A PHOTOMETRICAL INVESTIGATION ON THE RC SYSTEM OF THE 2m RITCHEY–CHRETIEN COUDE TELESCOPE OF THE ROZHEN OBSERVATORY

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ABSTRACT: Surface photometry techniques of data processing are applied for the qualitative analysis on the reflectivity of the two mirror system in the prime focus of the 2m Ritchey-Chrétien Coudé telescope of the Rozhen Observatory. There are considerable variations in the reflectivity, up to ±30%. An estimation on the upper limit of the average reflectivity, about 68% ±1%, of the two-mirror RC system is made. A loss of about 0.5 magnitudes in the limiting magnitude due to the low reflectivity and to the decrease in the reflecting surface is found.

1. Introduction

The present study is part of the tests on the new optics of the 2m RCC telescope of the Rozhen Observatory, which was produced at VB 'Carl Zeiss' Jena. It is equipped with a 2 m hyperbolic primary mirror. The equivalent focus of the RC system is 16 m and the optical efficiency is 1:8. The extrafocal star images are analyzed. They allow us to estimate the reflectivity of the system as a whole. However, the contribution of each mirror to this reflectivity can not be separated.

2. Observational Material and Data Reduction

The four plates, listed in the table below, have been measured with a digital microphotometer Joyce Loebl at the Rozhen Observatory.

Plate No.	Date	Object	Emulsion	Filter	Defocusing	Exposure
1501	06.04.89	Pi 59	ZU 21	GG 385	8 00	60 sec
1502	06.04.89	Pi 59	ZU 21	UG 1	8 00	420 sec
1503	06.04.89	Pi 59	103aD	GG 495	8 00	80 sec
1607	30.10.89	υ And	103aF	RG 1	8 00	80 sec

The images have been scanned in a circle of 1000 μm^2 aperture and a size 500 by 500 pixels stepped in 20 μm. The data reduction are carried out with the Rozhen Image Processing System

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(Georgiev 1987) on the PDP 11/34 minicomputer at Rozhen. The measured constants of the photometrical wedge (Ziener 1988) have been used to transform the photographic densities into relative intensities. These images are examined as the model of the allocation of the reflectivity on the effective surface of the two-mirror RC system.

3. Data Analysis and Results

Preliminary analyses show that deviations from the average value of the reflectivity larger than ±30% are not important for the images as they pertain to fewer than 5% of all the pixels. To compare the images of different colours, we make the following standardization. We examine as images the totality of the pixels in the range ±30% of the average value of the reflectivity, that is to say we take up to 96-98% of all the pixels. We normalize the maximum in each image as 100% reflectivity. The analysis of the histograms of these images makes it possible to estimate the upper limit of the average reflectivity in the prime focus of the 2 m RCC telescope in the wavelength range λλ 3500-6500 Å to be 68% ±1%. This result differs by more than 5% from that achieved with the B 240 installation (reflectivity for λ 5500 Å at least 88% ±2%, Ehrlich et al. [1988]). Really the quantitative aspect of this estimate depends on our normalization. In this respect the result that the considerable variations in the reflectivity amount to ±30% is more important. Besides which, the equivalent surface of the mirror system for which the variations are under than 5% is smaller than 50%; and for more than 10% of it the variations are in the range 15-30%.

The analysis of maps of the images clearly shows not only the local bad sectors of the mirror but their decreasing contrast with increasing wavelength. The ring structures are outlined against the smoothed images. Our suggestions are that the non-uniformity in the aluminium layer are responsible for the local fall in the reflectivity and that those in the magnesium fluoride layer contribute to the ring non-uniformity.

4. Conclusion

A final result is the determination on the loss in the limiting magnitude $\Delta m \geq 0.5$, that is due to the low reflectivity and to the decrease in the reflectivity surface, where $\Delta m = -2.5 (\log(R_e/R_n) + \log(D_e^2/(D_o^2 - d_o^2)))$, where we have estimated the effective reflectivity R_e = 68% ±1% and diameter of the system D_e = 1.68m ±0.02m, R_n = 90% is the accepted for astronomical two-mirror optics (Walker 1987) and D_o, d_o are the diameters of the mirrors. In this way we come to the conclusion that a new aluminization with a guaranteed reflectivity for each mirror $R(\lambda) \simeq 95\%$ ±1% in the wavelength range λλ 3500-6500 Å is necessary.

References

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