Wide-field TV Observations of Galactic and Solar System Objects: Facilities at the Crimean Astrophysical Observatory

The TV complex of the Crimean Astrophysical Observatory is used for fast identification and observation of different Galactic and Solar System objects: for example, the optical counterparts of X-ray sources, asteroids and comets, having brightness from 10 up to 20 stellar mag. There are wide-fields of about 50 x 50 arcminutes for identification and about 10 x 10 arcminutes for more precise identification and observation; the limiting magnitude seen on the TV monitor is 15 and 20 respectively. The convenient visual control of images on the TV monitor allows the observer to rapidly find objects in the field of stars and to guide on them during the observation. The recording of the full TV frame information, which has about 1000 x 1000 pixels, must be made photographically on account of limited computer memory. Only strobe selected regions of the field can be recorded directly in the mini computer. The accuracy of the photometric measurements is 0.08 - 0.05 mag. when data are photographically recorded and 0.01 - 0.02 in the case of direct computer data acquisition when the object is bright enough.

Various observations of asteroids and comets have been made in recent years. Three observing programmes are carried out: asteroid photometry, astrometry of the faint asteroids and comets and research into the structure of cometary nuclei. A search for the optical counterparts of X-ray sources is being carried out and subsequently their photometric behaviour studied.

The wide-field detector is very useful for investigating these objects. It is desirable to have high quantum efficiency, high signal to noise ratio, good photometric and astrometric accuracy in the wide field and comfort while making the observations. The price of apparatus must be low and observations inexpensive. The TV complex attached to the small telescope at the Crimean Astrophysical Observatory has satisfied these requirements for the most part.

Two channels are available with the small telescope TV complex: 0.2 metre (f 1/8) and 0.5 metre (f 1/13) telescopes mounted on the same base. The first (the guide) is used for searching for objects and taking pictures of field about 50 x 50 arcminutes, the second for taking pictures of the target fields about 10 x 10 arcminutes and making photometric measurements of each object under consideration. The two highsensitive peak up television tubes (I-Isocon) are used as detectors. The tube used for photometric measurements operate under air conditions and with temperature near 0°C during the night. The temperature of the tube mounted on the guide is about +10°C.

The limiting stellar magnitude which is seen on the TV monitor is 15 for the guide and about 20 for the halfmetre telescope. The reason for the limitation is the night sky background. Low temperature peak-up-tubes permit optimum sensitivity of the detector. We can change the integration time from 0.08 to 10 seconds. The signal to noise ratio increases in proportion with the integration time. In addition we use the integration of the TV frame. The full information of 1000 x 1000 pixels is integrated on the photoemulsion using automatically operated film. The mini computer incorporated into the complex allows us to have digital integration of the part of frame's information that is cut by special strobe. The strobe is located along the frame (vertical) scan. The information in the strobe area is converted into digital form and accumulated in the computer. The digital videosignal gives photoelectric accuracy.

The most important investigations recently carried out using the method described above are the discovery of the optical counterpart of the soft X-ray transient GRO J0422+32 and obtaining its UBVR lightcurves during the 3 month period after outburst; the 3-year photometric study of the strong black hole candidate V404 in quiescence; and multicolour photometry of the asteroid Toutatis at different distances from the Sun.

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