Searching for an Intrinsic Stellar Population in Compact High-Velocity Clouds

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Abstract. We are investigating the hypothesis that Compact High–Velocity Clouds (CHVCs) are the left-over building blocks of Local Group galaxies. To this end, we are searching for their embedded stellar populations using FORS at the VLT. The search is done with single-star photometry in V and I bands, which is sensitive to both, young and old, stellar populations. Five CHVCs of our sample have been observed so far down to I=24. We pointed the VLT towards the highest HI column density regions, as determined in Effelsberg radio data. In an alternate approach, we searched 2MASS public data towards those 5 CHVCs down to K=16. While the VLT data probe the central regions out to distance moduli of about 27, the 2MASS data are sensitive to a population of red giant stars to distance moduli of about 20. The 2MASS data, on the other hand, cover a much wider field of view than the VLT data (radius of 1 degree versus FORS field of 6.8 arcmin). We did not find a stellar population intrinsic to the CHVCs in either data. In this paper, we illustrate our search methods.

Keywords: dwarf galaxies, HVC, stellar content

1. Introduction

Recent cold dark matter simulations of the formation and evolution of galaxies predict the existence of a significantly higher amount of substructure around big galaxies like the Milky Way (Klypin et al., 1999), (Moore et al., 1999) than observed in the form of dwarf galaxies (Mateo, 1998). One solution for this so-called dwarf galaxy crisis could be that the predicted subhalos have been overlooked observationally and are hidden among the population of Compact High-Velocity Clouds (CHVC). Blitz et al. (1999) suggested that isolated CHVCs might be the leftover building blocks predicted in the CMD scenario with mean distance of about 1 Mpc. Braun & Burton (1999, 2000) identified an initial catalog of 65 CHVCs. We here present deep optical VLT imaging

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and 2MASS archival studies of five CHVCs to test them for the presence of a stellar population.

2. Observations

V and I band observations were obtained with FORS1 at the VLT down to limiting magnitudes to be sensitive to red giant stars at distances up to \( \sim 3 \) Mpc. The field of view, 6.8 by 6.8 arcmin, was centered on the highest column density regions (for four CHVCs) using Effelsberg radio data. We also selected all stars within a radius of 1° from 2MASS (second incremental data release). These near-infrared JHK data are sensitive to old stellar populations at the typical distances of Milky Way dwarf Spheroidal companions.

The optical CCD data were searched and analyzed with DAOPHOT II (Stetson, 1992). They are not only sensitive to old stars but would easily...
Figure 2. I, V-I CMD of the field of HIPASS J1712-64. Globular cluster ridge-lines of Da Costa & Armandroff (1990) are overplotted.

also reveal the presence of main sequence (MS) stars of a young stellar population to large distances.

3. Results

Fig. 1 shows color magnitude diagrams (CMD) for four of our CHVC fields. Fig. 2 is the CMD of a HIPASS HVC. Extended sources were excluded from the analysis; the amount of unresolved background galaxies is small anyway due to the excellent seeing of the data, namely 0.65 arc sec FWHM. The CMDs appear as expected for Milky Way halo fields. A visual inspection does not reveal any additional stellar component, e.g. a RGB or a MS at the expected distances/apparent magnitudes.

A visual inspection of near-infrared 2MASS CMDs does not show any evidence for a spread-out RGB or AGB population. For comparison, 2MASS CMDs of several dSph Milky Way companions, as well as positional plots of the stars, allow the detection of intermediate rich systems like For and Scl, while UMi can not be isolated from the halo stars.
We performed statistical tests by adding artificially, diluted red giant branches of known dwarf galaxies, to the observed CHVC CMDs. We then compared these distributions to those originally observed using a Kolmogorow-Smirnow test. A population of about 50 RGB stars at a distance of $\sim 0.5$ Mpc is at the detection limit of the VLT data; richer systems such as those of the known dSph Milky Way satellites would easily be found. For details of this analysis, see Hopp, Schulte-Ladbeck & Kerp, 2003 (MNRAS, in press).

4. Conclusions

We conclude that the observed compact clouds do not host an intrinsic stellar population. Our conclusions agree with and extend those reported by Simon & Blitz (2002), who did not detect stars in CHVCs on processed POSS scans.

Acknowledgements

This research has made use of the NASA/IPAC Infrared Science Archive, which is operated by the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration. UH acknowledges support by the SFB 375 of the DFG. RSL thanks the Department of Physics & Astronomy for a leave of absence, and the MPE Garching for hosting her visit.

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