

## Search Methods for Globular Cluster Candidates in M31

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**Abstract.** Searching for globular cluster candidates in nearby galaxies such as M31 is the first step to study the characteristics of extragalactic globular cluster systems. Previous searches for M31 globular clusters were mostly based on visual inspection of photographic plates. We have selected globular cluster candidates from a wide-field Washington CCD survey of M31, using various methods: color-magnitude diagrams, color-color diagrams, point spread function subtraction and visual inspection of the objects. The efficiency and accuracy of these methods for finding globular clusters are presented.

### 1. Introduction

M31 likely contains more globular clusters (GCs) than in all of the other Local Group galaxies combined, and its GC system often serves as a template, e.g. for GC luminosity function studies. Many surveys have been carried out to identify and study this important GCS. There are currently  $\sim 800$  proposed GC candidates in M31. Over 200 of these objects have been confirmed as GCs, 200 have been shown not to be GCs, and the nature of the remaining objects is as yet unknown (Barmby et al. 2000). However, most of the M31 GC catalogs were constructed from large scale photographic plates, while only a few studies are based on CCD photometry of (albeit) small areas in M31 (e.g. Battistini et al. 1993; Reed, Harris, & Harris 1994; Mochejska et al. 1998). Thus existing catalogs suffer from bright limiting magnitudes, poor photometric accuracy and confusion between GCs and contaminating stars and galaxies.

Therefore, over the past few years, we have undertaken a wide field CCD survey of the GCs in M31 using the KPNO 0.9m and the Tek 2k imager. Washington CMT1 images of 47 (23'x 23') fields covering a region 3° x 3° centered on M31 were obtained and analyzed to search for new GC candidates. We have selected GC candidates using several criteria: a) color-magnitude diagrams b) color-color diagrams, c) point spread function subtractions, d) visual inspection of the images. Our recovery rate of known GCs is > 90%.

## 2. Search Methods

For the purpose of this study, we use the DAOPHOT program and ALLFRAME for the photometry in 3 filters (C,M,T1) for each field. After obtaining the photometry, we generate a subtracted image and blink the original and the subtracted images, and look for objects with an oversubtracted center and an undersubtracted outer region, indicating the objects are resolved.

The GCs candidates have the following features:

- The FWHM are 2 px to 3.5 px (slightly to substantially resolved).
- Ellipticity < 0.2, with a round and smooth appearance.
- Candidates must fall in the GC region in the  $T_1$  vs  $C - T_1$  CMD and  $M - T_1$  vs  $C - M$  2 color diagram.

## 3. Results

Figure 1 shows the  $T_1$  vs  $C - T_1$  CMD of the objects in seven selected fields in M31. The mass of faint red dots is the tip of the RGB in M31. The x's represent previously known GCs and the circles are newly-discovered GC candidates. The square, triangle and star symbols represent, respectively, a background galaxy, quasar and stars which were included in previous catalogs of M31 GCs. Note how successfully the known GCs are recovered and how many more new GC candidates (especially faint ones) are found in our survey. We anticipate that our survey will generate a much more complete catalog of the M31 GC system. The photometry will be used to derive the luminosity function, metallicity distribution, etc. Note that the integrated  $C - T_1$  color is very metallicity sensitive and we should derive metallicities accurate to 0.2 dex.

## References

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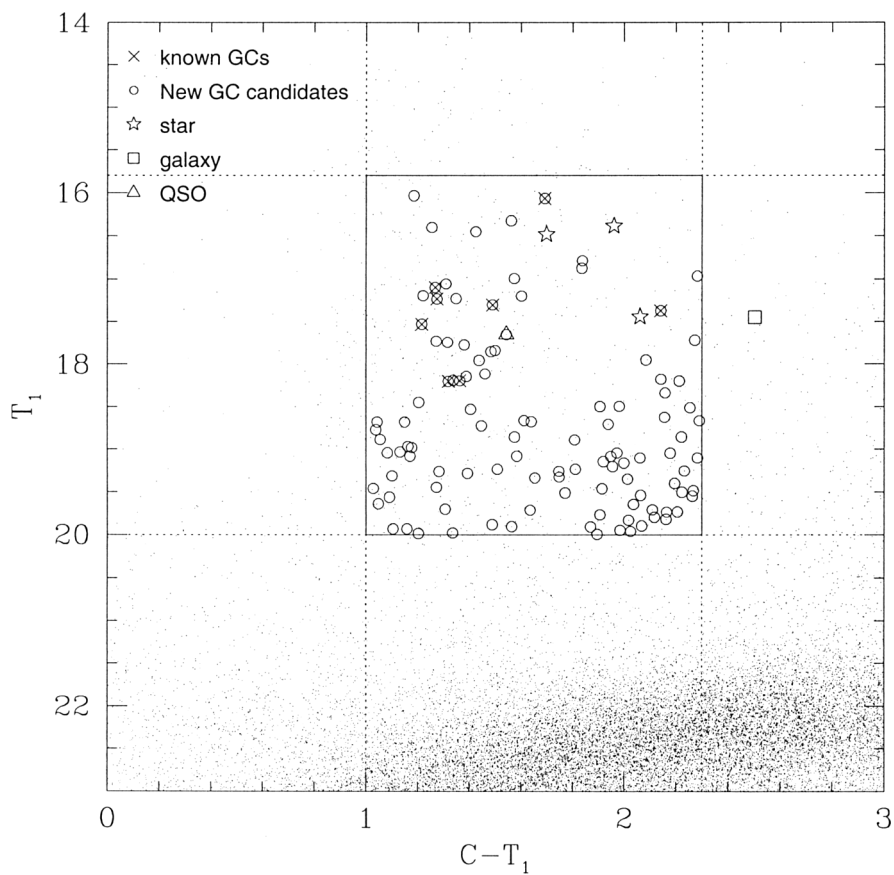


Figure 1.  $T_1$  vs  $C - T_1$  color magnitude diagram of the objects in seven selected fields in M31