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CONFIRMATION OF HALO SUBSTRUCTURE USING QUEST RR LYRAE DATA: THE NEW VIRGO STELLAR STREAM (VSS)

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RESUMEN

Se han obtenido observaciones espectroscópicas de dieciocho estrellas RR Lyrae (RRLs) que pertenecen al "cúmulo de 12.4 hr", una prominente sobredensidad de halo en la exploración QUEST de RRLs. Diez estrellas azules de la rama horizontal de la misma región del espacio que ha sido medida por Sirko et al. (2004) fueron añadidas a esta muestra. Trece de las 28 estrellas de toda la muestra poseen velocidades radiales muy similares lo cual representa una fuerte evidencia que éstas constituyen una corriente estelar. Mediciones de [Fe/H] para siete de las RRLs indican que en promedio es muy pobre en metales, pero con variaciones significativas en metalicidad de estrella a estrella. Esto sugiere que la corriente, localizada en Virgo, son los residuos de la destrucción por marea de una galaxia enana de baja luminosidad.

ABSTRACT

Spectroscopic observations have been obtained of eighteen RR Lyrae stars (RRLs) belonging to the "12.4 hr clump", a prominent halo overdensity in the QUEST RRLs survey. Ten blue horizontal branch stars in the same region of space that had been measured by Sirko et al. (2004) were added to this sample. Thirteen of the 28 stars in the whole sample have very similar radial velocities, which is strong evidence that they constitute a stellar stream. Measurements of [Fe/H] for seven of the RRLs in the stream indicate that in the mean it is very metal poor, but with significant star to star variations in metallicity. This suggests that the stream, which is located in Virgo, is debris from the tidal destruction of a low luminosity dwarf galaxy.

Key Words: **GALAXY: FORMATION — GALAXY: HALO — GALAXY: STRUCTURE — STARS: VARIABLES: OTHER**

1. FIRST RESULTS

This talk presented the first results of the Ph.D. thesis project of Sonia Duffau of the Universidad de Chile. This project is part of the collaboration in graduate education in astronomy between U. de Chile and Yale University. A more complete description of this research can be found in Duffau et al. (2006).

This project consists of spectroscopic observations of RRLs variables in the overdensities in the Galactic Halo that were indentified by the QUEST survey (Vivas 2002; Vivas et al. 2004).

This report concentrates on the "12.4 hr clump" that was first detected by Vivas et al (2001) in their partial reduction of the QUEST survey. The completion of the survey showed that it is the second most prominent feature in the survey after the stellar stream from the Sagittarius dwarf spheroidal galaxy (Vivas 2002; Vivas and Zinn 2003). An overdensity of F type main-sequence stars was discovered in approximately the same location by Newberg et al. (2002), who used SDSS photometry. Our spectroscopic observations were made primarily with the Magellan Clay telescope and its B & C spectrograph. A few additional ones were made with the ESO 1.5m and the WIYN 3.5m telescopes. We added to this sample of eighteen RRLs ten blue horizontal branch (BHB) stars from Sirko et al. (2004) that lie in the same region of space. Sirko et al. (2004) had previously measured the radial velocities of these BHB stars from SDSS spectroscopy.

Six of the nine stars in the densest region of the clump have a mean radial velocity in the Galactic rest frame ($V_{\rm gsr}$) of 99.8 and $\sigma = 17.3$ km s^{-1}, which is slightly smaller than the average error of the measurements. The whole sample contains eight RRLs and five BHB stars that have values of $V_{\rm gsr}$ suggesting membership in this stream . For seven of these RRLs, the measurements of [Fe/H], which have internal precision of 0.08 dex, yield $\langle[\mathrm{Fe/H}]\rangle = -1.86$ and $\sigma = 0.40$. These values suggest that the stream is a tidally disrupted dwarf spheroidal galaxy of low luminosity. To estimate the spatial extent of this

