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# Various aspects of stellar variability in the Magellanic Clouds from the EROS 2 survey

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**Abstract.** The current status of the search of variable stars in the Magellanic Clouds from the EROS 2 survey is briefly presented.

**Key words.** Surveys – Stars: variables: general – Magellanic Clouds

## 1. Introduction

The EROS (Expérience de Recherche d'Objets Sombres) has conducted during the nineties a wide field photometric survey of millions of stars, in order to detect the baryonic dark matter by means of the gravitational microlensing effect. Two important lines of sight were the Magellanic Clouds where 33 millions of stars were observed during almost 8 years from July 1996 to March 2003. As this experiment has ruled out that baryonic matter is the major component of the Galactic halo (Tisserand et al. 2005), a very large amount of data has been collected about variable stars. It is the goal of the present paper to show the efforts that are currently done to make this database available for the community abroad and to present some specific results which have been obtained on R Coronae Borealis stars in the SMC.

## 2. The observations

The EROS 2 instrument was a 1-m Ritchey-Chrtien f/5 dedicated reflector at the La Silla (Chile) ESO observatory. It was equipped with a dichroic beam splitter allowing simultaneous imaging in two non-standard broad passbands, the so-called EROS filters $V_E$ (420- 720 nm) and $R_E$ (620- 920 nm). Each camera was composed of a mosaic of eight 2K x 2K LORAL CCDs with a pixel size of 0.6″and a field of view of 0.7° (right ascension) x 1.4° (declination). A total of 88 and 10 fields has been observed for the LMC ans the SMC, respectively. The light curves of individual stars were constructed from fixed positions on templates using PEIDA, a software specifically developped for the photometry of EROS 2 images (Ansari 1996).

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## 3. The extraction of variable stars

After the photometry and cleaning stages it remains in the database more than 29,230,000 analyzable stars for the LMC and more than 4,170,000 for the SMC. Various filters were applied to the time series in order to detect potential variables objects (Tisserand 2004) and an analysis was then processed to determine individual periods of pulsation. Because of the large number of objects to

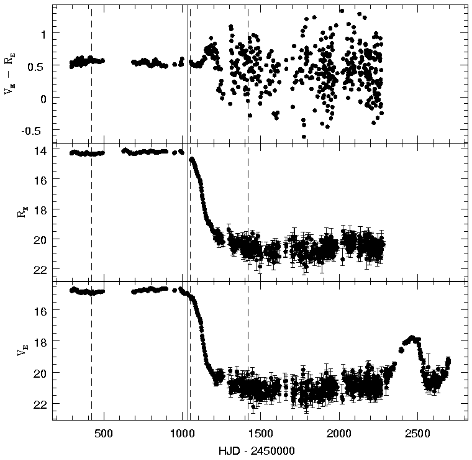


**Fig. 1.** EROS 2 light curve of RAW 476 : $V_E$ (bottom), $R_E$ (middle), $V_E$ - $R_E$ (top).

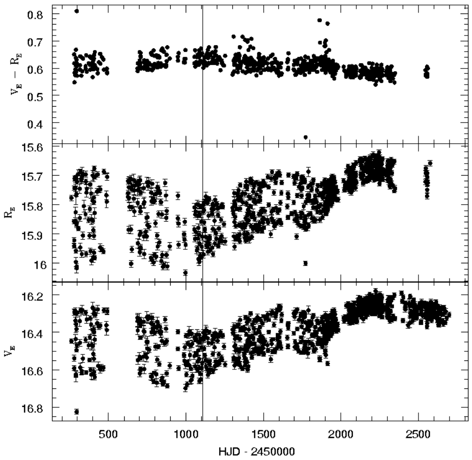


**Fig. 2.** EROS 2 light curve of a Cepheid-like object in the SMC : $V_E$ (bottom), $R_E$ (middle), $V_E$ - $R_E$ (top).

be considered, the automation of this method based on an Analysis of Variance formalism (Schwarzenberg-Czerny et al. 2005) was pursued as far as possible. Once the period is known, a five-harmonics Fourier analysis is performed for each star. It is then possible to build color-magnitude diagrams for the LMC (70280 objects) and the SMC (18880 objects), respectively, on which it is easy to distinguish a main sequence (containing most of the eclipsing binaries), an instability strip (containing Cepheids), a branch with Long Period Variables, and a clump of RR Lyrae. The use of Autoclass to automatically classify these different populations is currently under study. This bayesian software is based on an unsurpervised algorithm and is fed with a set of 6 parameters, some of them issued from the Fourier analysis such as the phase difference $\phi_{21}$ and the amplitude ratio $R_{21}$.

## 4. Specific objects

During the process of detection of microlensing events some rare stars were identified. Figure 1 shows the spectacular decline of a R Coronae Borealis (RCB) star in the SMC which is known in the Simbad (CDS, Strasbourg) database as RAW 476. The five first and previously unknown RCBs were thus found in the SMC (Tisserand et al. 2004). Figure 2 shows the light curves of an object detected at the northern edge of the SMC. Behaving like a first overtone Cepheid at the beginning of the survey, it exhibits since then a dramatic change towards brighter magnitudes and a drastic evolution of amplitude variation. This puzzling star is still under study.

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