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M31 Globular Clusters in the Near-Infrared

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Abstract. We have observed the M31 globular clusters with the University of Hawaii Adaptive Optics System Hokupa'a at the Gemini North 8m telescope on Mauna Kea. This is part of a project which aims at spatially resolving intermediate-age and old-age stellar populations in the Local Volume and beyond - possibly out to distances of the Virgo and Fornax clusters. The sparse M31 globular cluster G27 (Hubble 6) is for the first time resolved into individual stars. The tip of the red giant branch (TRGB) at K≈18.8mag yields a metallicity of Z around 0.001 solar for G27.

1. Introduction

The observations were obtained in Nov. 2000 with the University of Hawaii Adaptive Optics System Hokupa'a (Graves et al. 2000). The targets selected were either themselves bright enough for the AO system to lock on (as in the case of G1) or were located within ≈20″ of a sufficiently bright stellar source (as in the case of G27). Two clusters were readily resolved. By resolving G27 (aka Hubble 6) into individual stars we confirm for the first time that it is indeed a globular cluster as originally suggested by Hubble (1932).

2. TRGB magnitude vs. metallicity and age

The estimate of the effect of metallicity and age on the TRGB magnitude are based on the isochrones from Bertelli et al. (1994). In the K-band, an uncertainty in the age estimate of ±5 Gyr around an assumed age of 10 Gyr amounts to less than ±0.1 mag change in the TRGB magnitude (see Figure 1).

In the case of G27, the sparseness of the cluster and the strong contamination by M31 field stars makes it difficult to determine the exact location of the tip of the red giant branch (TRGB). The K-band luminosity function for G27 suggests that the TRGB is located between $K' = 18.5$ mag and 19.0 mag, though with a large uncertainty (see Figure 2).

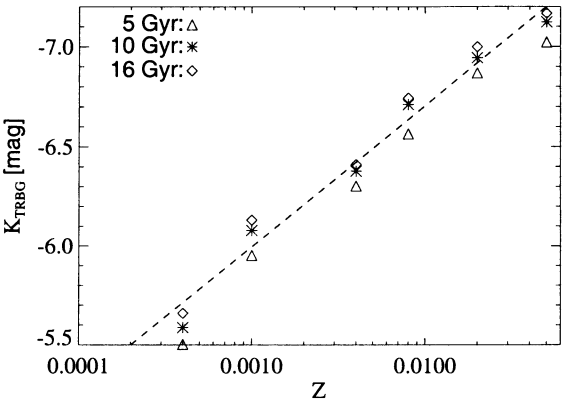

Figure 1. TRGB K-band magnitude for ages of 5, 10 and 16 Gyr.

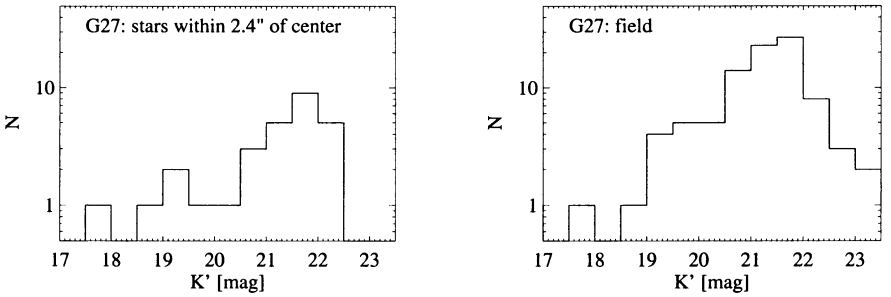

Figure 2. K-band luminosity function for stars within 2.4″ of the center of G27 (left) and for stars outside this region (region).

3. Prospects: Adaptive Optics at 8 m-class telescopes

Extrapolations of the observations with Hokupa'a and Gemini, and simulations on the expected performance of NAOS & CONICA at the VLT indicate that stars at the TRGB can be easily detected in the K-band out to a distance modulus of 30 mag in ≈30 min of integration time at 8m class telescopes with adaptive optics. A K-band detection of TRGB stars in the Virgo and Fornax clusters would require several hours of 8m class telescope time and is probably close to the limit of what is achievable with ground-based 8m class facilities equipped with adaptive optics.

References

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