The ASTEP South photometric analysis

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ASTEP workshop
March 14-15, 2011



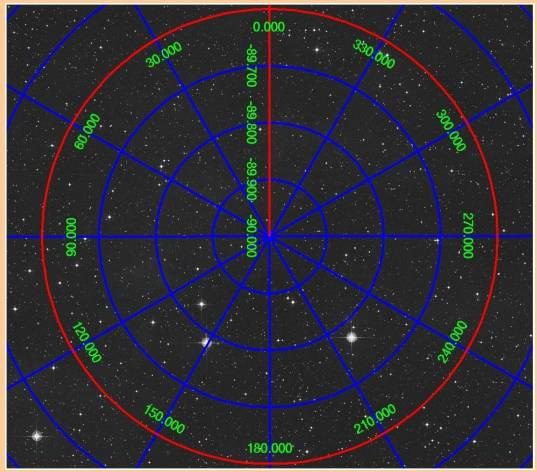




The ASTEP South photometric analysis

The ASTEP South data: some rough numbers





1 image = 32 MB

	Hours	Science Images	Total volume
2008	1500	150 000	5 TB
2009	2500	250 000	8 TB
2010	2500	250 000	8 TB

About the same volume
for bias & darks

Total: ~ **40 TB**
(allocated space on merak ~ 30 TB)



The ASTEP South photometric analysis

The ASTEP South data: storage on merak (merak.unice.fr)

/DATA/astep/astep-sud/

Raw data

data/

2008/

2008-04/

...

2008-10/

2009/

2009-04/

...

2009-10/

2008-08-01/

2008-08-02/

...

Calibration images

working/

2008/

2009/

...

C-2008-08-01/

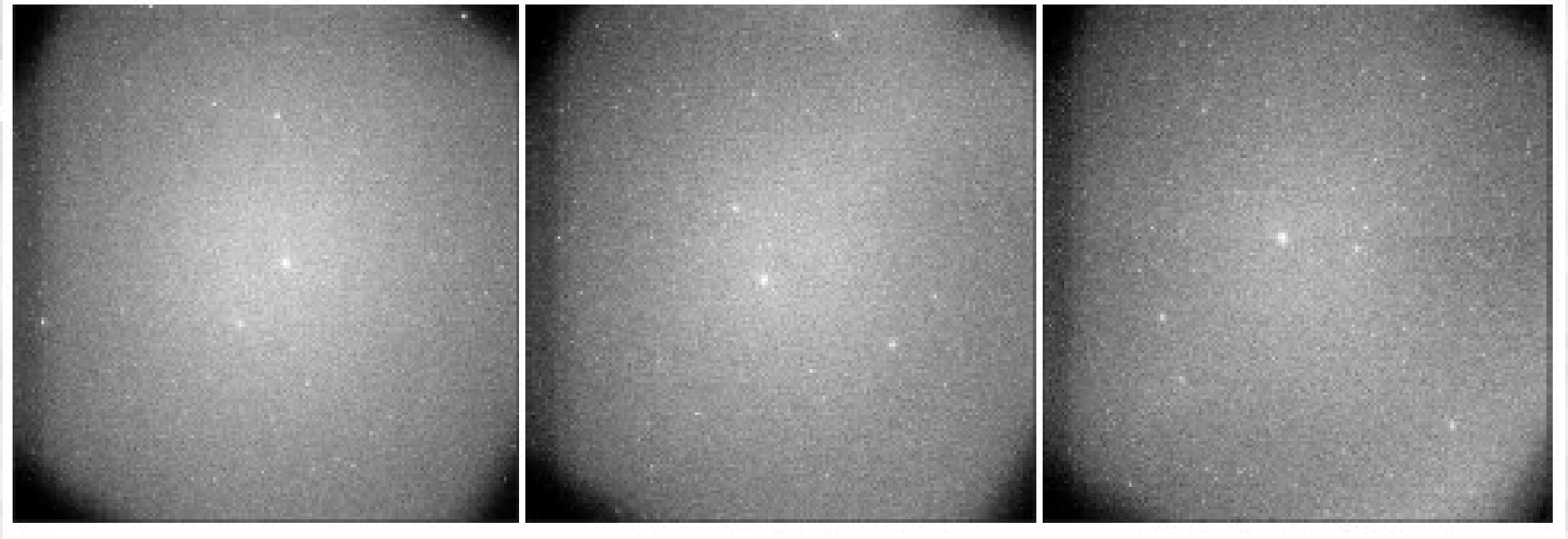
C-2008-08-02/

...



