First Steps Towards a Photometric Analysis of the Sonneberg Sky Patrol Plates

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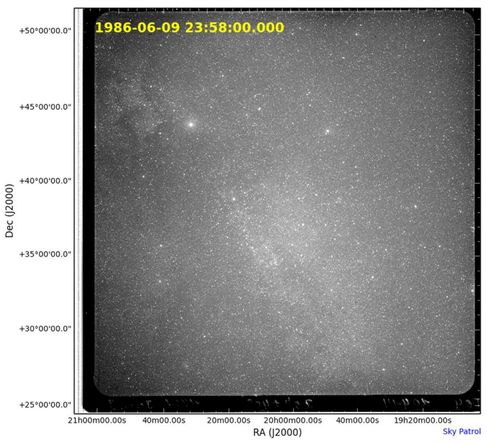
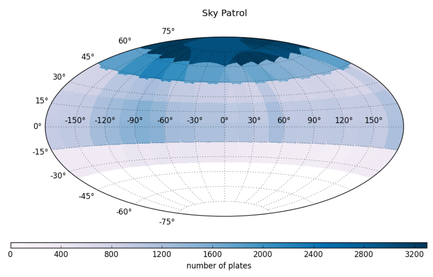
Sonneberg Plate Archive

- The Sonneberg Plate Archive – Observatory Sonneberg
  - ~270 000 plates, 1925 – 1997. Two programs:
    - Field Patrol – 80 selected fields, scale 2‘‘/pixel
    - Sky Patrol – entire northern hemisphere, scale 17‘‘/pixel



Sky Patrol Plate
- Cygnus
- 26° x 26°
- 14 bit scan



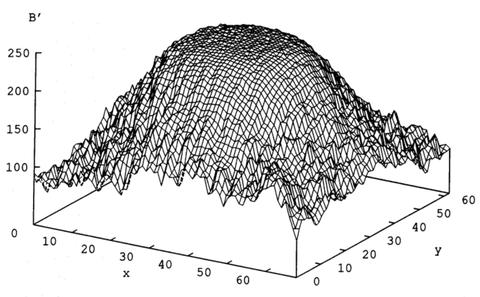
- Early works on Sky Patrol Plates (Kroll 1993, Vogt & Kroll 2004)
  - Sky Patrol Plates, 8 bit CCD line scanner
  - Ansatz for intensity:

$$I \sim Ae^{-\left[\frac{(x-a)^2}{\sigma_x^2}-2\rho\frac{(x-a)(y-b)}{\sigma_x\sigma_y}+\frac{(y-b)^2}{\sigma_y^2}\right]}+A_0 = g(x,y)$$

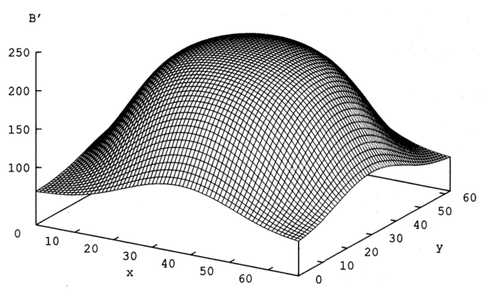
  - The relation between intensity *I* and brightness *m*:

$$\Delta m = m - m_0 = -2.5\log\left(\frac{I}{I_0}\right)$$

a)

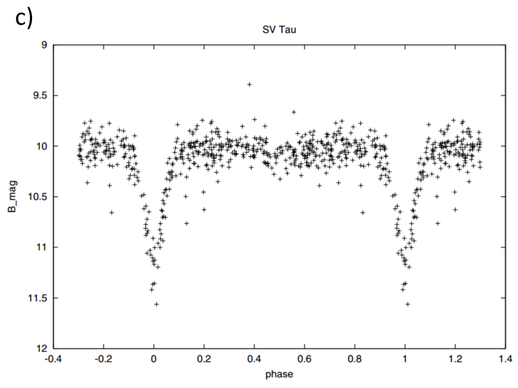


b)



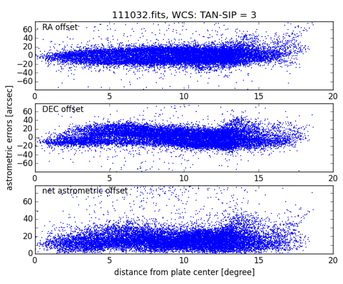
a) Imprint of star as it is found on the plate (Kroll 1993)
b) Fitting function for the object star (Kroll 1993)
c) Light curve of the Algol type binary SV Tau, P=2.1669051d (Voigt & Kroll 2004)

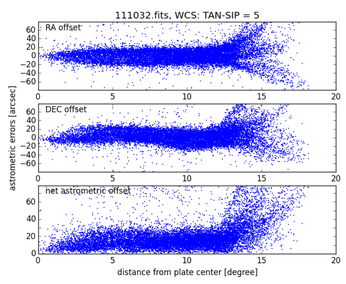
c)

