

SOME FIRST EXPERIMENTS ON THE PHOTOMETRIC CALIBRATION OF SCHMIDT PLATES AGAINST THE TYCHO CATALOGUE

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ABSTRACT

This paper presents our first efforts at photometrically reducing new GSC-II measures of Palomar II plates (J passbands) with Tycho for a 625 square degree test field centred on the North Galactic Pole.

Key words: Schmidt Plates; Photometry.

1. INTRODUCTION

The Tycho Catalogue, with its high spatial density of stars having good photometry and astrometry to $V \approx 12$ mag, offers unprecedented opportunities for enhancing our calibration methods for Schmidt plates. Both because it has been less explored and because our need for new tools and results therein was greater, we focused our first experiments, which are reported in this Paper, on the photometric calibrations.

We are currently constructing a second Guide Star Catalog (GSC-II), which will be complete to $V = 18$ mag, with colours and proper motions, and which is based on all-sky Schmidt surveys. Photometric reductions, while based on deep CCD sequences taken in the center of each plate specifically for this project, will use the rich grid of Tycho stars to ensure that the position dependent photometric effects are removed from each plate.

The data for the present experiments consist of ST ScI scans of the blue (B_J) plates of the POSS-II survey in a 625-square degree area around the NGP. Using software jointly developed by ST ScI and OATo for the construction of the second Guide Star Catalog (GSC-II), objects lists were extracted from these scans and matched to the Tycho Catalogue.

2. VIGNETTING

Our first goal was to obtain direct measurement for the vignetting function of the Palomar Schmidt. (The previously available function was an analytic

one adopted from older work by Campbell (1982) and by Dawe & Metcalfe (1982) with the UK Schmidt.) We performed basic polynomial reductions of the plate measures to the Guide Star Photometric Catalog (GSPC-I, Lasker et al. 1988). So that the vignetting arguments would not be circular, we excluded all plates with sequences not centrally located. The differences between the plate reductions and the Tycho magnitudes in the bandpass of the plates (labeled J to designate IIIaJ) are plotted below against radial distance, and the superposed dotted line is the function from the UK Schmidt (see Figure 1).

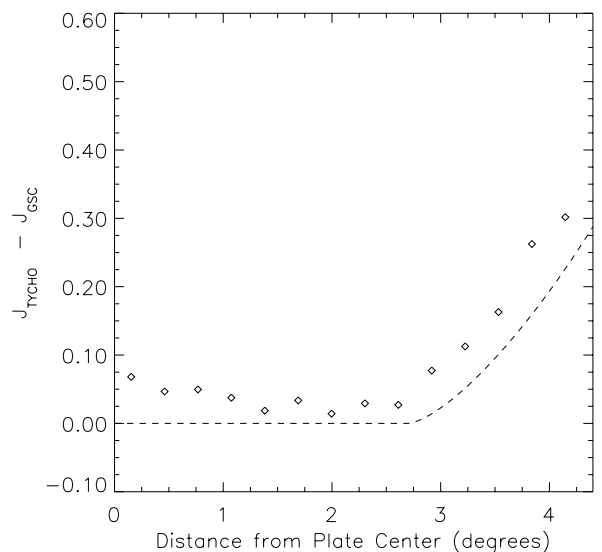


Figure 1. $J_{\text{Tycho}} - J_{\text{GSC}}$ versus radial distance for 8711 objects uniformly distributed across 26 plates.

From Figure 1 we see the onset of vignetting and the steep increase at the plate edge are evident as expected. The scatter in this diagram requires further study; however, as the quality of the photometric reductions near the sequences is relatively good (typically 0.05–0.10 mag) and the plate-uniformity is believed to be excellent, we expect that most of the scatter is due to correctable defects in image processing and object-matching. The central offset, undoubtedly an artifact, is a topic for further investigation.

We plan to improve the statistical accuracy of this vignetting function by including more plate reductions and then to generate a tabular version for use in routine reductions. These data also support a determination of the two-dimensional vignetting (the telescope geometry does not truly have circular symmetry); a first estimate of this is shown in Figure 2.

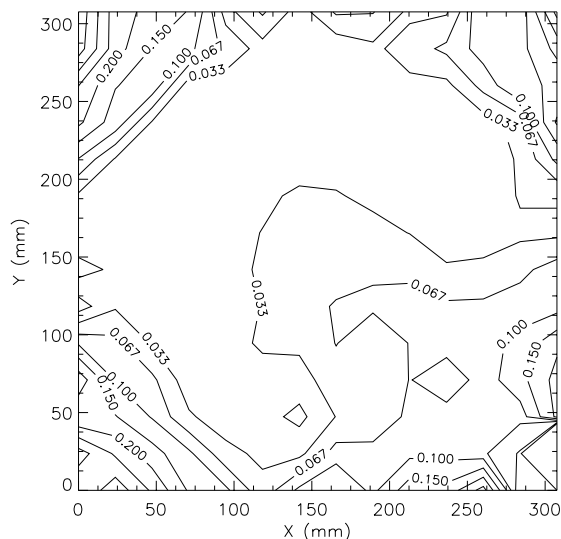


Figure 2. Two-dimensional vignetting function.

Finally, for plates that are not as photometrically uniform as the POSS-II, e.g. the POSS-I and Quick-V, the Tycho Catalogue may be expected to support two-dimensional correction functions on a plate-by-plate basis.

3. COLOUR

Because the Tycho Catalogue contains colour information, it may be used to investigate the transformation between the BV system and the natural passband of the photographic plates. For the subset of the above stars that lie in unvignetted areas ($R \leq 2.7$), the run of residuals against Tycho BV colours is shown in Figure 3.

The transformation used was $B_J = V + \alpha(B - V)$, with $\alpha = 0.72$, which is a value consistent with previous literature.

Experiments still in progress and not reported here include astrometric testing involving reductions which employ techniques to remove the well-known systematic errors remaining after traditional polynomial plate modeling.

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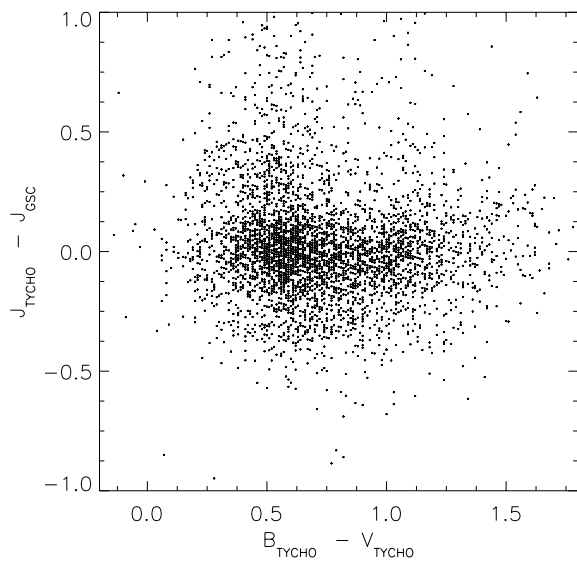


Figure 3. Residuals as a function of Tycho colour for $\alpha = 0.72$.

tronomy (Italy), and various collaborative arrangements with our two institutions.

REFERENCES

- Campbell, A. W., 1982, Observatory, 102, 195
- Dawe, J.A., Metcalfe, N., 1982, Proc. Astron. Soc. Aust., 4, 466
- Lasker, Barry M., Sturch Conrad R., et al., 1988, ApJ Suppl., 68, 1