Photometric Data Analysis

StarDICE workshop
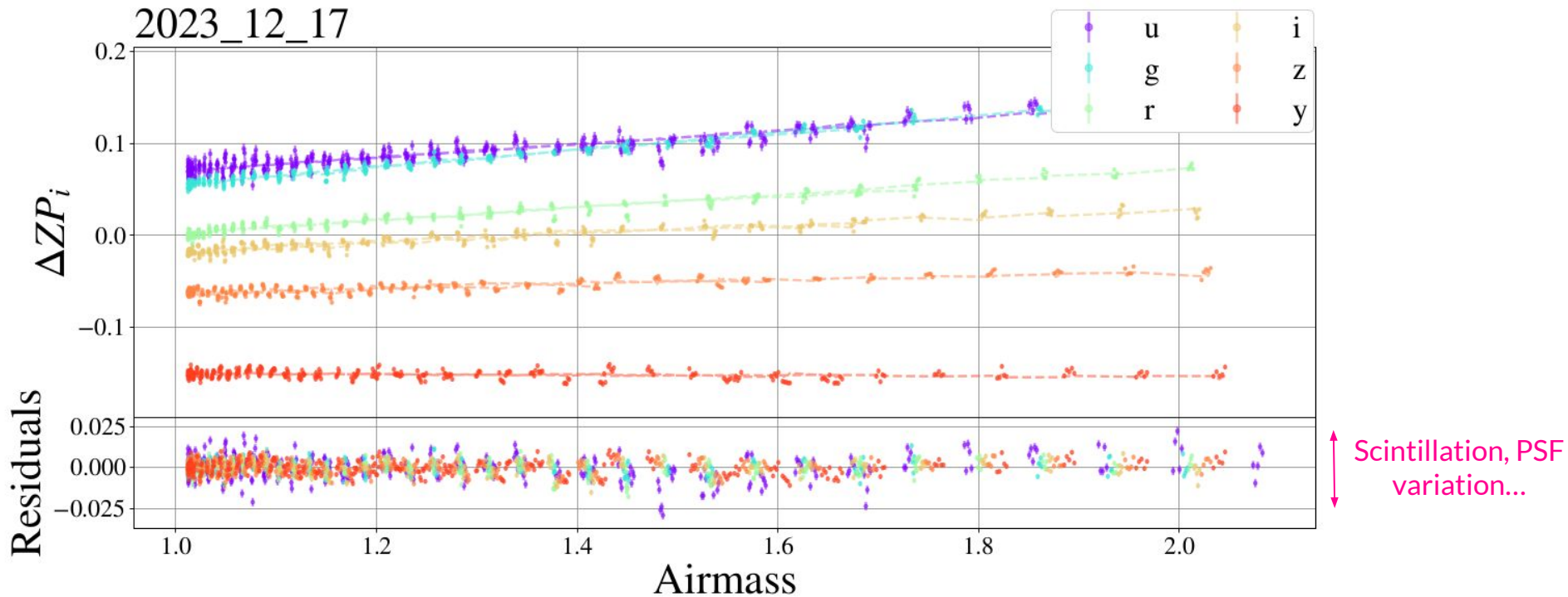
LPNHE, 11 décembre 2024

