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Toward a census of variable stars in northern local group dwarf irregular galaxies

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Abstract. Dwarf galaxies in the local group provide a unique astrophysical laboratory. In particular, they allow us to probe pulsating (and other) variable stars in low-metallicity environments with abundances below that of the SMC. Our observing program, described in detail by C. Gössl's contribution, yields a large number of intrinsically bright variable stars that can serve as probes of the stellar population and star formation history of these galaxies. Most prominent are pulsation variables like Miras (LPVs) and δ Cep stars, but we also find other types of variable stars, e.g. RV Tauri stars, irregular red variables etc. We present a preliminary census for the three galaxies DDO 216, Leo A and GR8.

Key words. Galaxies: dwarfs – Stars: variables: general

1. Sample and Data Reduction

We selected a sample of six local group irregular dwarf galaxies. So far the observations were carried out in the *R*- and *B*-Band sparsely sampling a three year period starting with test observations in 1999. This part of the data set consists of approximately 80 individual epochs per galaxy and is sensitive to long period variable stars with periods up to ∼ 500 days. Additional observation in the *R*, *B* and *I*-Bands were obtained during three observing campaigns at the 1.23 m telescope on Calar Alto densely sampling three two week long periods. These observations provide a ground for a search for variable stars with shorter periods ranging from ∼ 1.5 days up to ∼ 10 days. The depth of each epoch is roughly 22.5 mag in the R-Band. The acquired data were bias-subtracted, flat-fielded and cosmic-rejected, at the same time propagating the error of each pixel. Consequently the images from one night were astrometrically aligned to a common reference frame and combined with individual weights proportional to the S/N. For each epoch, a difference image against a common deep reference frame was created using the Alard algorithm (Alard & Lupton 1998) implemented by Gössl & Riffeser (2002), still propagating the individual pixel errors. In a final step these difference images were convolved with a stellar PSF. The short period variables were detected using an implementation of the Lomb algorithm (Scargle 1982). For the LPVs the Lafler-Kinman (Lafler & Kinman 1965) statistic was applied. Lightcurve examples for LPVs are shown in Figs. 2 and 3.

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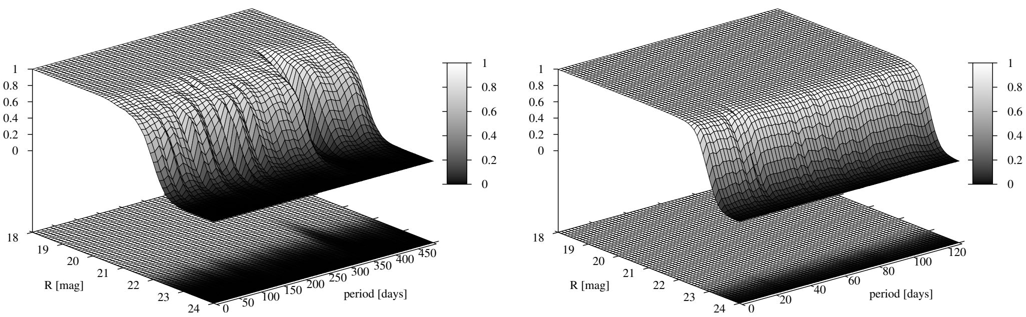

Fig. 1. Completeness simulation for variables with a cosine shaped light-curve and an amplitude of 1 mag, using the Lafler-Kinman statistic (left panel) and the Lomb algorithm (right panel). The break-in for periods of about one year in the left figure, can be explained by our half-year observing window.

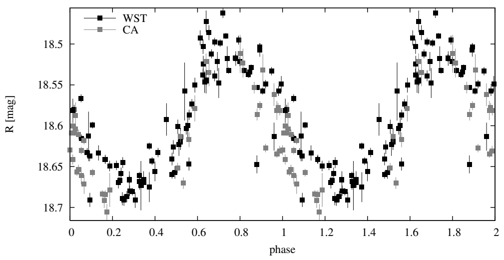

Fig. 2. Light-curve of an LPV in Leo A with a period of 74.9 days. The black points are observations from Mt. Wendelstein, the grey points from Calar Alto.

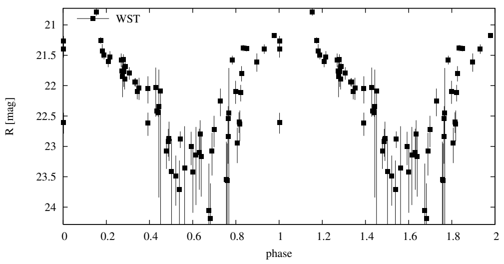

Fig. 3. Light-curve for a LPV with 255 days period in the pegasus dwarf galaxy (DDO 216).

2. Completeness Simulations

To obtain a measure of the completeness of the resulting catalogue of variable sources, we carried out extensive simulations covering the complete set of relevant parameters: magnitude, period and amplitude. The tests were conducted using a sample of nearly 900 artificial sources. As light-curve shapes both a cosine and a sawtooth were used, testing both an ideal, as well as a worst case. With exception of the limitation for one year periods the simulations show no notable deficiency (Fig.1).

Table 1. Preliminary census of the detected variables.

	δ Cep	LPVs
Leo A	14	16
DDO 216	10	47
GR 8	1	3

3. Preliminary Variable Census

So far, we finished analyzing three galaxies from our sample. Table 1 gives a short overview of the amount of detected variables.

The next step will be the final reduction and evaluation of the remaining dwarf galaxies, and a scientific analysis of possible SFHs of these, using the found pulsation variables and the completeness simulations.

References

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