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MULTIBAND PHOTOMETRY OF SELECTED AREAS IN A STUDY OF GALACTIC STRUCTURE

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ABSTRACT. The BATC (Beijing-Arizona-Taipei-Connecticut) intermediate-

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band 15 filter photometry system has been tested by using the Michigan Curtis Schmidt telescope at CTIO taking one-degree fields around NGC 288, SA 92, 94, 95, Lp 543-32/33. BVRI and uvby, Hβ filter observations of these same fields were also made using the 0.9 m CTIO telescope. The main purpose of these observations is to compare the results from the standard filter color systems (UBVRI and ubvy, Hβ) to those we can construct from the BATC filter system. These fields were chosen based on available filter color data in those systems. The BATC data are being taken on a Schmidt telescope similar to that at CTIO, so that these observations can provide an independent source of calibration for the BATC data. This is a report on the status of this study.

[redacted]

Galaxy: structure

1. INTRODUCTION

The observational goal of the BATC survey is to obtain accurate spectral energy distributions (SEDs) of all objects - stars, galaxies, AGNs - found in

[redacted]

500 selected 1-degree fields in the northern hemisphere. The scientific goals of

[redacted]

standards as primary calibrators, and developing secondary calibrators from our own observations.

The present study uses the second BATC filter set to begin defining the relationship of our filter system to the more standard color systems in use today. By establishing these relationships both empirically and theoretically, the usefulness of the BATC survey data can be expanded to include accurate UBVRI and uvby, Hβ colors of stars and galaxies. In so doing, we can make use of the extensive literature that explores the physical properties of stars using these filter systems.

2. OBSERVATIONS AND ANALYSIS

Two CTIO telescopes were used for these observations. The BATC filters were used with the Michigan Curtis Schmidt telescope. The angular resolution of the 2048 x 2048 CCD on this telescope is about 2"/pixel, compared to a resolution of 1."67/pixel for the BAO Schmidt CCD system. In both cases, the field of view is about 1 square degree. The large pixel size means typical good seeing at CTIO (< 1."5 during our run) will undersample the seeing disk in the CCD image. As such a problem also affects the BATC data, these observations give us a separate data set against which we can test our methodology of stellar photometry. We also used the 0.9 m telescope to observe the same fields with UBVRI and uvby, Hβ filters, so as to have complete data for the comparison

With both good weather and excellent support from CTIO staff, we were able to observe all five fields in all 15 BATC filters over a three night period, 29 - 31 October 1995. Simultaneously, we also observed with the standard filter sets on the 0.9 m. The BATC filters were divided into three sets of five each, as detailed in Table 1. In each set we placed filters with a range of central wavelengths, so as to reasonably cover the spectrum each night. The typical observing time per image for each part of the spectrum is given in Table 1.

TABLE 1. Central wavelengths of filters in BATC sets observed in 1995

Night	#	CWL	#	CWL	#	CWL	#	CWL	#	CWL(A)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10/30/31	2	3890	5	4925	8	6070	11	7490	14	9190
10/31/01	3	4210	6	5270	9	6660	12	8020	15	9745
Exp(s)		~1200		~900		~700		~500		~400

time, only the data in the NGC 288 field have been calibrated in all standard filter passbands. The overall photometric accuracy is about ±0.024 in magnitude and ±0.028 mag in color for UBVRI, and ±0.017 in mag and ±0.023 in color for uvby, Hβ and ±0.06 in mag and ±0.1 in color for BATC data We expect to obtain ±0.01 accuracy for the BATC filters eventually.

It is desirable to obtain more than one exposure with each BATC filter, for cosmic ray removal and related issues. In the case of the blue and the UV filters, multiple images are needed to go as faint as for the red filter. However, the Schmidt telescope had occasional guiding problems which limited how many exposures could be taken in this run. As a result, the limiting magnitude in each filter is not optimum, and the total number of stars detected in each field in each filter varies. This is shown in Fig. 1 for Sa 92.