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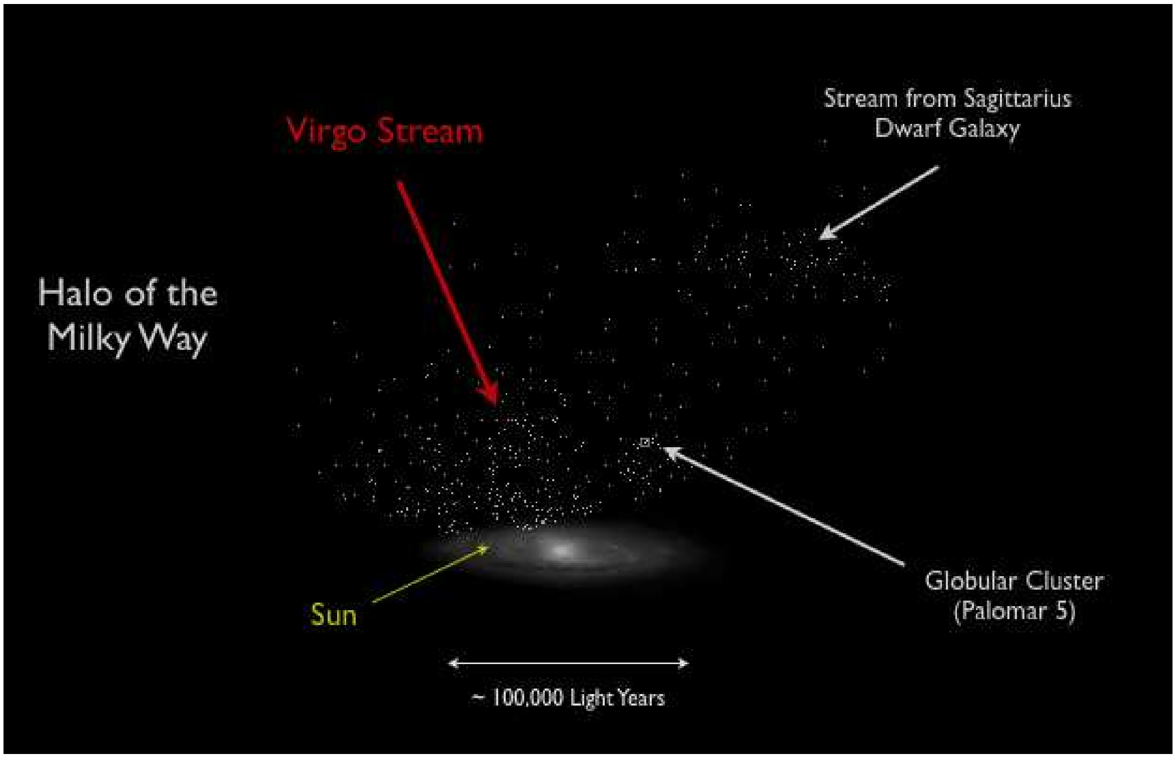

Fig. 1. The QUEST RRLs (small points) are plotted in a schematic diagram of the Milky Way's halo. The positions of the Virgo Stellar Stream and other prominent features are indicated.

halo substructure, we examined the SDSS photometric database for evidence of an upturn in the luminosity function at the magnitude where the subgiant branch and the main-sequence are expected to merge if the stellar population is as old as a globular cluster. Evidence for such an upturn was found in 106 deg^2 of the sky in the constellation of Virgo.

The new Virgo Stellar Stream (VSS) is depicted in Fig. 1, which is a schematic diagram of the Galactic Halo where the QUEST RRLs are plotted as small points. Our radial velocity measurements indicate that VSS is not related to the stream from the Sgr dSph galaxy or to the globular cluster Pal 5. It appears to be yet another example of the cannibalization of a dwarf galaxy by the Milky Way. We continue to gather more spectroscopic data of possible VSS members in order to determine better its spatial extent and its kinematic and metallicity signatures.

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