



MULTIPLE MIRROR TELESCOPE OBSERVATORY

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MMT Technical Memorandum 88-1

From: Daniel Fabricant, Jeff McClintock, Dan Blanco

Re: Calibration of the MMT Focal Plane Scale

Date: March 24, 1988

In order to be able to construct aperture plates for use at the MMT, we undertook a calibration of the MMT focal plane by means of direct photography. Dan Blanco designed a simple plate holder to accept 4 by 5 inch glass plates at the nominal focal plane 9 inches below the top box flange. On an engineering night in November 1987, we obtained 4 useful exposures, 2 each of the open clusters NGC2099 and NGC7654. The nominal coverage of these plates is 6 by 7.5 arcminutes, but we obtained useful images over about 4 by 5 arcminutes due to vignetting and plate holder losses.

Conard Dahn at the Naval Observatory kindly obtained exposures of NGC2099 and NGC7654 with the 60 inch astrometric reflector. This telescope has an accurately calibrated and linear focal plane scale of 13.55 arcsec/mm, and we based our calibration of the MMT focal plane scale on a comparison of stellar positions in the two sets of plates. The Naval Observatory plates of the two clusters were obtained a few weeks apart.

The MMT plates were scanned on the Yale PDS machine. Unfortunately, the Naval Observatory plates arrived after the trip to Yale and were scanned visually on the somewhat antiquated measuring engine at the CFA. However, this machine is equipped with precision glass scales, and the dominant error is due to centering of the crosshairs on the stellar image. Repeated measurements indicated that the rms centering error is about 4 microns or 0.05 arcsec at the Naval Observatory plate scale. The error in determining the centroid of the MMT images is probably comparable, especially at the edge of the field of view where the image quality is poorest. The PDS reduction software at Yale fits a bivariate Gaussian to the data.

The Naval Observatory data were compared to the MMT data for 55 stars in NGC7654 and 56 in NGC2099 using a linear least squares fit. Three stars in each field with fitted residuals of 0.3 arcsec or more were excluded. Four of these were stars at the very edge of the field with very poor images, and two were probably misidentifications. The rms residuals after exclusion of these points was about 20 microns at the MMT scale or 0.07 arcsec. We have not made a careful search for second order distortions in the MMT focal plane; this is complicated by the image deterioration at the edge of the field. Such nonlinearities are not important at the 0.2 arcsecond level over a 4 by 5 arcminute field. We will make the raw data available to anyone who wishes to pursue this subject further.

The results:

NGC7654 N-S axis scale: 3.586 arcsec/mm
E-W axis scale: 3.586 arcsec/mm

NGC2099 N-S axis scale: 3.587 arcsec/mm
E-W axis scale: 3.583 arcsec/mm

Note that the scales determined independently for the two axes in each cluster agree better than the values for the two clusters. Note however that the error due to knowledge of the Naval Observatory scale is about 1/1355, or 0.0026 in the scales above.

The grand average: 3.585 +/- ~0.003 arcsec/mm.

This is in good agreement with the design value of 3.587 arcsec/mm given to us by Nat Carleton.