In attempting to combine all filters, we find that the number of point sources (stars and AGNs) in coincidence among the 15 filters is a monotonically

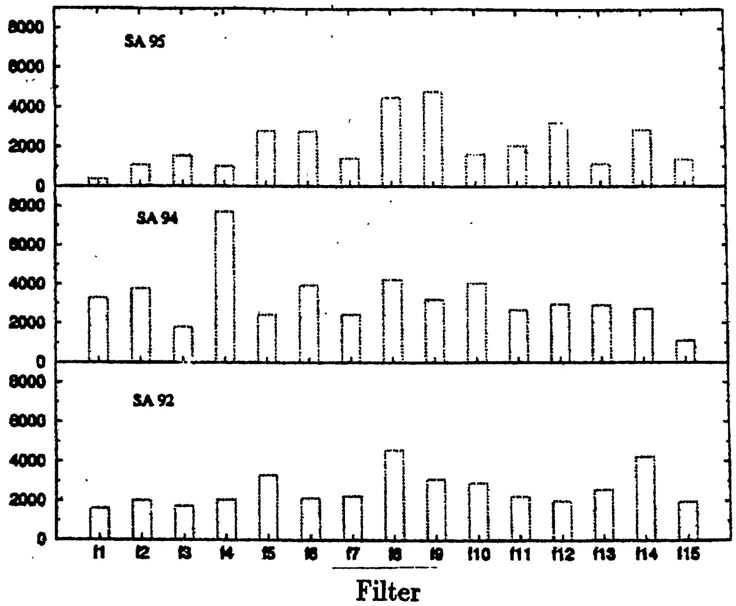

Fig. 1. Numbers of stars by BATC filter

Unfortunately, these trends are not surprising. Random noise sources, including cosmic rays and bad pixels, ensure a loss of stars for each image added. Stars with a range of color ensure differences in the detected stars near the mag- nitude cutoff for each filter. This is one reason we desire to obtain the same magnitude limit per filter. Multiple exposures per filter that are "dithered" can eliminate some of these problems, but not all.

Separately, Fig. 3 shows the distribution of stars detected as a function of instrumental magnitude per filter for the SA 92 field. As is evident, we detect mostly red objects among the brighter point sources, mostly objects that are either blue or of intermediate color at the faint end. As this kind of difference is also seen in the other fields observed, this indicates that our integration times for the near-infrared filters is too short by a wide margin (see Table 1). On future observing runs, integration times will be increased to be equal to the UV filters.

3. RESULTS AND SUMMARY

Fan et al. (1996) discuss a number of tests done with the BATC filters in the M 67 field, using the BAO Schmidt telescope and the first BATC filter set. For the present observations our ultimate goal is to calibrate the second BATC

filter set to the first set as accurately as possible. This goal is yet to be met, but we can still examine the relative accuracy of our data using the preliminary calibrations to UBVRI and uvby, Hβ systems. BATC filter m7 (5795 Å) is that [redacted]

V.

Color-magnitude diagrams for the full one square degree field in terms of the V - (B-V) BATC equivalent, m7 versus (m4 - m7), for SA 92 and SA 95 show no unusual distributions. The scatter in these diagrams is as expected for an arbitrary galactic field, and color cutoffs at the red and blue end are evident

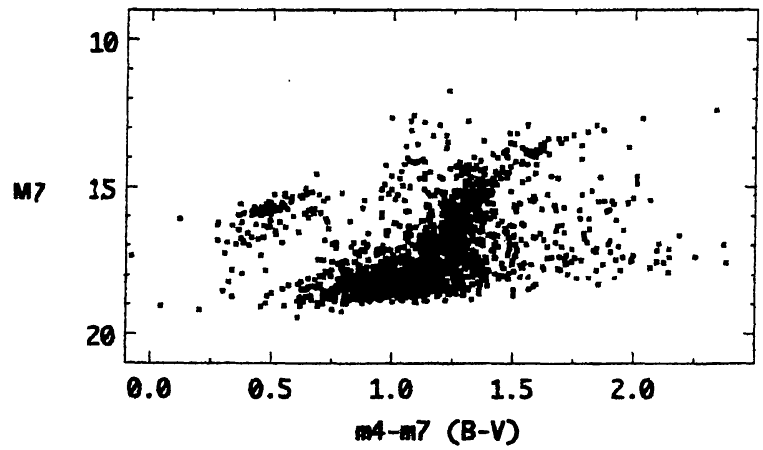

Fig. 4. m7(V) versus m4 - m7 (B-V) for NGC 288.

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