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THE NEW 60-CM TELESCOPE OF THE SHUMEN UNIVERSITY ASTRONOMICAL CENTER

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Abstract. We present the 60-cm Ritchey-Chretien telescope of the Shumen University Astronomical Center (Fig.1) and its equipment allowing remote-controlled observations. We found that the unit is appropriate for observations of different types of stars up to 17 mag with precision better than 0.02 mag for short exposures. The fainter stars would require exposures in the order of several minutes. We determine the transformation equations for transfer to standard Sloan g', r', i' photometric system and standard set of UBVRI filters with response curves close to those listed in Bessell (1990).

We briefly describe the telescope assembly process and calibration procedures. The telescope will mainly be used for photometric observations of variable stars and finally, we present the first observational results gathered with the new instrument.

1. INTRODUCTION

The Astronomical Observatory of Shumen University (AOShU) is the newest one in Bulgaria Kjurkchieva (2017). There are two telescopes for professional astronomical observations, 40-cm and 60-cm. The first light of the 40-cm telescope was taken in late 2017 Kjurkchieva et. al. (2020), and the first light of the new 60-cm telescope was made in mid-2023. This paper presents information about the equipment of the 60-cm telescope, the realization of remote control and the first results based on observations by this unit.

2. THE 60-cm TELESCOPE AND ITS EQUIPMENT

The 60-cm Ritchey-Chretien ASA RC600 (Fig. 1) is located in the 4-m Scope-Dome. The ASA DDM200 equatorial mount is fixed on a custom pole specially designed for the latitude of the observatory. The diameter of the telescope's main mirror is 60 cm. Its focal length is 4200 mm with a relative aperture of f/7. The main detector is an SBIG Aluma AC4040 a large format Scientific CMOS camera, featuring a 16.8 megapixel sensor (4096 × 4096 pixels) with 9 micron pixels.

The presence of a focal reducer (x0.64) makes the field of view 47 × 47 arcmin and the corresponding resolution is 0.69 arcsec/pixel. The telescope is equipped with an AFW-10-50SQ filter wheel with squared 50-mm Sloan filters g', r', i', narrow-band filters $H\alpha$ and also with a standard set of UBVRI filters with response curves

Figure 1: 60-cm Ritchey-Chretien telescope of the Shumen University

close to those listed in Bessell (1990). The remote control of the telescopes gives a possibility for more effective usage of the observational time and saving of human time, efforts and financial resources Iliev ()2014). Remote-controlled small telescopes have provided the huge ground-based wide-field surveys: ASAS (Pojmanski 1997), ROTSE (Akerlof 2005), Super-WASP (Pollacco et al. 2006), CRTS (Drake et al. 2014), etc. They are able to discover variable stars, exoplanets, transient and other interesting celestial objects, as well as to carry out follow-up observations of most of them. The ASA-provided software, as well as the purchased TheSky 10Pro and MaXimDL 7.0, provide remote viewing of the telescope, dome, camera and filter unit.

3. OBSERVATIONS

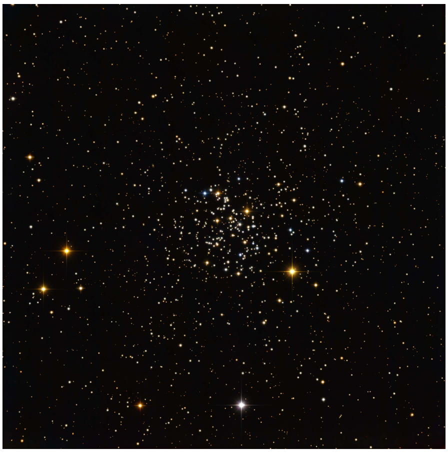
One of the first observations was of the open cluster M67 (Fig.2a) in order to determine the transformation coefficients of the system. The transformation coefficients are determined by the following formulas.

$$B_{var(transf)} = b_{var} - b_{comp} + T_{b-bv} * T_{bv} * [(b_{var} - v_{var}) - (b_{comp} - v_{comp})] + B_{comp} \quad (1)$$

