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THE QUEST RR LYRAE SURVEY OF THE CANIS MAJOR OVERDENSITY

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RESUMEN

Presentamos los resultados del Sondeo QUEST de estrellas RR Lyrae en la sobredensidad del Can Mayor. El sondeo consiste en observaciones multi-época en los filtros V y R, obtenidas con el telescopio Jürgen Stock y la cámara QUEST-I ubicados en el Observatorio Astronómico Nacional de Venezuela, abarcando un área total de 16.7 grados cuadrados. Se identificaron 12 estrellas RR Lyrae, 6 de tipo ab y 6 de tipo c. Comparamos nuestros resultados con el número esperado de estrellas RR Lyrae del halo y disco grueso, así como con el esperado en galaxias esferoidales enanas con diversas frecuencias específicas de estrellas RR Lyrae.

ABSTRACT

We present results from the QUEST RR Lyrae Survey in the Canis Major overdensity. The survey consists of multi-epoch observations in V and R filters, obtained with the Jürgen Stock telescope and the QUEST-I camera at the National Observatory of Venezuela, spanning a total area of 16.7 square degrees. A number of 12 RR Lyrae stars were identified, 6 of type ab and 6 of type c. We compare our results with the number of RR Lyrae stars expected from the halo and thick disk, as well as that expected from dSph galaxies with different specific frequencies of RR Lyrae stars.

Key Words: galaxies: individual (Canis Majoris) — Galaxy: stellar content — Galaxy: structure — stars: variables

1. INTRODUCTION

The nature of the Canis Major (CMa) overdensity is currently a subject of debate. It was identified by Martin et al. (2004) as an excess in the density of M giants in the southern galactic hemisphere relative to the north, and was originally interpreted as the remnant core of a disrupting dSph galaxy. An alternate interpretation was soon after proposed by Momany et al. (2004), where they argued that the CMa feature is due to the galactic thin disk warp seen in projection. Furthermore, it has been shown by Moitinho et al. (2006) that a young population formerly attributed to CMa, is instead associated to the extension of the Norma-Cygnus spiral arm. Finally, it has been suggested by Carraro et al. (2007) that the whole population of the CMa overdensity can be explained as a signature of the Galactic warped thin and thick disks.

In light of the ongoing controversy, the goal of our work was to conduct a large scale survey of RR Lyrae stars (RRLS) in the CMa region. Since RRLS have been detected in all Milky Way (MW) dSph satellites (e.g., Vivas & Zinn 2006), an overdensity of these stars would be expected if CMa were indeed a dwarf galaxy. Moreover, the RRLS spatial distribution would allow us to disentangle more clearly the galactic contribution from a possible extragalactic one, since RRLS are excellent standard candles thus allowing for the determination of accurate distances.

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2. OBSERVATIONS AND PHOTOMETRY

Multi-epoch observations were obtained in V and R filters, using the QUEST-I mosaic camera (Baltay et al. 2002) installed at the 1.0 m Jürgen Stock Schmidt telescope, located at the National Astronomical Observatory of Venezuela. The survey is centered at $l = 240°, b = -9°$ and covers a total area of 16.7 square degrees, with a mean of 15 observations per star.

Data reduction was performed using standard *IRAF* tasks. PSF photometry was obtained for all objects by means of standard DAOPHOT tasks, using a PSF spatially variable up to second order, constructed from 110 to 130 psf stars per frame. The photometry was calibrated using 316 secondary standards, calibrated from Landolt standards. Since the extinction in the surveyed region is highly variable due to its proximity to the galactic plane, the magnitudes for each object were corrected individually using the Schlegel et al. (1998) dust maps with the asymptotic correction of Bonifacio et al. (2000).