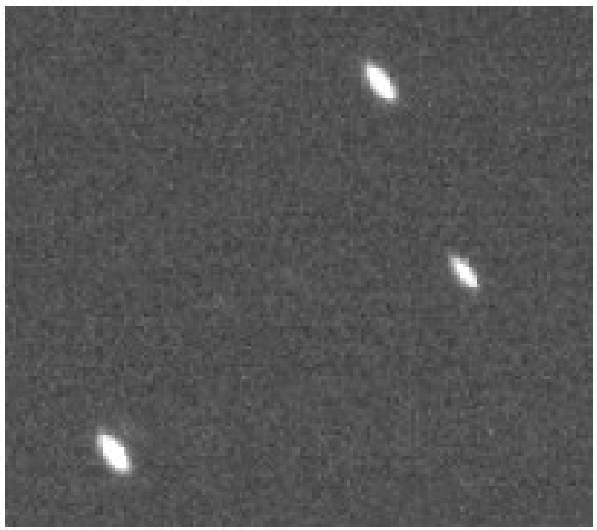
The ASTEP South photometric analysis

Specificity: the stars are moving on the CCD



* Variable position on the CCD

* Elongated PSF: 4.5 px / 30 s on the edge of the field
(FWHM = 2.5 px at the center)





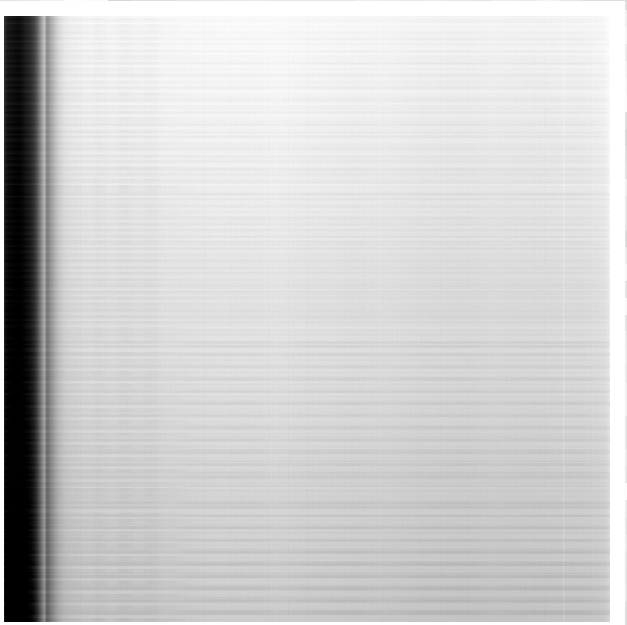
The ASTEP South photometric analysis

Calibration: bias & darks

1 bias between each science image
1 dark (30 s) every 10 science images

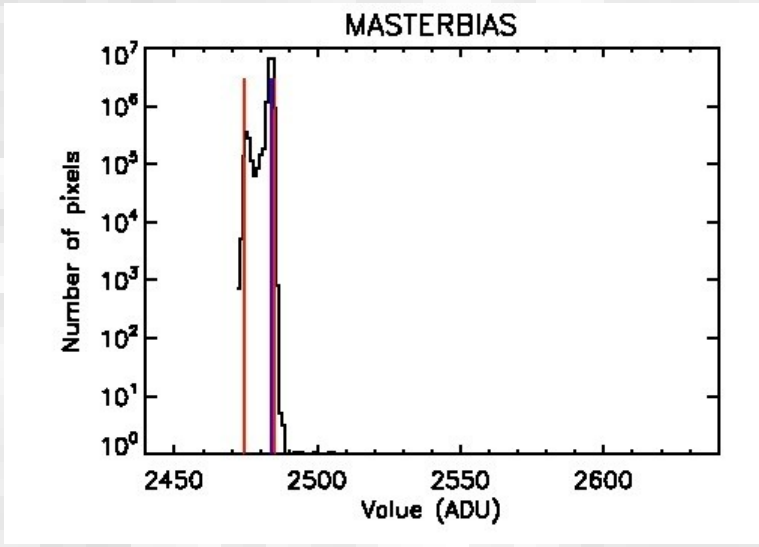
Calibration on a daily basis:

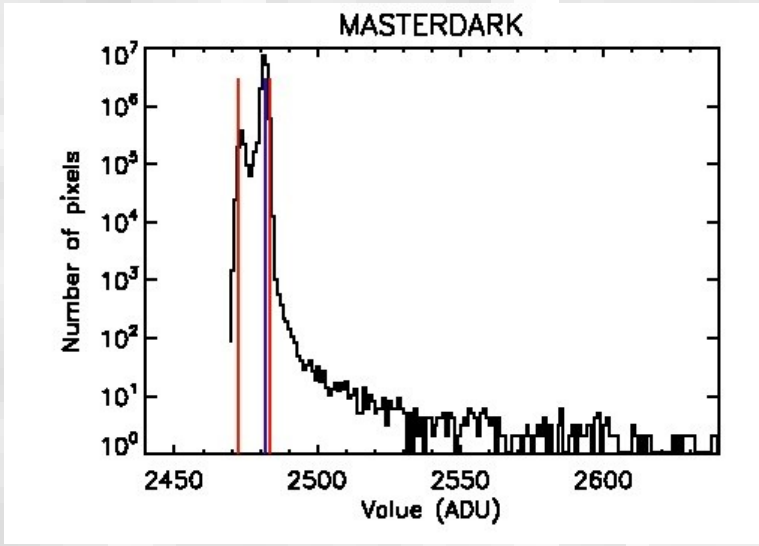
1 Masterbias / day = median of all biases
1 Masterdark / day = median of all darks



Masterbias 2008-07-12

2008-07-12







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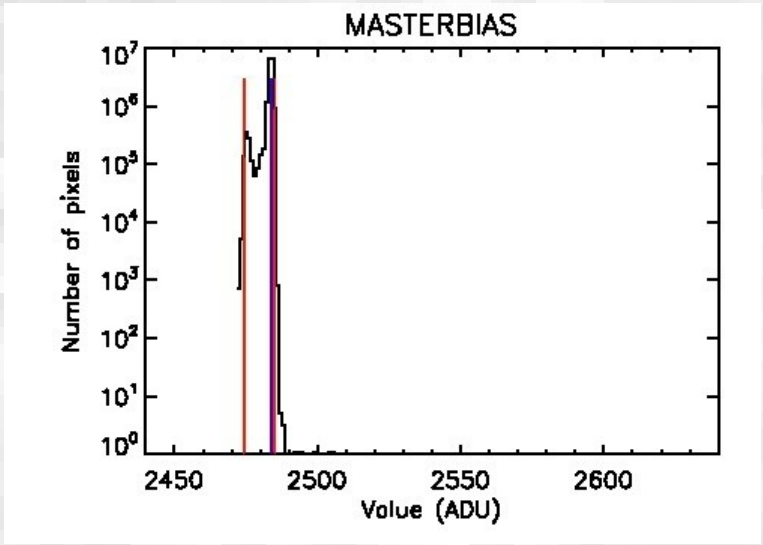
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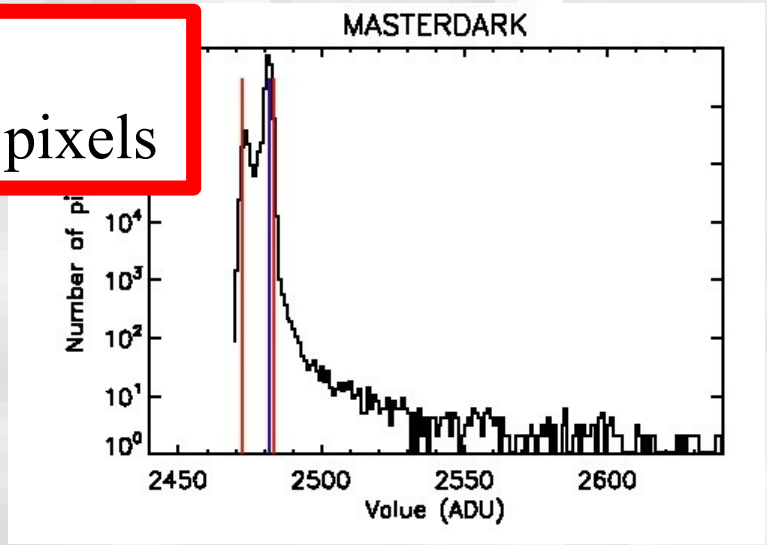
2008-07-12





Masterbias 2008-07-12

Masterbias used to calibrate the image
Masterdark used only to correct for bad pixels





