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New panoramic camera for SAO RAS BTA

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Abstract. The development of a new multifunctional panoramic sky-viewing system for the 6-m optical telescope BTA at the Upper Scientific Site (VNP) of the Special Astrophysical Observatory of the Russian Academy of Sciences (SAO RAS) is described. The new viewing system based on an IP camera with a CMOS detector is being created to replace the panoramic system of the previous generation. The multifunctional online operating mode of the new system will provide remote monitoring of the sky over the VNP both at night and in the daytime (in color mode) with a variable field of view ranging from 5° to 87° and the ability of 360° scanning in azimuth and 90° by elevation angle. It is also possible to obtain not only the images of the night sky with stars and/or the Moon but also images of the Sun in daytime with sunspots resolved.

Keywords: methods: observational; techniques: image processing

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1 Introduction

In astronomical observations at the BTA and other optical telescopes located at the VNP of SAO RAS, remote round-the-clock video monitoring of both the entire celestial hemisphere and the panorama of the surroundings near the observing facilities is necessary. For this purpose, a digital television complex of the BTA and Zeiss-1000 telescopes was developed more than 20 years ago (Komarov et al. 2002). Its television cameras operate around the clock and are constantly modernized. Currently, there is a need to replace the outdated systems of this complex partially or even completely. One of such systems is the panoramic sky-viewing camera at the VNP.

2 Panoramic sky-viewing system in operation

The current panoramic sky-viewing system FEP50/10K, which is part of the digital television complex, has been operating and providing round-the-clock monitoring since 2008. The main characteristics of FEP-50/10K are given in Table 1.

Table 1. Characteristics of the panoramic viewing systems.

Parameter	FEP-50/10K	FEP-87/5[(a)]
Scanning angle (azimuth/elevation), deg	330/90	360+[(b)]/180
FOV, deg	10–50	5–87
Pointing accuracy, deg	±1	±0.5
Limited magnitude	9[(c)]	11
Operating mode	b/w	color+b/w
Format	4:3	16:9
Resolution, pix	768 × 576	1920 × 1080
Operation in direct sunlight	–	+[(d)]

[(a)] optional; [(b)] unlimited azimuth rotation; [(c)] $T_{\rm exp} = 2^{\rm s}.5$; [(d)] with solar filter.

The FEP50/10K system does not fit our current needs for a number of reasons, some outdated parameters being the essential ones. Therefore, either modernization of FEP50/10K or its complete replacement is necessary. The second way, in our opinion, is the most promising, so we have started developing and creating a new online panoramic camera for the VNP of the SAO RAS.

3 New online panoramic viewing system

Currently, we create a new panoramic viewing system for the VNP of the SAO RAS based on an IP camera with a CMOS detector. It is designed for remote monitoring

