FULL TITLE
ASP Conference Series, Vol. **VOLUME**, **YEAR OF PUBLICATION**
NAMES OF EDITORS

Short term variability in Be stars and binaries in the Magellanic Clouds.

C. Martayan, M. Floquet, A.-M. Hubert, M. Mekkas

GEPI/UMR8111-Observatoire de Meudon, 5 place Jules Janssen 92195 Meudon cedex FRANCE

Abstract. We observed a large sample of B & Be stars in the Magellanic Clouds, respectively 176 and 344 stars, with the multi-object spectrograph GIRAFFE at ESO/VLT. We obtained spectra at different settings at various epochs. It allowed us to discover several spectroscopic binaries with short and intermediate periods. By cross-correlation in coordinates with the MACHO database, we found the light-curves for 350 stars in our samples. Among them, 19 (14 new) are photometric binaries (5 in the LMC, 14 in the SMC). Among these 19 photometric binaries 6 are also spectroscopic binaries (5 in the LMC, 1 in the SMC) and 2 others are Be stars (2 in the SMC). For all these binaries the orbital period was determined. Among our sample, 134 Be stars were observed by MACHO and, for these stars, we searched for short-term photometric variability. We have found 13 objects among Be stars in the SMC which present short-term photometric variability (P<2.5d) with amplitude lower than 0.1 magnitude. This short-term variability is often superimposed to a long-term variation.

ccsd-00018651, version 1 - 6 Feb 2006

1. Observations

Thanks to the VLT-FLAMES/GIRAFFE facilities in MEDUSA mode, a large sample of B and Be stars have been observed in the LMC-NGC2004 and SMC-NGC330 regions and their surroundings, 176 and 346 hot stars respectively. We used a medium resolution R=6400 in the blue wavelength range around Hγ (LR02) and R=8600 in the red one around Hα (LR06). Among this sample 178 Be stars were observed. We have cross-correlated the coordinates of observed stars with the MACHO and OGLE databases and we found light curves for 350 stars. Among them 134 are Be stars.

Blue spectra of B and Be stars in the LMC were obtained 4 days before red ones and it was therefore possible to study the variation of the stellar radial velocities and to detect spectroscopic binaries. Despite the small number of spectra for each object it was possible to estimate the mass ratio and the systemic velocity for some binaries (see Martayan et al. 2005a). By cross-correlation with the MACHO and OGLE databases we detected 19 photometric binaries. Among them 14 are new photometric binaries (5 in the LMC, 9 in the SMC). Among these 19 photometric binaries 6 are also spectroscopic binaries (5 in the LMC, 1 in the SMC) and 2 others are Be stars (2 in the SMC). For eclipsing binaries, the orbital period was determined with an accuracy of 0.001d.

2. Binaries

2.1. Binaries in the LMC

Thanks to observations with VLT-GIRAFFE spectrograph, we find 23 new binary systems among the B stars of our sample (see Martayan et al. 2005a). The orbital periods were found thanks to the MACHO data. Results concerning eclipsing binaries are given in Table 1. As an example, the case of the LMC spectroscopic binary (SB2) MHF87970 (Porb=7.117d) is illustrated in Figure 1. Spectra obtained with the VLT-GIRAFFE are located at their orbital phases. The other eclipsing binaries are shown in Martayan et al. (2005a)

2.2. Binaries in the SMC

Contrary to the LMC, the observations in the blue and red wavelength have been done the same night and we cannot detect the variation of radial velocity. We find 14 eclipsing binaries. Periods were determined and compared to previous studies. Results are given in Table 1. The nature of SMC5_49816 is reconsidered and we propose SMC5_49816 like a WUMa binary because of its very short orbital period.

Table 1. Characteristics of eclipsing binaries in the Magellanic Clouds. The first column gives the name of the star, the second column gives the period of eclipses with an accuracy of±0.001d . The third column gives the ratio of masses and the last column gives different comments about the binary.

