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The Small IRAIT telescope

Photometric time-series during the polar night

R. Briguglio[1], G. Tosti[2], K. G. Strassmeier[3], H. Bruntt[4], R. Nesci[1], and L. Sabbatini[5]

[1] Sapienza University, Rome, Italy, e-mail: runa.briguglio@uniroma1.it
[2] Perugia University, Dept. Physics, Italy, for the IRAIT collaboration
[3] Astrophysikalisches Institut Potsdam, Germany
[4] University of Sydney, Institute of Astronomy, School of Physics, Australia
[5] University Roma3, Rome, Italy

Abstract. The Small IRAIT is a 25 cm telescope which was deployed and installed at Dome C, on the high antarctic plateau, in 2007. During the polar night an intensive photometric program was carried out: despite the harshness of the polar winter, the telescope worked in a semi-robotic way giving us a large amount of photometric data and precious informations about technology and procedures for polar missions.

Key words. Antarctica, Site testing, Techniques: photometric, Telescopes

1. Introduction

Concordia Base, Dome C, on the high antarctic plateau is a joint Italian-French research station (Candidi & Lori 2003); since 2005 it has provided logistic support for scientific activity all year long. Site-testing over the past ten years, carried out by Italian, French and Australian teams, have shown very promising features of Dome C as an observing place: favorable weather conditions with low cloud coverage, high sky transparency, low wind regime (Storey et al. 2003); cold temperatures give rise to low thermal noise and foreground emissions (Lawrence et al. 2007); the atmospheric turbulence is confined to a thin layer (Agabi et al. 2006); Dome C has almost three months of complete darkness allowing virtually uninterrupted observations. This last condition, in particular, is so attractive to compensate for the difficulties and the harshness of working during the polar winter, when the temperature can go down to -80°C.

2. Small IRAIT: Wintertime activity

The Small IRAIT is a 25 cm Cassegrain telescope, projected and prepared in Italy in 2006, to be an optical precursor of the larger IRAIT infrared telescope (Tosti et al. 2006). It is a commissioning project, to perform technological tests and to optimize working procedures to be applied during the future IRAIT operations. Small IRAIT was deployed at Concordia Base, Dome C, at the beginning of the winter campaign 2007. Its installation took four months from February to May, including instrumental and technological tests and optimization for the Antarctic environment. An ex-

Send offprint requests to: R. Briguglio

haustive description of the telescope, the optimization and the installation procedures is given in (Briguglio et al. 2008): in the present paper we will discuss some preliminary results of our photometric surveys.

2.1. V841 Cen and V1034 Cen

An intensive photometric study of a field in Centaurus was proposed by K. G. Strassmeier (AIP). The field includes V841 Cen (α=14h34m16s, δ=-6024'28" (2000), V = 8.6) which is a chromospherically active, rapidly rotating star, and V1034 Cen (α=14h35m01s, δ=-6023'32" (2000) V = 8.7) a δ Scuti star (A9 IV), showing a fundamental period of 0.235 d, with an oscillation amplitude of 30 mmag in the V band (Koen et al. 1999).

The time-series observations started on July 6 and ended on the 17. The midday sky brightness was so low that V841 Cen could be observed without interruptions. Over 4000 images were collected in each filter (B, V, and R). Flat fields were recorded on July 21, using the midday skylight as a source. The optics were cleaned daily to remove the thin snow accumulation, due to the action of the wind. The cleaning operations took 20 minutes and were done at the same time as the telescope de-rotation. The acquisition was basically uninterrupted for ten days and the overall duty cycle was close to 98.2%. A preliminary light curve of V841 Cen in the V band is shown in Fig. 1. A complete description of these results may be found in Strassmeier et al. (2008).

2.2. The young open cluster NGC 3293

The young open cluster NGC 3293 contains 11 β Cephei stars (Handler et al. 2007), including a binary system (Freyhammer et al. 2005), a Be star, and a fainter group of SPB-type variables, oscillating on a longer time scale. The presence of δ Scuti stars is suspected at even fainter magnitudes. In the beginning of August we observed the cluster during five consecutive days, obtaining the result in Fig. 2, where the V 381 Car preliminary V-band light curve from two days is shown. We find that the typical photometric precision is close to 5 mmag at $V \simeq 9$ (2 minutes exposure time). We expect to improve the photometric precision by installing a more sensitive camera during the next summer campaign.

2.3. The eclipsing binary ψ Cen

ψ Cen is an eccentric, detached eclipsing binary system with an orbital period of 38.9 d: the primary and secondary eclipses last 19 and 14 hours, respectively, so that a complete coverage is unachievable from a single site at mid-latitudes. The WIRE satellite (Bruntt et al. 2006; Bruntt & Southworth 2007), completed a 28.7 day observing run, obtaining a 2 mmag point-to-point dispersion in the light curves. We selected four eclipses to be observed, on July 20 and 27, and on August 28 and on September 4. Given the brightness of the program star, as a suitable comparison we selected BS 5471, at a few degrees distance: a robotic sequential pointing was implemented in the telescope control software, to allow unmanned program star–comparison star sampling.

The first and the second eclipses occurred during the polar night, giving us a chance to achieve full coverage; this goal was unfortunately not fulfilled because of technical problems (e.g. entanglement of cables). Also, the observing conditions were quite poor. The third eclipse was sampled without interruption for 11 hours, while the observations of the last eclipse lasted for just 9.5 hours, being interrupted by the sunlight. In Fig. 3 we show the eclipses measured on September 4 (primary eclipse, left) and August 28 (secondary, right). The increasing scatter in the second half of each eclipse is due to the high airmass increasing from Z = 2.0–2.5.