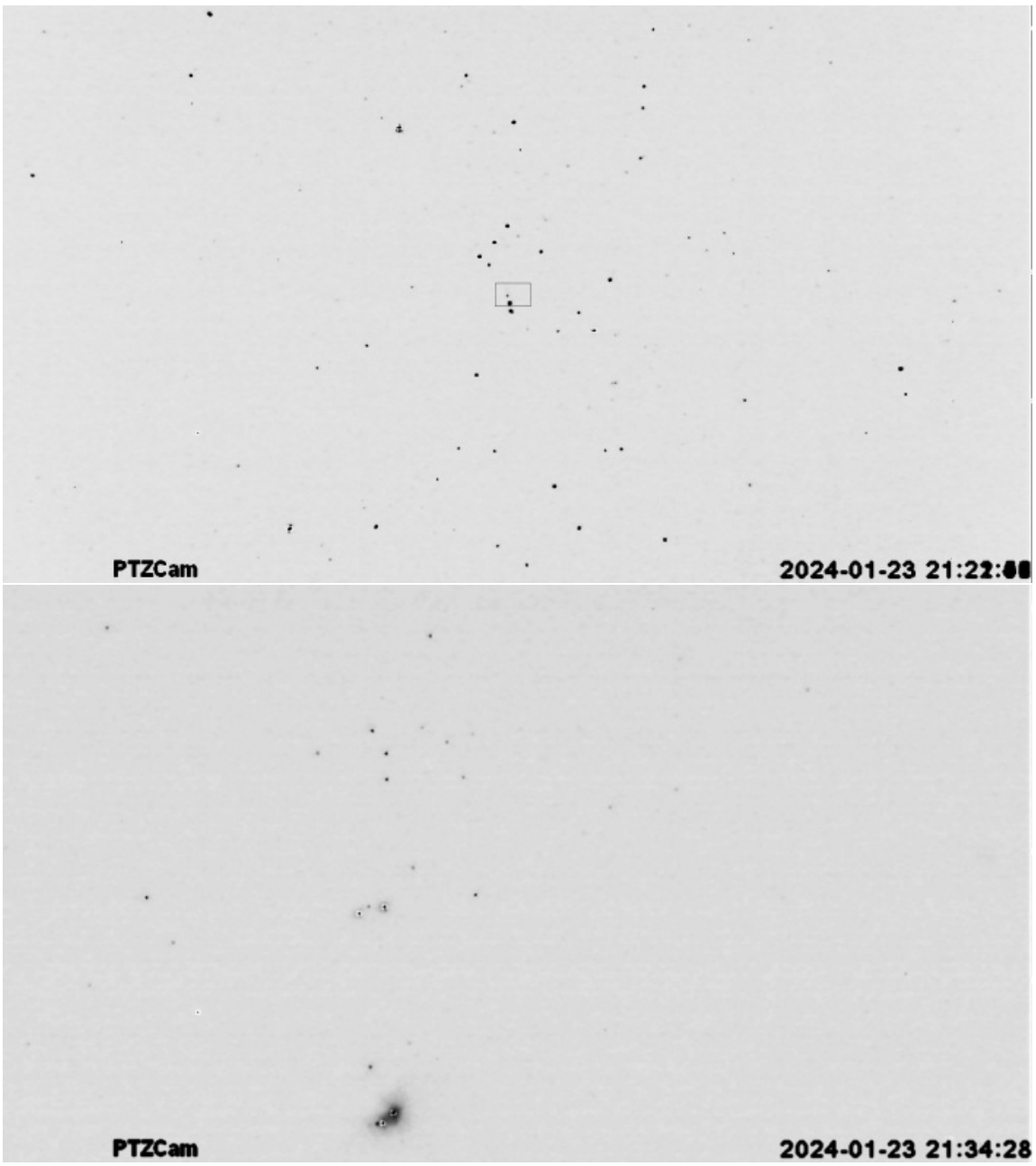

Fig. 1. Top: a series of 12 images of a sky region in the direction of the constellation Orion with a 87° FOV, the total exposure time is 12×80 ms, b/w mode. The rectangle in the center highlights the area shown in the bottom panel. Bottom: an image of the sky area taken in the same direction as the upper one but at maximum zoom (FOV = 5°), the exposure time is 80 ms, b/w mode. The images are given in inverted colors.

with a variable field of view (FOV) both at night and in the daytime (in color mode) and the ability of scanning over a wide angle range.

When choosing the receiver and components, we kept in mind the fact that the photodetector should have high sensitivity and be mass-produced. The SONY IMX291 sensor with an aspect ratio of 16:9, which is the most suitable for a viewing system, was selected to meet these requirements. The JZC-N83020 camera was chosen as a receiver. It is equipped with a 30X zoom lens and a Sony IMX291 CMOS detector with a format of 1/2.8 inches and high sensitivity. The varifocal lens provides a variable field of view from 5° to 87°. At a low price, the receiver has the necessary characteristics to operate as part of the complex of VNP viewing systems (see Table 1).

The camera is able to take images of the Sun and sunspots with good resolution. For this purpose, an EYSDON solar filter with a diameter of 46.5 mm is used. The panoramic camera was tested in the night time on 23 and 30 January, 2024. Examples of images taken at minimum and maximum zoom are presented in Fig. 1.

4 Conclusion

The development of a new panoramic system using an IP camera based on a CMOS sensor has been presented. The advantage of the new system compared to the previously developed one is the possibility of the online remote video monitoring of the sky, weather conditions, and surroundings in the vicinity of the SAO RAS optical telescopes both at night and in the daytime (in color mode) with variable FOV of a wider range: from 5° to 87°. It has the ability of azimuthal scanning without limitation, i.e., the camera can be rotated by more than 360° degrees. The scanning by elevation angle is from horizon to horizon: 180°. The azimuth and elevation coordinates are shown in the resulting images. It is also possible to take images of the solar disk with sunspots resolved. The system control is remote via a web interface.

References

Komarov V., Fomenko A., Vitkovskij V., et al., 2002, Bulletin of the Special Astrophysical Observatory, 53, p. 134