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Long-term monitoring of variable stars in open clusters

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Abstract. Using the 'C2' and 'C3' CCD cameras mounted respectively on the 1.2m Swiss Telescope at La Silla, Chile and on its Flemish twin at La Palma, Canary Islands, Spain, we have been conducting long-term photometric observations of chosen galactic open clusters, with the aim of identifying and analysing their variable stars. A mmag overall accuracy ensures various kinds of variable stars are within our reach. Given the large time baseline, this project is particularly well suited for tackling long-term variability. Here, we present preliminary results on NGC 1901, which we began to analyse recently. Other clusters are still being monitored, with results to be published soon.

Key words. clusters and associations: individual: NGC 1901, stars: variables: delta Sct

1. Project overview

Since late 2002, we have been monitoring selected southern and northern open clusters to identify and characterize their variable stars. The observations are done in differential photometry in the V-band. We typically gather around 1500 V-band images per object over 2-3 years. Besides, in order to exclude non-member stars and build the HR diagram of each cluster, we take a set of exposures through all 7 Geneva filters plus modified R and I Cousins filters (Golay 1972). The data are then reduced using dedicated scripts under the Python/Pyraf environment. Flux extraction is done using aperture photometry, or PSF fitting for the case of crowded fields. Using a set of about 20 reference stars, differential photometry is then performed on the V-band images. Meanwhile, absolute photometry based on standard stars of the Geneva Catalogue is done on the nine-color images. Once the data are reduced, they are searched for periodicity, and eventually, further analysis is carried out on the phase-folded lightcurve whenever possible.

2. Preliminary results on NGC 1901

Here are preliminary results on the southern open cluster NGC 1901. Unfortunately, it is not representative of our sample, but with coordinates α=5h17m51s and δ=68:23:40, it was the only object that was up most of the night when the campaign started. According to Pavani et al. (2001), it is actually an evolved cluster comparable to the Hyades, 0.45 kpc away from the Sun and aged 0.6 ± 0.1 Gyr. As viewed from Earth, it happens to be in front of the LMC, which is why a large amount of the stars we observed are actually background,

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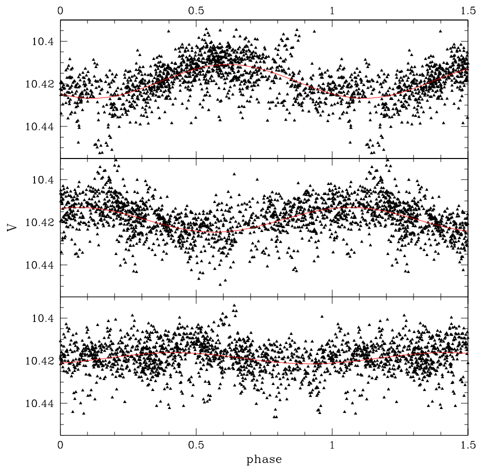

Fig. 1. HD 269312, an A7 δ Scuti candidate belonging to NGC 1901 and showing three modes of pulsation, with respectives frequencies $\nu_1 = 2.98$ c/d, $\nu_2 = 3.52$ c/d and $\nu_3 = 2.61$ c/d (from top to bottom).

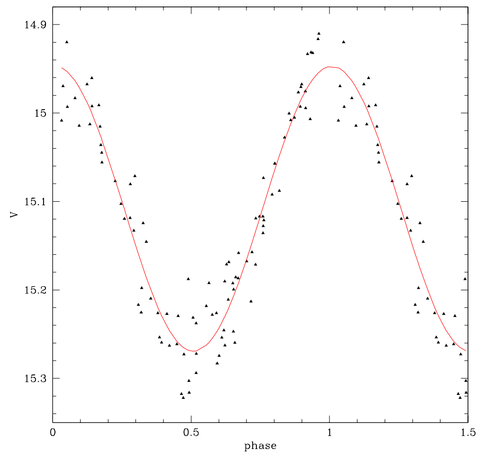

Fig. 2. New Cepheid star with period $P = 3.46$ d and belonging to the LMC (smoothed data).

LMC objects not belonging to NGC 1901 itself. The figures show the V-band lightcurves of three stars : a δ Scuti candidate, likely member of NGC 1901 (Fig. 1), and two LMC stars, namely a new Cepheid (Fig. 2) and an eclipsing binary (Fig. 3). A full study of this cluster

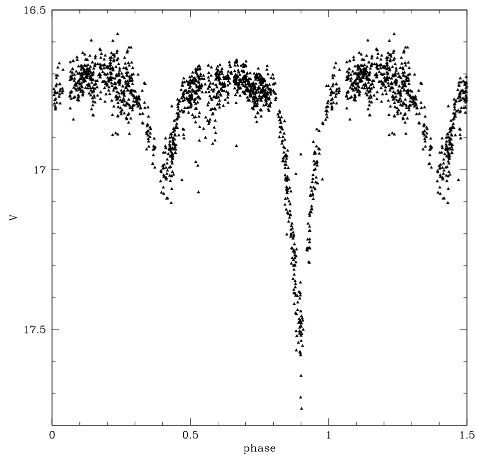

Fig. 3. Eclipsing binary with an orbital period $P =$ 1.58 d and belonging to the LMC.

is under way and will appear in a forthcoming paper.

3. Conclusion

We are conducting a long-term monitoring of variable stars in selected open clusters, both southern and northern. Our very first results are presented in this paper. Though preliminary, they nevertheless illustrate how promising this survey is, since it allows us to detect both short-term and long-term variations with a precision of a few mmag. Taking advantage of the constraints imposed by the stars belonging to a given cluster, we will be able to determine additional parameters, such as mass and age, for the most interesting objects, on which specific follow-up studies (e.g. spectroscopic measurements) could then be undertaken. With a total number of more than 20 clusters being monitored, this program is about to yield new and innovative results on a wide range of variable stars.

References

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