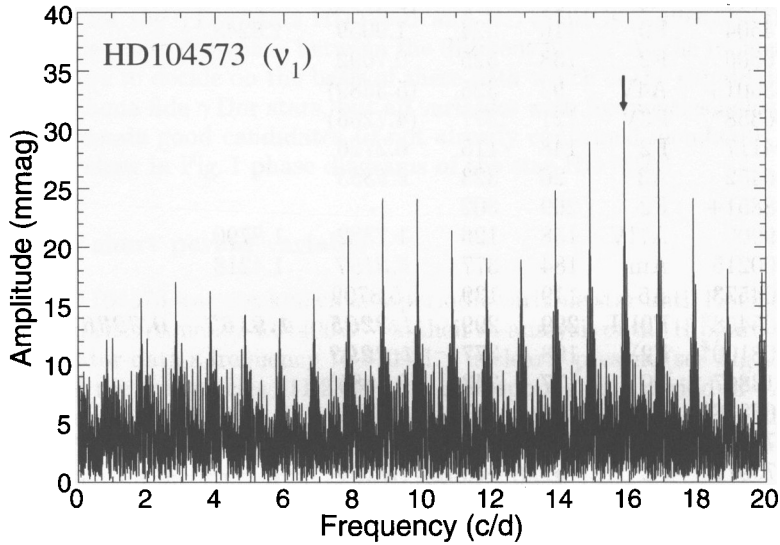

Figure 2. Lomb-Scargle periodogram of a Mercator time series of the star HD 104573, in which we found the frequency $15.8709\,\mathrm{d}^{-1}$. Note the strong alias patterns. We found confirmation, however, in the Hipparcos dataset.

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