ON THE PROBLEM OF STANDARD FIELDS FOR CCD ASTROMETRY

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At the start of CCD observations one must investigate the metrological properties of the complex instrument: optics + CCD. One needs a densely spaced set of stars with precise coordinates and magnitudes. We first used the Pleiades catalogue by Eichhorn et al. (1970). Experimental observations were started at Pulkovo in 1993 using a very small refractor (D = 100 mm, F = 712 mm) equipped with a CCD ISD015A (520 x 580 pixels, 18 x 24 microns). The focal length of our astrograph provides an angular field of view of 45 x 67 arcmin (angular scale is 5.2 x 7 arcsec/pixel). With different exposures we can observe all stars with magnitudes from 2 to 16. The first observations were made to evaluate the accuracy of our positional and photometric measurements. Unfortunately, it appears that the catalogue of the Pleiades by Eichhorn is not good enough for this purpose because its epoch is very far from that of our observations and proper motions were not provided for the majority of the stars. The internal precision of our measurements (0.1 - 0.3 arcsec) allows us to determine the corrections to the stellar positions by Eichhorn et al. (1970)

After a significant improvement to our CCD camera a new series of observations was obtained of different standard fields. It appears that we cannot find any appropriate standard field catalogue to investigate the general distortion of our instrument. That is why we have started with a metrological investigation of the "optics + CCD" by use of North Pole observations with different positions of the instrument. This way does not allow us to determine the scale of the instrument only.

Thus, the problem of the creation of standard fields seems to be very important now, especially for large telescopes. The necessary parameters of standard field stars are not only their positions but their proper motions also. CCDs allow us to increase dramatically the precision of positional measurements, and all the standards without proper motions will yield imprecise results. It is very important to give positions of standard stars in a correctly defined global reference system, because any differential positions given relatively to an arbitrary chosen group of stars will not allow us to obtain correct proper motions, and the precision and use of such standards will vanish with time.

The next important obstacle is that increasing positional accuracy needs a very exact knowledge of photometric values of stars, because chromatic refraction becomes the main limiting factor for differential observations in a small field of view. On the other hand, any modern photometric standard field requires precise positions and proper motions of stars, because it is not realistic now to identify numerous faint stars without computers. Thus, stars in standard fields should have both astrometric and photometric parameters known. It is especially important to make photometric measurements with an R filter (of the UBVRI system or with corresponding filters of other systems in the red part of spectrum) because the majority

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of CCDs has the maximum quantum efficiency in this band. Moreover, this range of the spectrum is very useful for astrometry due to the small influence of refraction. This range is preferable also when it is necessary to make observations in daytime or in twilight. Unfortunately, this band of the spectrum is often absent in many catalogues.

Standard fields for CCD calibration should be chosen without bright stars, because they can produce additional problems for the investigation. It is necessary to avoid possible overlapping of star images on CCDs. That is why globular clusters are not very suitable to be taken as standard fields. Even with high resolution (for the ground-based observations it does not exceed 0.5 arcsec) we never know if a star is a double or not (really or optically). The accuracy of positional measurements with CCDs is much better than 0.5 arcsec, that is why open clusters without bright stars or analogous regions on the sky are preferable to be taken as standard fields.

It seems to be very useful to create standards in the polar zones. The main advantages of these regions are: a) These areas can be observed at any time. b) They can be observed for any desirable time without limitations connected with the Earth's rotation. c) The zenith distances of stars in this region vary very slowly; that simplifies the refraction problem. d) The majority of telescopes may observe these regions in any position of the instrumental CCD frame relative to the sky area. It allows us to investigate the distortion of "optic + CCD" system without exact knowledge of the star positions.

We have made some series of North Pole observations with our small instrument. Observations of the Pleiades, open clusters M 35, M 38 and others have been made also. It is important that these clusters have been used as standard fields, and it is possible to obtain proper motions for the stars for which first epoch plates have been taken. After investigation of distortion and other possible errors of our instrument a preliminary version of catalogues of these clusters will be prepared. The final versions of these catalogues will be prepared after a photometric investigation of the clusters and the correct reduction of positions, taking into account chromatic refraction.

It seems to be very useful to join our efforts with the efforts of other astronomers on the creation of precise standard fields.

REFERENCE.

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