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Memorie della

$uvby-\beta$ photometry of the RR Lyrae star AC And

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Abstract. In the present paper we determine the true nature of AC And an RR Lyrae or δ Scuti star and its physical parameters from multi-color photometry.

Key words.

1. Introduction

The nature of AC And has been disputed: the variable star catalogue (Kholopov, 1985) classified it as a unique variable star outside the range of the canonical classification; Simbad reported it to be a variable star of the RR Lyrae type; Rodríguez (2002) defined it as the prototype of its own class.

2. Observations

The observations were carried out at the San Pedro Mártir Observatory, OAN, México. We present the results of the analysis to determine the periodic content and physical parameters once its true nature is established.

Correction for interstellar reddening is needed before a direct comparison with the theoretical models can be made. Since at this stage it has not yet been determined which type of star AC And is, the determination of the reddening of AC And was undertaken considering it to be possibly either: 1) a δ Scuti 2) an RR Lyrae star.

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3. Analysis

The first procedure we employed in the determination of the metal content of the star is based on that of Nissen (1988), equations which give the expression [Fe/H] $= -(10.5+50(\beta-2.626))\,\delta m_0 + 0.12$, valid for main sequence stars in the range $2.59 < \beta < 2.72$. The mean [Fe/H] for main sequence stars is 0.46. As an alternative method, assuming this time AC And is an RR Lyrae star, we used the technique of Fourier decomposition of the light curve. Under this approach, the light curve is represented by a series of harmonics of the form: $f(t) = A_0 + \sum(A_k \cos(2\pi k(t-E)/P + \phi_k))$. Simon & Clement (1993) first offered calibrations of the effective temperature $T_{\rm eff}$, a helium content parameter Y, the stellar mass M, and the luminosity $\log L$, in terms of the period and Fourier parameter ϕ_{31} for RRc type stars. Their work was extended to RRab

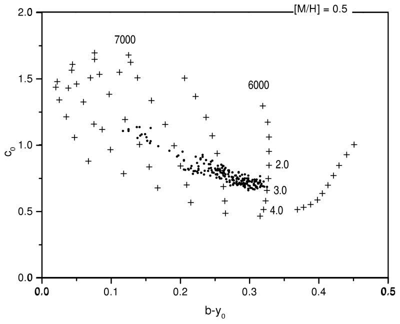

Fig. 1. Location of AC And in the $(b - y)_0$ vs. c_0 diagram of Lester et al. (1986) that fixes the temperature and log g range.

stars by Jurcsik (1998 and references within). A [Fe/H] of −0.995 is obtained

The first reliable periods were proposed by F&S76 and have remained undisputed since then. It would be interesting, as K&B94 suggested, to study the periodicity of pulsation of this star with more data. The result confirms the validity of the frequencies proposed by F&S 76, and predictions from these results, compared to the observations, were derived although we mention that even when the phasing is adequate, the fine details of the light curves are not fully described by this set of frequencies, amplitudes and phases.

What is the status of AC And? If AC And is of a δ Scuti nature, its physical values should be similar to those large amplitude δ Scuti stars. There are several of these stars, CY Aqr, DY Her, DY Peg and YZ Boo, which have been measured in multicolor Strömgren photometry (Peña et al., 1999). A compilation of the obtained results in the same $(b - y)_0$ vs. c_0 diagrams from Lester et al. (1986), except for their proper chemical compositions fixes them at temperature ranges from 7000 K to 8000 K and log g values of 4.0. For both chemical compositions determined here of either 0.5 or −1.0, and assuming either a main sequence or RR Lyrae star, we establish a temperature range variation at cooler temperatures with values between 6000 K or 5750 K, respectively, up to 7500 and, more importantly, with log g values at 3.0 or 2.5 depending on the metallicity value considered. It is important to point out that it has log g values of a more evolved star than those found for any of the large amplitude δ Scuti stars considered. In view of this we conclude that AC And is NOT a large amplitude δ Scuti star but an RR Lyrae star, but it is atypical because it has already been proved that it is multi-periodic. Its peculiarity is a fact that was stated in the literature long ago.

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