Astrometric Characteristics of the Abastumani Astrophysical Observatory 125 cm Reflector (AZT-11) of Ritchey-Cretien Optical System

G. N. Salukvadze
Abastumani Astrophysical Observatory, USSR

Quite a number of instances are known when Schmidt, mirror-lens system telescopes and generally reflectors are used for solving the problems of photographic astrometry.

This paper describes the use of the Ritchey-Cretien telescope (AZT-11) at the Abastumani Astrophysical Observatory for determining relative positions of the members of multiple systems.

The diameter of the primary mirror of the AZT-11 is 125 cm, that of the secondary, 35 cm. The equivalent focal length is 1598 cm, the focal ratio is thus 1:13. The field has a diameter of 30'. 50% of the radiative energy are contained within a circle of 0".5 diameter and 90% within one of 1" diameter (Fig. 1). This energy distribution within the image does not change over a field of 20' diameter.

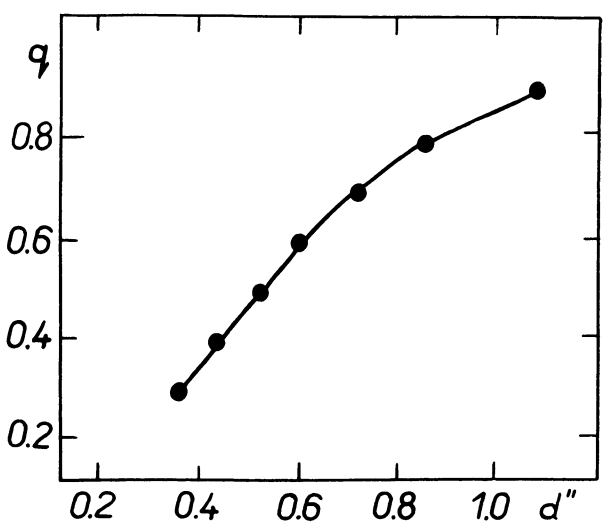

Figure 1

H. K. Eichhorn and R. J. Leacock (eds.), Astrometric Techniques, 289–292.

In the telescope tower, the axes of the telescope intersect 15m above the floor level. The dome has a diameter of 12m and a slit 3m wide. The dome is covered with a double coating of thermoinsulation.

Synchronous observations of the image quality inside and outside the dome were performed with two identical suitable devices. We obtained 135 synchronous sets of estimations of the image quality on both devices. The comparison of the image quality histograms on both devices (Fig. 2) shows that the stellar image diameter inside the dome is 2.3 times as large as that outside the dome.

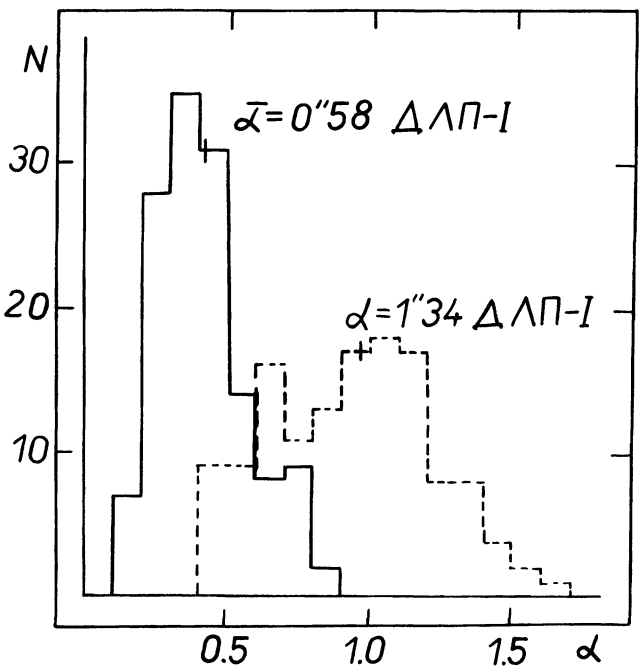

Figure 2

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In parallel with estimations of atmospheric tremor, we measured and investigated temperature inhomogeneities inside the dome.

