Part 6. Stellar Clusters

Section B. Poster Papers

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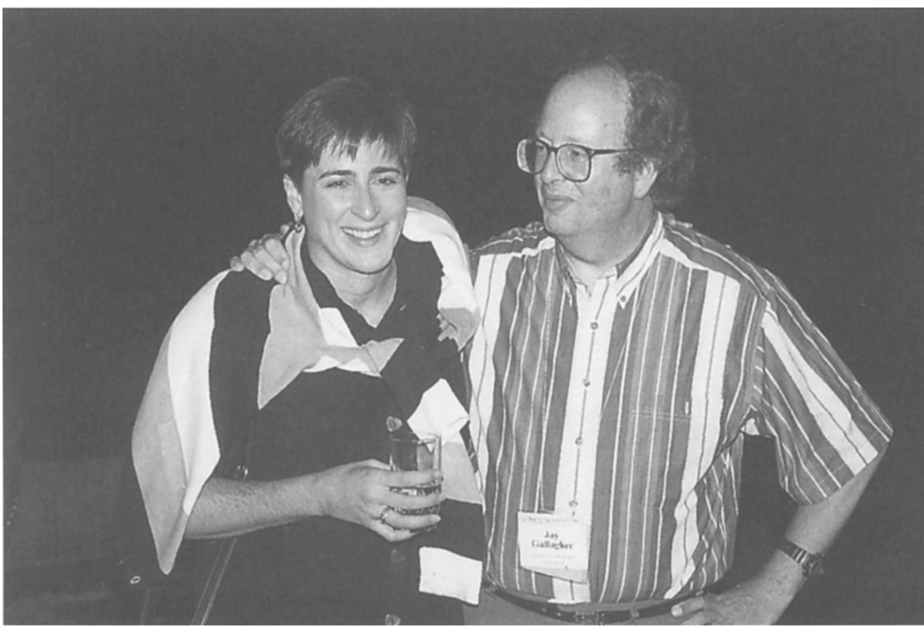

Tammy Smecker-Hane and Jay Gallagher enjoy a moment following the Symposium banquet.

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Ages and Metallicities of LMC Clusters and Their Surrounding Fields

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Abstract. We report on a survey of 25 candidate old LMC clusters. Washington photometry was obtained on the CTIO 0.9m in $< 1^h$, reaching below the turnoff. Ages based on the magnitude difference δT_1 between the giant branch clump and the turnoff revealed that no new old clusters were found. The candidates all turned out to be of intermediate age (1-3 Gyr). We confirm that there was apparently no cluster formation in the LMC from 3-9 Gyr ago, and that there was a pronounced epoch of cluster formation beginning 3 Gyrs ago that peaked at ~ 1.5 Gyrs ago. We also determine ages for the surrounding fields, as well as metallicities for both the clusters and fields from the color of the giant branch. In most cases the stellar population of each cluster is quite similar to that of its field. The mean metallicity for the intermediate age outer disk clusters is -0.65. A few clusters stand out in the age–metallicity relation in the sense that they are intermediate age clusters at relatively low metallicity. In the northern part of the LMC disk 3 fields all have a secondary clump $\sim$0.45 mag fainter than the dominant clump, suggesting a component located behind the LMC at a distance comparable to that of the SMC.

1. Introduction

There are only a handful of known LMC clusters that are genuinely old, similar to the globular clusters (GCs) in the Milky Way. LMC clusters show a pronounced age gap between a large number of intermediate age clusters (age $\sim 1 - 3$ Gyr, hereafter IACs) and the classical GCs, with ages > 12 Gyr (Olszewski et al. 1991), with the sole exception of ESO121-SC03 with an age of ~ 9 Gyr. This prevents us from using clusters to tell us any details about chemical evolution in the LMC over most of its history, despite our ability to determine accurate ages and metallicities for them. Finding even a single additional cluster in this age gap, or more old GCs, would significantly enhance our knowledge of the chemical evolution in the LMC. Several studies have uncovered a number of interesting old cluster candidates. Our primary source was the catalog of integrated UBV photometry for 624 clusters by Bica et al. (1996). We obtained Washington photometry for the 25 best candidate old clusters from this study.

2. Results

Our results have been published in Geisler et al. (1997) and Bica et al. (1998). Our CMD for ESO121-SC03 reaches well below the turnoff in this $\approx$ 9Gyr cluster and therefore shows that our technique can easily distinguish between IACs and older clusters. The magnitude difference (δT_1) between the giant branch clump in IACs (the horizontal branch in GCs) and the turnoff is well correlated with age, and is independent of reddening and distance.

Our intriguing result is that all the old cluster candidates turned out to be IACs!. This confirms with a larger and more homogeneous dataset previous indications that the LMC apparently did not form clusters between 3–9 Gyrs ago, a period covering $\sim 1/2$ of its life, and that it only formed a single (surviving) cluster between 3 Gyrs and the epoch of formation of the classical GCs. We have also found additional evidence that the onset of IAC formation ocurred at 3 Gyr, with a peak at $\sim$ 1.5 Gyrs.

Da Costa and Armandroff (1990) showed the utility of the $(V - I)$ color of the giant branch for measuring metallicities in old stellar populations. Geisler and Sarajedini (1999) introduced a similar technique using the $(C - T_1)$ color. This technique **has three times the metallicity sensitivity of** $(V - I)$. We have used their calibration (corrected for age effects) to derive metallicities for both clusters and their fields, as well as their age-metallcity relation.

Three of our fields present a unique feature: a populated secondary clump $\approx$0.45 mag fainter than the prominent main clump seen in all other fields. Intriguingly, these 3 fields are all located within about 1° of each other! This feature might be interpreted as a depth structure consisting of a layer of stars located approximately 10 Kpc behind the LMC, at a distance comparable to that of the SMC, or perhaps a dwarf companion to the LMC. More studies are needed to investigate this intriguing feature.

References

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Discussion

David Graff: Do you have a program to map out the velocities of this area? What is the density of stars in your field?

Geisler: Yes, radial velocities wil be very important to understand the origin of this phenomenon. I would guess we roughly have 5,000-10,000 stars in our 13.6′ × 13.6′ fields.

Despina Hatzidimitriou: Do you have a rough estimate of the number of old red HB stars compared to the total number of red clump stars?

Geisler: We are currently assessing such values. Although not yet available in detail, the ratio in these dual clump fields is very small (maybe 10%).