Name	P ±0.001d	M1/M2	Comments
LMC33-MHF87970	7.117	2.8	SB2
LMC33-MHF111340	1.074	1.2	SB2
LMC33-MHF127573	2.932	≃1	SB2, total eclipse
LMC33-MHF141891	2.975		SB1
LMC33-MHF149652	1.458		SB1, total eclipse
SMC5_977	3.128		SB2
SMC5_4477	2.987		MOA P=4.482d
SMC5_4534	4.051		
SMC5_13723	2.059		OGLE same P
SMC5_20391	2.320		MOA same P
SMC5_23571	3.534		Ellipsoidal bin.
SMC5_23641	2.010		
SMC5_24122	4.246		Eccentric bin.
SMC5_49816	0.332		WUMa
SMC5_74928	2.137		Ellipsoidal bin.
SMC5_84353	1.557		
SMC5_2807	454.959		*Cool Sg. OGLE same P*
SMC5_3789	2.087		*Be bin.*
SMC5_16461	54.317		*Be Ellipsoidal bin.*

3. Photometric variability in Be stars

As for galactic Be stars observed with Hipparcos (Hubert & Floquet 1998) and for Be stars candidates in the SMC (Mennickent et al. 2002), the short-term variability is often superimposed to a longer one which can be complex: short-, long-lived outbursts or fadings, periodic or pseudo-periodic variations. Therefore, when the Be stars lightcurves are not too complicated, we searched for

short-term variability by using PDM and FT+CLEAN algorithm methods. Under these conditions we find that 13 Be stars present short-term photometric variability (P<2.5d) with amplitude lower than 0.1 magnitude. Results are given in Table 2. The value of periods of short-term variations seem to be of the same order in the MC and in our Galaxy (see Hubert & Floquet 1998). We observed 6 stars proposed by Mennickent et al. (2002) as Be stars candidates and we confirm their Be nature. Due to their complex light curves it was not possible to investigate the short-term variability of Be stars in the sample in the LMC.

Table 2. Characteristics of short-term photometric variability in Be stars in the Magellanic Clouds. The first column gives the name of the star, the second column gives the period with an accuracy of ±0.001d . The third column gives the amplitude and the last column gives different comments about the Be star.

Name	P ±0.001d	Amplitude	Comments
SMC5_3296	0.499	0.04	
SMC5_13978	1.685	0.04	P_{Bal}=0.731d
SMC5_14727	0.891	0.04	
SMC5_16523	1.547	0.09	
SMC5_16544	0.586	0.07	
SMC5_21152	1.015	0.04	
SMC5_37162	1.130	0.08	
SMC5_43413	1.000	0.06	
SMC5_82042	0.402	0.05	
SMC5_82941	1.600	0.1	
MHF[S9]35238	0.754	0.07	
MHF[S9]37842	0.846	0.05	
MHF[S9]39981	0.783	0.04	

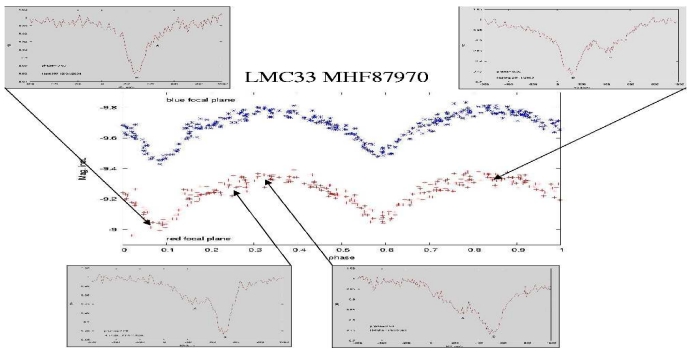


Figure 1. Binary LMC33-MHF87970, P=7.117d, MACHO60.7950.16. The central panel shows the MACHO lightcurves in phase. The four little panels show the GIRAFFE spectra and their correspondence with the phases.

References

Balona, L. A., 1992, MNRAS, 256, 425
Bayne, G., Tobin, W., Pritchard, J. D., et al., 2002, MNRAS, 331, 609B
Hubert, A.-M., Floquet, M., 1998, A&A, 335, 565
Martayan, C., Hubert, A.-M., Floquet, M. et al., 2005a, A&A, in press, astroph0509339
Mennickent, R. E., Pietrzyński, G., Gieren, W., et al., 2002, A&A, 393, 887