Marc Betoule
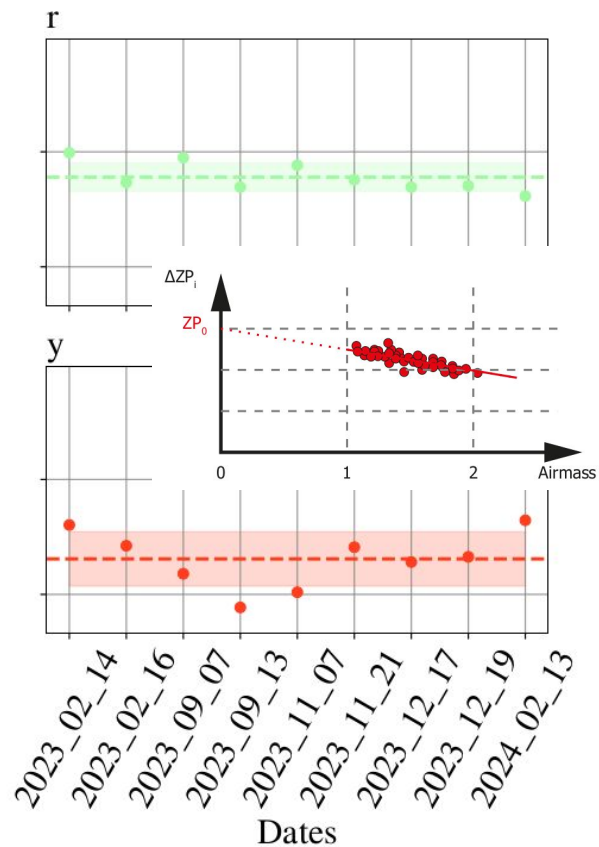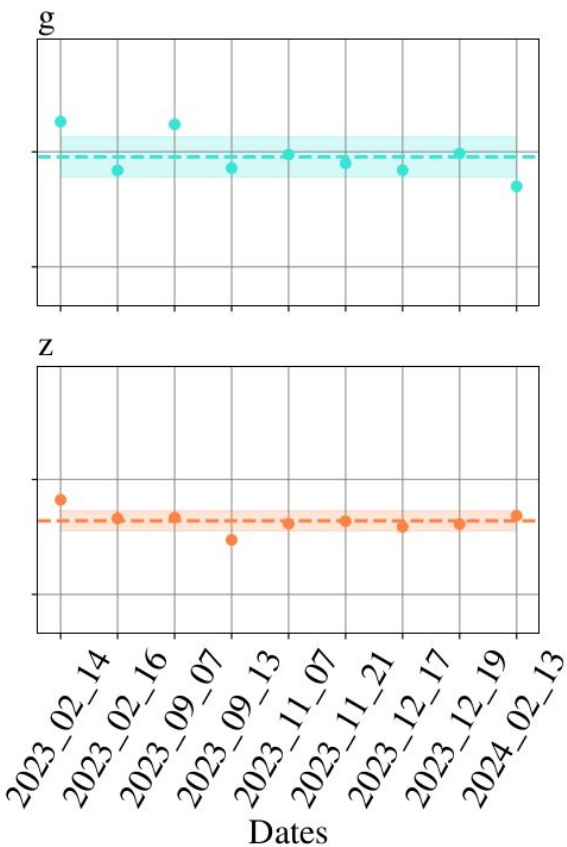