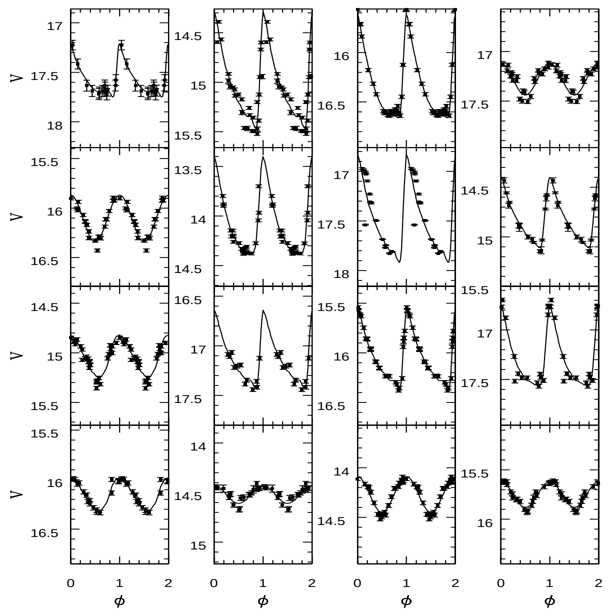

Fig. 1. Light curves of the identified RRLS.

3. RR LYRAE SEARCH RESULTS

The RRLS search was conducted among variable stars (selected via a χ^2 test as in Vivas et al. 2004) with color indices in the range expected for RRLS, by means of a light-curve template fitting algorithm. A total of 6 type-ab and 6 type-c RRLS were identified and the corresponding light curves are shown in Figure 1. In the distance range covered by our survey (3 kpc $\leq D_\odot \leq$ 49 kpc), the completitude was estimated to be $\sim 95\%$ and $\sim 85\%$ for types ab and c respectively.

In the volume covered by our survey, the expected number of galactic RRLS was calculated by integrating the halo and thick disk density profiles. Depending on the parameters assumed for these profiles, we estimate that $\sim 11-13$ RRLS are expected. This is consistent with the 12 RRLS found in our survey. Particularly, in the distance range of CMa (conservatively $D_\odot < 10$ kpc) we find 6 RRLS and $\sim 3-5$ are expected.

We also calculated the number $N_{\rm CMa}$ of RRLS expected in CMa for the different RRL specific frequencies observed in the dSph satellites of the MW, based on the data compiled by Vivas & Zinn (2006). The results are shown in Table 1. Thus, if CMa were a dSph galaxy with a stellar population similar to any of the MW satellites, the number of RRLS expected differs by more than two orders of magnitude from the predicted number for even the satellite galaxies with the lowest values of SRR, for which $N_{\rm CMa} \sim 700$. Hence, the results of our survey rule out that CMa could be a dwarf galaxy with an old population having an SRR typical of the dSph satellites of the MW and also M31.

TABLE 1

SPECIFIC FREQUENCY AND EXPECTED NUMBER OF RRLSs*

Galaxy	M_V	[Fe/H]	S_{RR}	$N_{\rm CMa}$
Carina	−8.6	−2.0	28	10985
Draco	−8.4	−2.0	117	46573
Fornax	−13	−1.3	4	1658
Leo I	−11.5	−1.5	2	740
Leo II	−9.6	−1.9	21	8517
Sagittarius	−13.9	−1.0	14	5702
Sculptor	−10.7	−1.8	26	10446
Sextans	−9.2	−1.7	54	21626
Ursa Minor	−8.4	−2.2	37	14598

* M_V, [Fe/H] and S_{RR} taken from Vivas & Zinn (2006).

4. CONCLUSIONS

In this contribution we presented results from the QUEST RRL survey in CMa. A total number of 12 RRLS were found in an area of 16.7 square degrees. We calculated the number of RRLS expected from the halo and thick disk of the Galaxy, obtaining $\sim 11-13$, which is statistically consistent with the number of RRLS found in our survey, thus weakening the hypothesis of an extragalactic origin of the CMa overdensity.

Furthermore, from the known specific frequencies of RRLS in dSph satellites of the MW, we obtained an expected number of RRLS in CMa large enough to have been detected given the completeness of our survey. Hence, the only possibility that remains for CMa to be a dwarf galaxy, is having a stellar population with a specific frequency of RRLS as low as Leo I. A more detailed analysis of our data is presently being conducted in order to test this hypothesis.

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