2.4. AGB stars

We observed a number of AGB stars in the I-band, which is a goal in one of the IRAIT science cases. A large sample (including KO Ser, V424 Sct, GR Ser, HY Ser, V3908 Sgr and NSV 10266) was observed in the field around

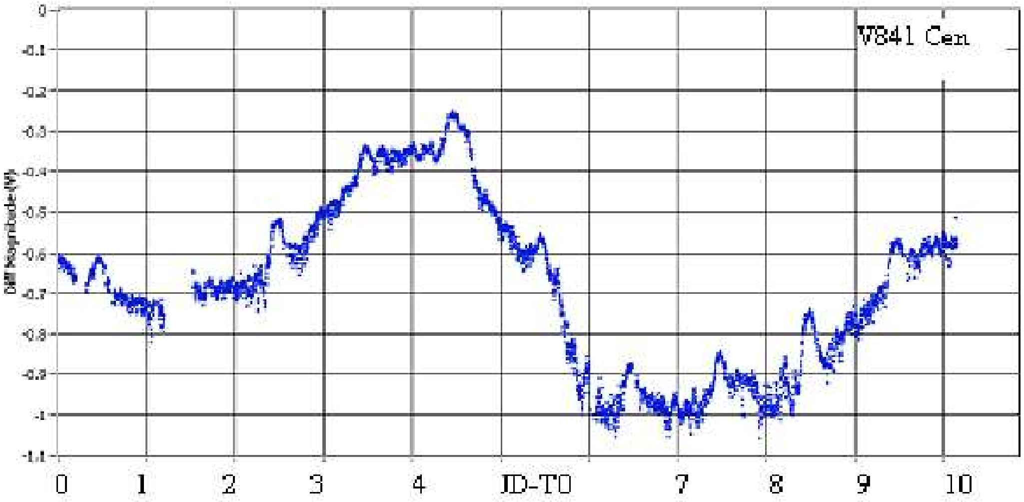

Fig. 1. The uninterrupted 10-day light curve of V841 Cen from Small IRAIT.

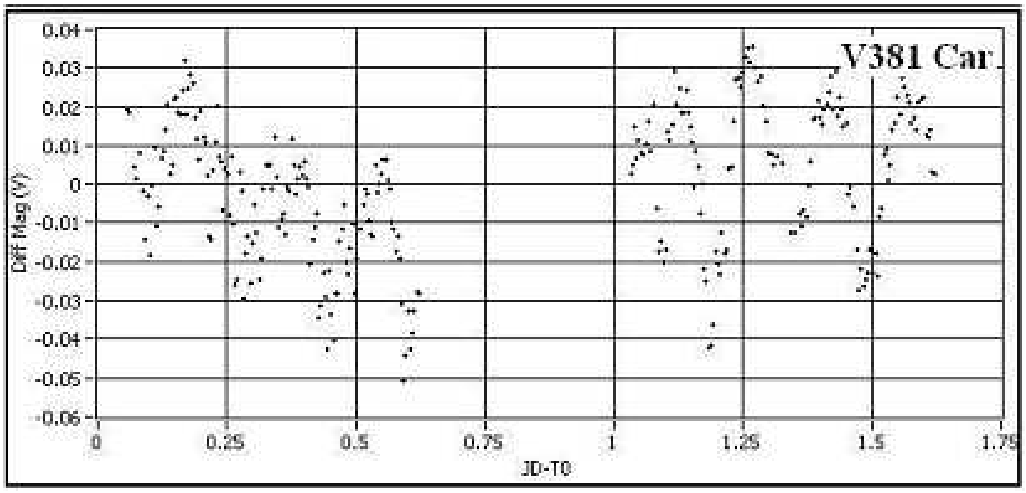

Fig. 2. Light curves for a sample of stars in the open cluster NGC 3293; T_0=2454320.8247.

M16/M17, which has been observed since the 1950s by the Italian group of P. Maffei (Maffei 1999). They have obtained accurate light curves and have determined periods, which for most of them is longer than 200 days. Using Small IRAIT, we intend to measure the actual magnitude of some of these AGB stars and find out if some stars show changes in the period.

The measurements took place on the second and third week of August. As a comparison star we selected GSC 05635-00564 (α=16h30m18s, δ=-1239’8” (2000), V = 10.069, $B - V$ = 1.568). We also calibrated the instrumental magnitude using the original sequences provided by Maffei, finding in general a good agreement between the two methods. Further analysis is necessary to clarify

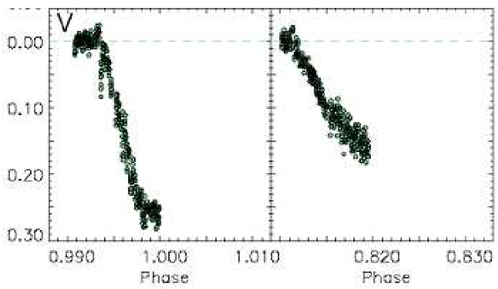

Fig. 3. Light curves of the eclipses in ψ Cen.

the behavior of the targets GR Ser and of NSV 10266. Details on the observations are given in Briguglio (2008).

3. Conclusion

Multi-band photometry has been obtained during the polar night with the Small IRAIT telescope. We have collected light curves of several types of variable stars in the field and in the open cluster NGC 3293. We succeeded in collecting data over several days with a high duty cycle (up to 90% during a run of 10 days), thanks to the low midday sky brightness and to an affordable remote control system. Astronomical observations will continue during the polar night in 2008.

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