The results of these investigations permitted us to improve the microclimate in the dome. Under good seeing conditions, the stellar image diameter on the plates was not less than 2".5, but after the improvements, the image diameters of faint stars did not exceed 1".2.

During the investigation of the microclimate inside the dome of the telescope, we carried out a quantitative estimation of the image quality on Mt. Kanobili. We intend to continue this for another calendar year to obtain data on the astroclimate.

Altogether, 180 nights within the year were suited for observations. Out of these, 110 were fully clear. The total number of good seeing night hours is 1250 and we made 1116 sets of observations.

On the average, the quality of the images for the observing year was 0".63 (Fig. 3). There were 520 observing hours with images less than 0".5.

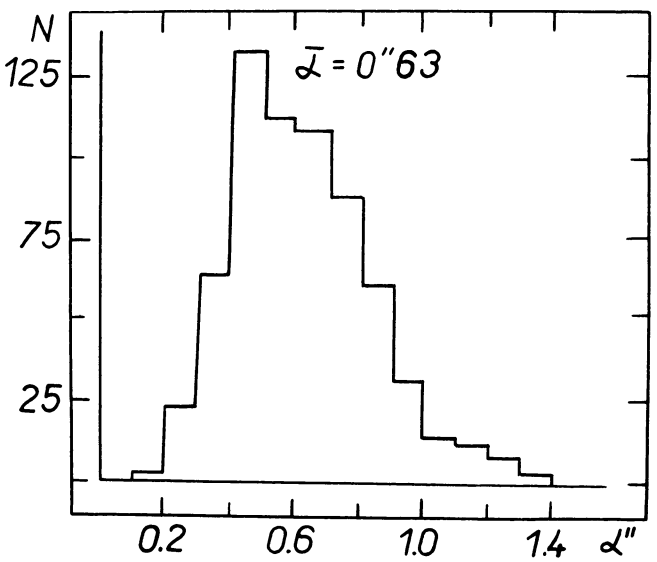

Figure 3

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As mentioned above, the average stellar image diameter inside the telescope dome is 1".5. Under these conditions, on plates of galactic clusters, 19^m stars are exposed for one hour on 103aO and $2^h\ 21^m$ on nitrogen treated IIIaJ plates.

Complete separation of the components of a double star is thus possible when their centers are 2" apart.

The plate scale was determined from comparison with appropriate plates of galactic clusters as 12".961 ± 0".002 mm^{-1}.

In order to check the stability of the optics, the scale was redetermined after three years, with the results of 12".964 ± 0".002 mm^{-1}

To study the accuracy of estimation of the object's position, plates of galactic clusters were used. The rms error of one estimation in both coordinates is 0".19.

The results of the investigation thus show that the AZT-11 telescope is useful for the purposes of photographic astrometry.

Currently, the telescope is used for the estimation of relative positions of the components of Trapezium type multiple systems. In so doing the following precisions are obtained: The mean error, in the results of photographic measurements in Δx and Δy differences for the 125 cm mirror telescope according to one image derived due to deviation from the mean one out of five images on the plate, is 0".034 (2.4μ); this compares favorably with corresponding quantities from other instruments: for the Dearborn 45 cm refractor, it is 0".086 (2.9μ); for the Lowell Observatory 60 cm refractor 0".075 (3.3μ); and 0".070 (3.4μ) for the 65 cm refractor of the U.S. Naval Observatory.

The standard errors of distances estimated for the 125 cm mirror telescope derived according to the measurement results of five plates are within 0".006 - 0".040; in the catalogues of the Naval observatory these range from 0".005 to 0".030.

The mean error in the catalogue of distances using the 125 cm reflector is 0".020 and in that of the Naval Observatory 0".017.