Photometric analysis of the Pi of the Sky data

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Pi of the Sky detector in Chile, 2004 - 2009

- Las Campanas Observatory
- 2 cameras on equatorial mount (coincidence)
- FoV of one camera $20^\circ \times 20^\circ$
- Range: 11.5 - 12.5 mag
- IR-cut + R Johnson-Bessel filter (since May 2009)
- In March 2011 we moved detector to SPdA for details see Marcin Zaremba talk
Pi of the Sky database

Open access to all raw data:

http://grb.fuw.edu.pl/pi/databases

Data period May 2006 - April 2009

16.7 x 10^6 of objects,
2.16 x 10^9 measurements

Data period May 2006 - Nov 2007

10.8 x 10^6 of objects,
1002 x 10^6 measurements

Data period July 2004 - June 2005

4.5 x 10^6 of objects,
790 x 10^6 measurements
Removing observations with poor quality

System of dedicated filters to remove bad measurements or frames:

- Hot pixels
- Measurements near CCD edge
- Planet or planetoid passage
- Columns around bright stars (reading the chip with the shutter opened)
- Frames with strong and varying sky background
- Frames with large astrometric error
Photometry accuracy significantly improves after removing bad quality data.

For stars $7^m - 10^m$

$\langle \sigma_m \rangle \approx 0.018 - 0.024$ achieved
The spectral sensitivity of Pi of the Sky detector

Only UV-IR filter, CCD sensitivity relatively wide

Average $\lambda \approx 585$ nm - closest to $V$ filter
Approximate color calibration algorithm

- Detector response is correlated with the star spectral type (B-V or J-K)
- Reference stars measurements are corrected for spectral type:
  \[ M_{\text{coor}} = M - 0.2725 + 0.5258(J-K) \]
- Reject comparison stars with large \( \Delta M \)
Approximate color calibration algorithm

Normalization method

- quadratic corrections fitted to reference stars
- weights depending on distance and brightness

Correction fit quality check

Average square distance of the reference stars from the fitted correction surface

- $\chi^2$ of about 0.05-0.06
- For about 20% of frames calculated $\chi^2$ is greater than 0.058
- This information can be used to select measurements with most precise photometry
BG Ind light curve

Uncorrected light curve for BG Ind variable

- Quality improves significantly
- Uncertainty $\langle \sigma_m \rangle$ of the order of $0.013^m$ can be obtained

Corrected light curve for BG Ind variable

Corrected light curve with correction quality cut


Absolute properties of BG Ind - a bright F3 system just leaving the Main Sequence
M. Rozyczka, J. Kaluzny, W. Pych, M. Konacki, K. Malek, L. Mankiewicz, M. Sokolowski, A.F. Zarnecki
**T Cru light curve**

- Uncorrected light curve for T Cru variable
- Corrected light curve with correction quality cut
GH Car light curve

Uncorrected light curve for GH Car variable

Corrected light curve with correction quality cut
Magnitudo vs spectral type

Detector in LCO

New unit in Spain
Summary

- Public databases:
  - http://grb.fuw.edu.pl/pi/databases
- A system of dedicated filters to remove bad measurements or frames available in interface (applied with cataloging procedure for new data)
- Approximate color calibration algorithm based on the spectral type of reference stars available on request
THE END

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Spectral type

![Magnitude vs spectral type](image1.png)

![Magnitude vs spectral type](image2.png)