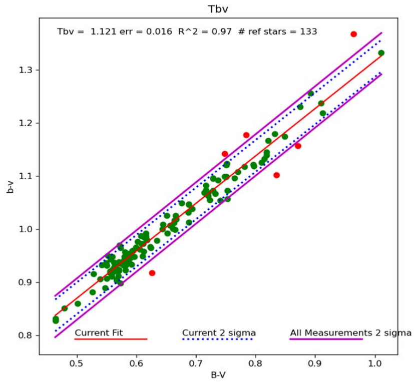
$$V_{var(transf)} = v_{var} - v_{comp} + T_{v-bv} * T_{bv} * [(b_{var} - v_{var}) - (b_{comp} - v_{comp})] + V_{comp} \quad (2)$$

$$R_{var(transf)} = r_{var} - r_{comp} + T_{r-vr} * T_{vr} * [(v_{var} - r_{var}) - (v_{comp} - r_{comp})] + R_{comp} \quad (3)$$

$$I_{var(transf)} = i_{var} - i_{comp} + T_{i-vi} * T_{vi} * [(v_{var} - i_{var}) - (v_{comp} - i_{comp})] + I_{comp} \quad (4)$$



(a) The open cluster M67 photographed with the 60-cm telescope on 03.03.2024 (BVRI-filters).



(b) The graph for determining one of the coefficients (Tbv)

Figure 2: About the transformation coefficients

Standard software of the AAVSO was used. Figure 2b illustrates the method for determining the coefficients. The obtained coefficients are shown in Table 1.

The symbiotic star T CrB has been observed in the last three months and it is expected to explode soon. Figure 3 shows the latest BVRI photometry of the star from 03.09.2024.

Table 1: Transformation coefficients with a set of BVRI filters.

Name	Value	Error
Tbv	1.121	0.016
T$b-bv$	0.091	0.013
Tbr	1.136	0.012
T$b-br$	0.063	0.009
T$b-bi$	0.060	0.007
Tbi	1.097	0.012
T$v-bv$	-0.035	0.011
Tvr	1.156	0.015
T$v-vr$	-0.066	0.021
T$r-vr$	-0.194	0.021
Tri	0.984	0.028
T$r-ri$	-0.282	0.021
T$i-ri$	-0.250	0.037
Tvi	1.048	0.016
T$v-vi$	-0.051	0.012
T$i-vi$	-0.081	0.017
T$r-vi$	-0.113	0.011

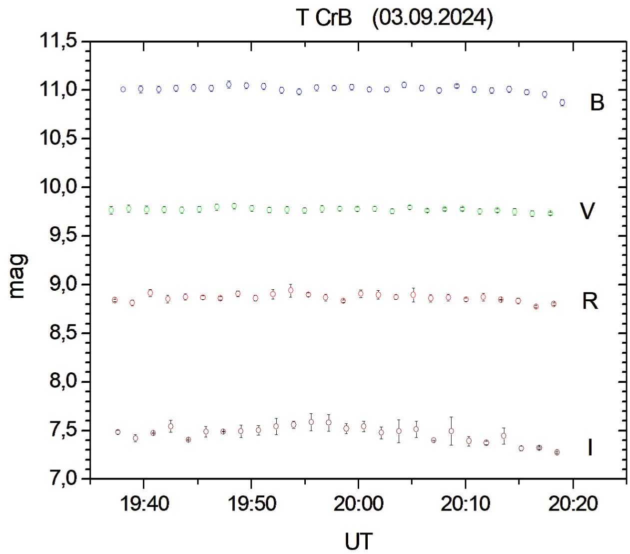


Figure 3: BVRI photometry of the T CrB from 03.09.2024

4. SUMMARY

The system allows accurate photometry of stars down to magnitude 17. The large field (near a degree) is very convenient for variable star photometry. Precise aiming and good mount guidance allow for long exposures. These features of the system expand the range of tasks that can be worked on.

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