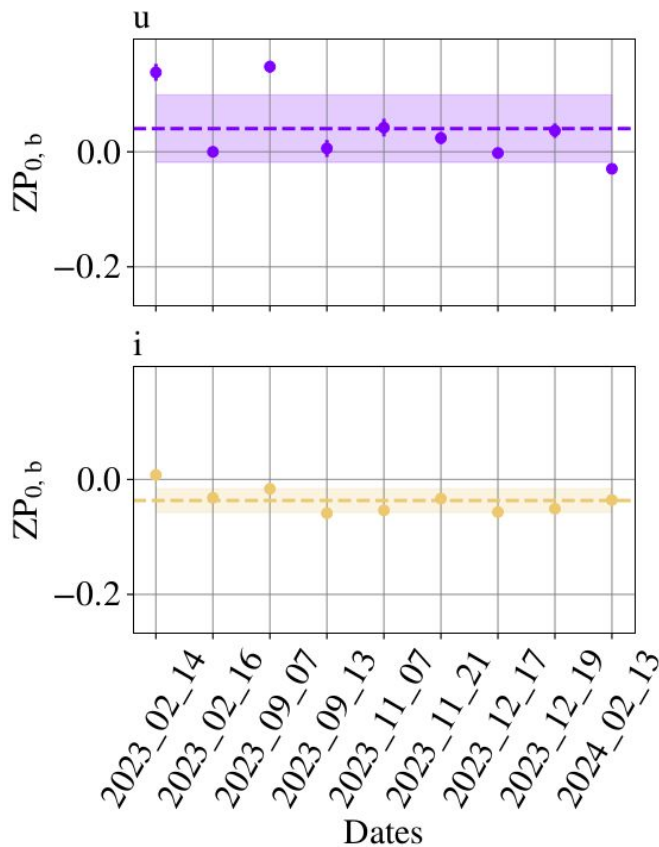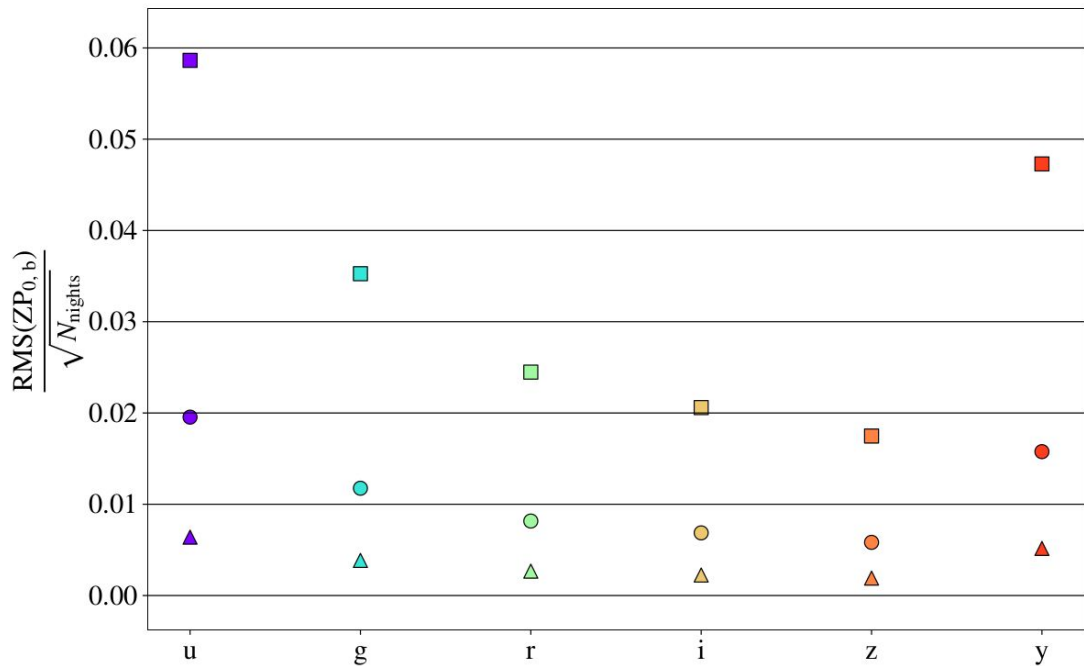
Analysis published in Thierry's thesis

