PHOTOGRAPHIC UVB PHOTOMETRY OF THE GLOBULAR CLUSTERS M 15 AND NGC 6712

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Abstract. Photographic intermediate band uvb observations of RGB and some AGB stars in 7×7 arcmin fields centered on the globular clusters M 15 and NGC 6712 are obtained. The photometric data is not fully reduced to the standard system but it is converted in an unique instrumental system. The photometry confirms the existence of the gaps in the giant branch of M 15. For NGC 6712 the Stromgren colors show a bimodal distribution and point at a bimodal carbon abundance for the bright giants from the central part. The possibilities of the uvby system for a classification of RGB and AGB stars are briefly discussed.

1. Introduction

Observations in the uvby system are rather informative about the metallicity and the chemical composition of late type stars (Bell and Gustafsson, 1975; Gustafsson and Bell, 1979). Such observations can be also applied to classify these objects (Olson 1974; Bond, 1980). In the uvby photometry of K-M stars difficulties arise in the reduction to the standard system and this explains the episodicity and the relatively insufficient homogeneity of the existing observations. The uvby data for the late type stars in globular clusters are also scarce. Now data about 80 RGB stars from several clusters is available (Richtler, 1988, 1989; Richtler and Nelles, 1983).

The present study reports the photographic uvb photometry of bright stars in 7×7 arcmin fields centered on M 15 and NGC 6712. From M 15 112 RGB stars brighter than 15 mag according the BV photometry of Spasova (1988) are measured. From NGC 6712 29 RGB and AGB stars brighter than 15.6 mag according the list of Cudworth (1988) are included.

2. Observations

The observations were performed on the 2 m reflector of the National Astronomical Observatory Rozhen, Bulgaria, during August 1989 – August 1991. The filters used are close to the standard uvby filters (Kaltcheva, 1990). The observations are comprised of 18 plates in colors u, v and b.

3. Photometric Reduction

It is impossible to perform a completely correct photometric reduction of the observations to the standard system. This is due to the different type of photometry
and the absence of standards suitable for photographic observations in this system. To fulfill a partial photometric calibration, on each plate together with the globular cluster, an open cluster with known uvby photometry was photographed, and from which stars were chosen for standards.

A photometric wedge was used to build the characteristic curve of each plate. In this way the instrumental stellar magnitudes $u$, $v$ and $b$ and the quantities $u - v$, $u - b$, $v - b$ and $c_1$ were obtained. We used the photoelectric uvby photometry of 5 stars from the open cluster NGC 7790 (Schmidt, 1981) to determine the zero point of these quantities. Preliminary corrections for the different air masses at which the objects from one plate had been photographed were made. This method of the zero point determination gives an accuracy 0.05 mag. Of course, there is no way to estimate the error in the zero point determination arising from the neglect of the color corrections. The intrinsic accuracy of the performed photometry is 0.03 mag. Because of the long exposure time our observations do not include plates in color $y$. For this reason the question to what extent the intermediate band $y$ quantities are more informative about these objects than the wide band $V$ values was considered. According to Schreur (1973) as far as normal objects are concerned an interchange with satisfactory electrophotometric accuracy is possible between the $y$ and $V$ value. In the course of the observations a possibility appeared to obtain a $y$ plate of the open cluster M 11 and of the globular cluster M 15. We compared the instrumental $y$ values of stars from these two clusters to the $V$ values taken from McNamara et al. (1977) and Spasova (1978) respectively. The dependencies obtained (Fig. 1) are linear, show small dispersion and show that the interchange within the photographic accuracy between the $y$ and $V$ values is