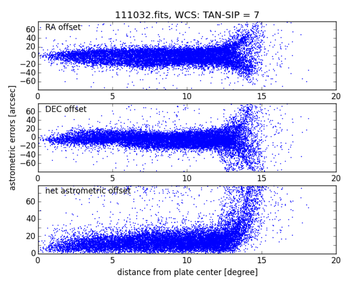


Astrometric Solution

- No astrometric solution for entire plate, astrometric error ascends with the distance from plate center independent of wcs conventions
  - TAN-SIP solution over 2/3 of the plate of sufficient accuracy
  - Modified version of pyplate







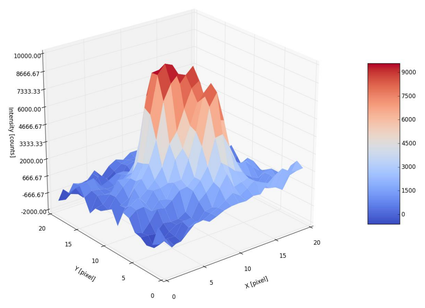
- Small sections of the plates 2°x 2° - astrometric error of 3-5 arc seconds
  - Cygnus – about 200 Stars per square degree
  - Sufficient accuracy for matching with catalogs
- Still searching for solution for entire plate

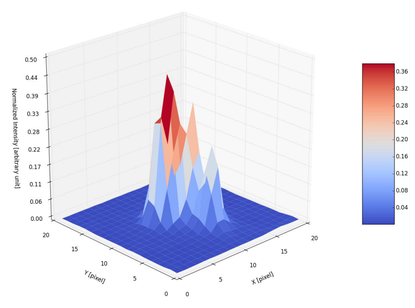
Photometry

- Deblending, linearity:
  - Separation of multiple overlapping objects & restoring the linearity

$$I = \frac{\gamma}{\ln 10}10^{-0.4\,m_0}\,10^{D/\gamma}$$

γ – contrast index of the emulsion (estimated), D – original pixel value



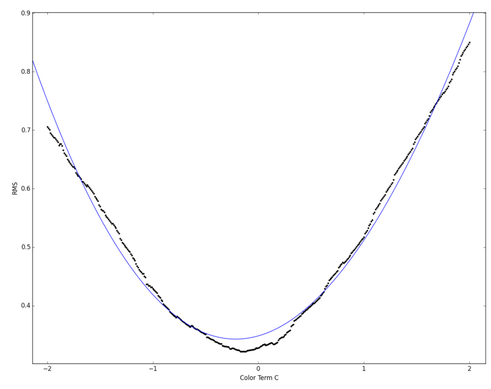


- Color response of photographic emulsion, color term C
  - Different wavelength response of photographic emulsion and standard pass band filters

$$m = M_1 + C(M_1 - M_2)$$

M∗: Catalog magnitude of different colors, m: catalog magnitude in photographic plate system

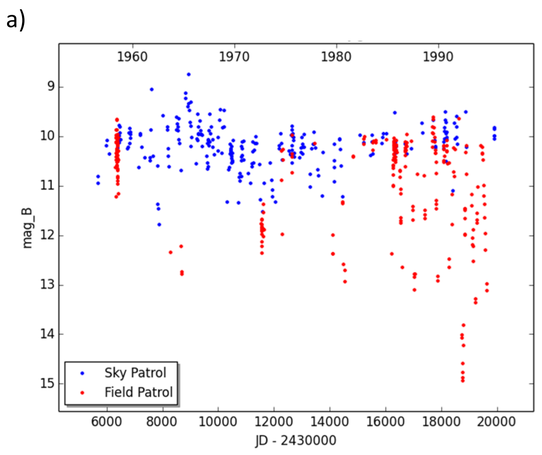
- Color term → stepping through a series of values for *C* and determine RMS of catalog vs. instrumental magnitude fit
- Minimum of RMS → color term *C*
- Consistent values for *C* for all plates



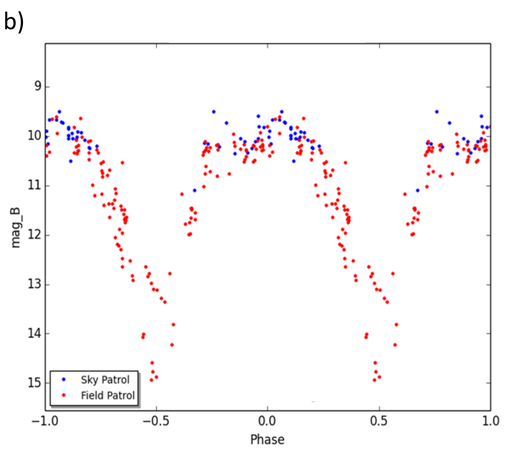
- Photometry on Sonneberg Sky Patrol Plates
  - Source Extractor used for photometry:
    APER, ISO, ISO_COR, AUTO, PETRO, PSF
  - Comparing RMS of different methods – small differences
  - **Best results: ISO and PSF photometry**
  - First results not as good as click and fit routine (Vogt & Kroll 2004)

- Photometry first results, e.g. RS Cyg
  a) combined measurement of Sky Patrol and Field Patrol Plates
  b) Phase plot of the combined measurement P=431.82 d

a)



b)



References

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