$$\Delta ZP_{b,i}(X, C) = k_b X_i + \alpha_b C_i + ZP_{0,b}$$

Atmosphere **Aperture correction** **Out-of-atmosphere zero point**

A night to night dispersion larger than expected

The goal is to decrease the dispersion by modeling more effects


- **9** photometric nights
- StarDICE 2-year survey estimation ⇒ **84 nights**
- **~0.2 to 0.4% uncertainty**

⇒ **2 to 4 times the suitable value to fully exploit the future LSST SNe Ia dataset**

- Improve photometry
  - forced photometry
  - better model of aperture corrections
- Improve the model of the atmosphere
  - Decrease the number of parameters
 - Incorporate additional constraints from IR and spectroscopy

Modeling aperture corrections
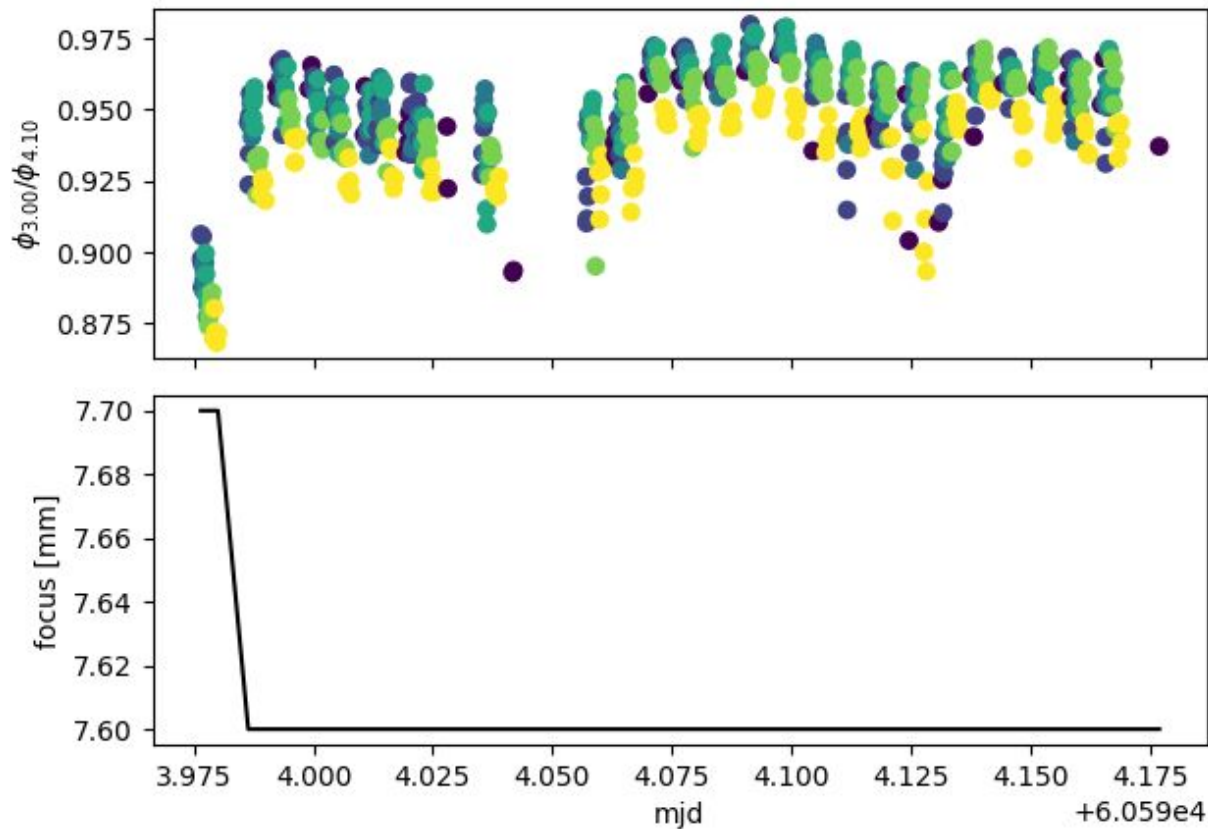
- The ratio between two fluxes at different apertures is a proxy for the total aperture correction
- But this quantity is noisy (especially for faint stars) and variable (both in time and position)
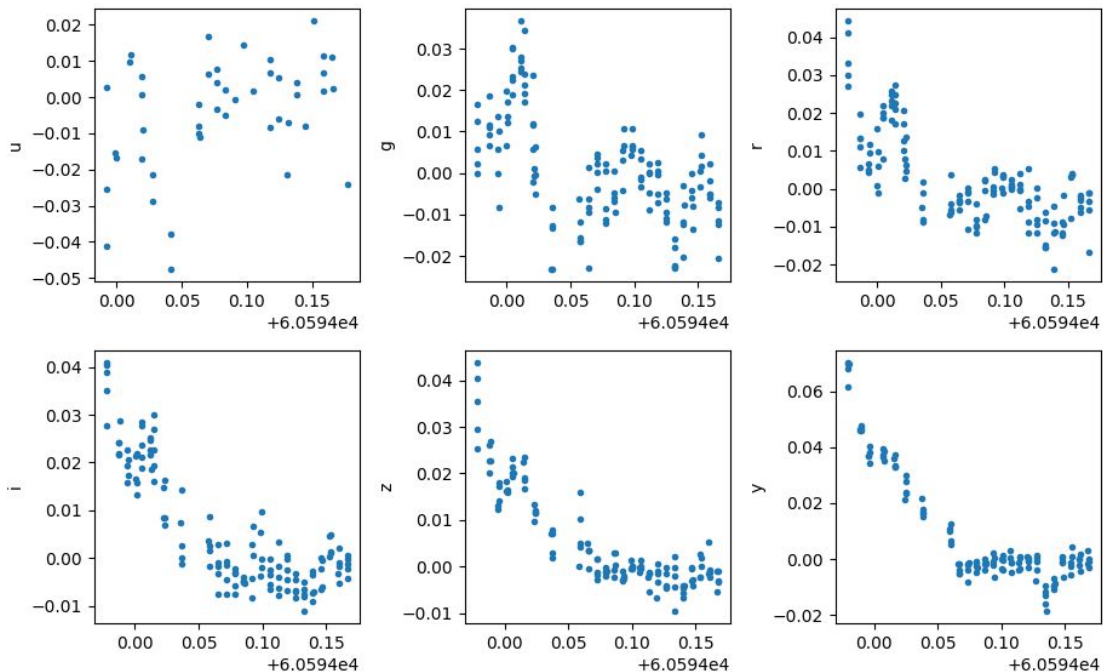- We build a model and fit the measured aperture corrections

$$c = a(band)\ r^2 + b(image)$$

Aperture correction on the focal plane
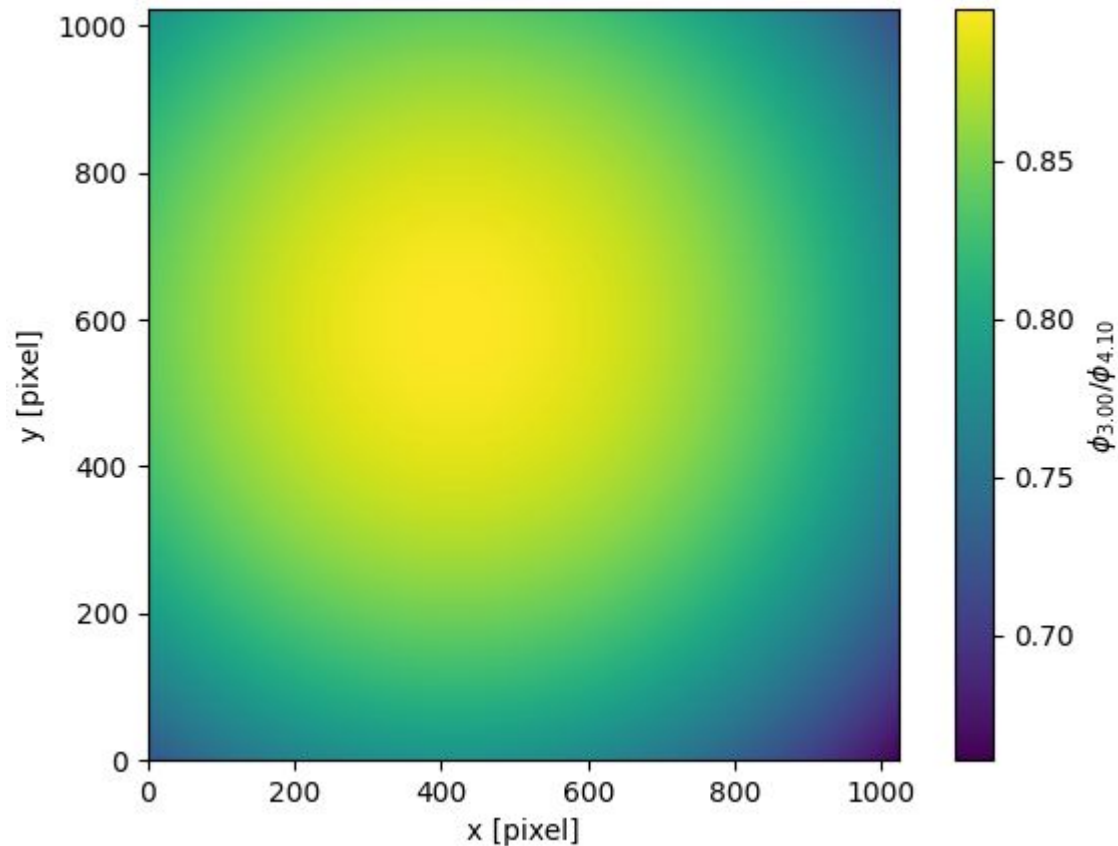
- Correction scale is measured at better than 0.01 mag in all exposures
- y is noticeably larger
- Shape is very consistent accross bands
- Amplitude seems to vary slightly
- Confirm that we are likely a bit off-axis

Modeling the photometry

Synthetic photometry written in jax

614ms for 150 000 measures

Maximally flexible model: one atmospheric transmission computed per measure

Gradient available for optimization

- airmass computed
- pressure fixed to meteo station value
- ozone and aerosol fixed
- free params : aperture correction scale and zero point

The dispersion for 2024/10/11 after midnight in mmags are:

u	g	r	i	z	y
10.0	8.1	5.8	4.2	3.5	5.0

Conclusion

The goal is to complete this study on the full dataset up to producing per exposure atmospheric parameters that can then be analyse and compared

- night variation of the qrey extinction -> to the IR
- ozone pwv and aerosols
  - to the spectro
  - to external dataset
- Long term variation of the grey extinction -> to the LEDs

The production of the forced photometry completed this morning but it was a bit to late to have a look at it