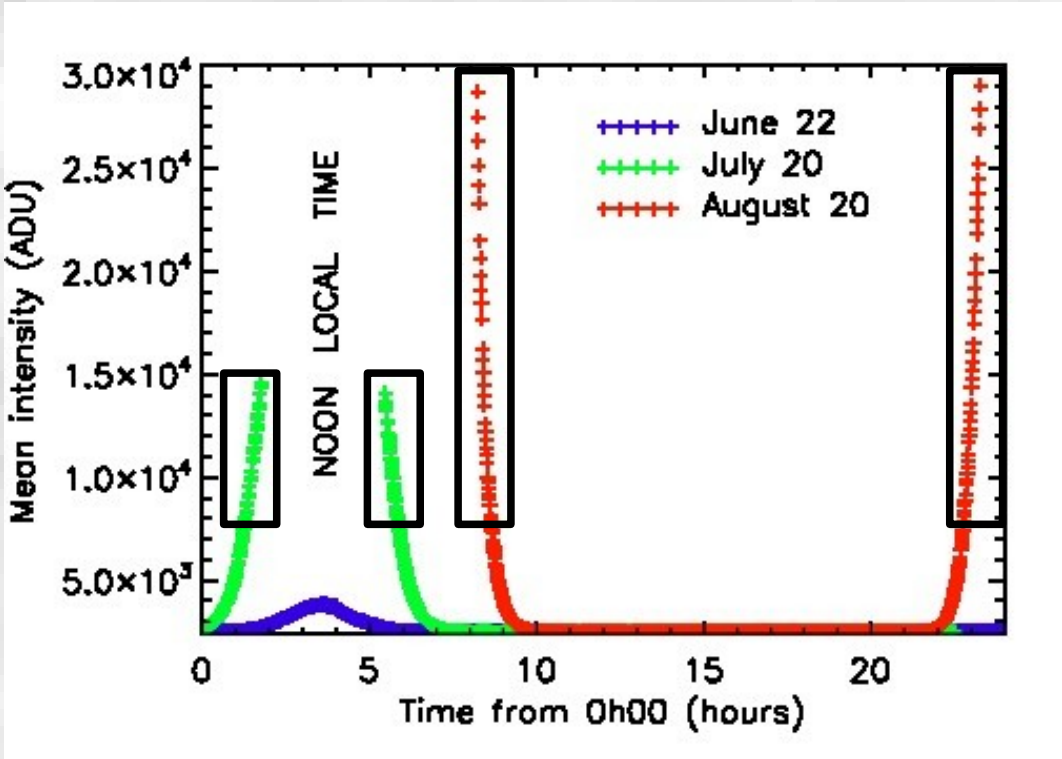
The ASTEP South photometric analysis

Calibration: flats

~100 flats when the sky is bright (around noon, 8000 < I < 30000 ADU)

Calibration on a daily basis:

1 Masterflat / day = several medians of all flats



Masterflat 2008-07-12

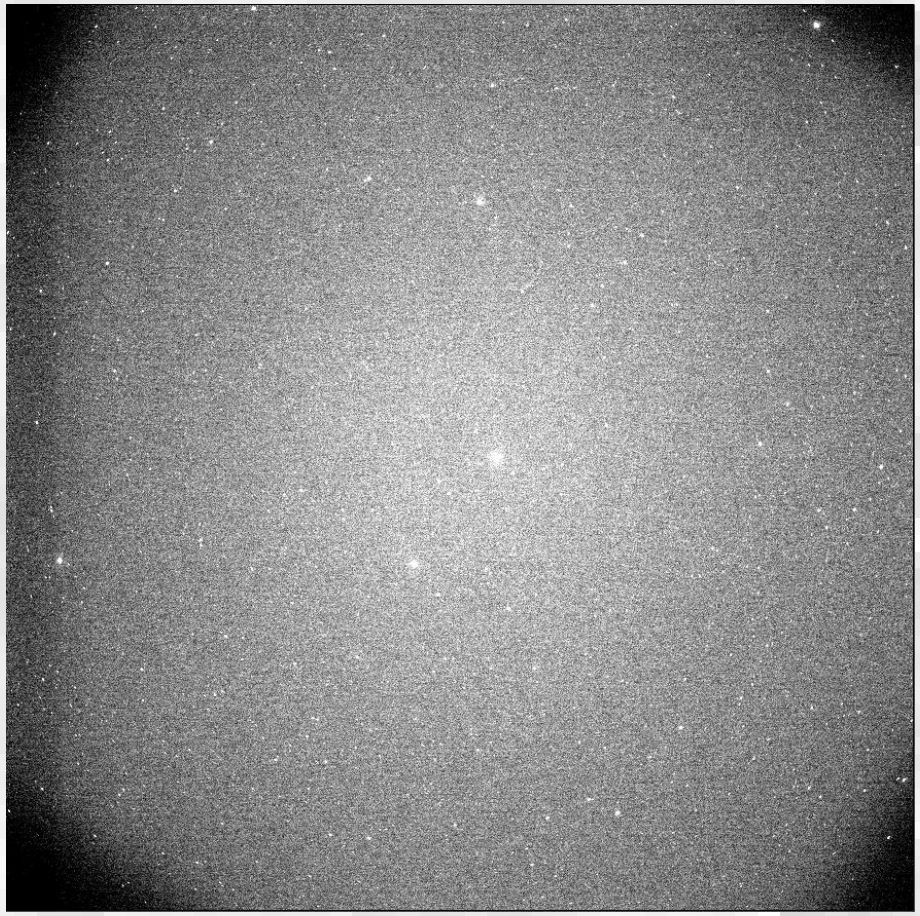


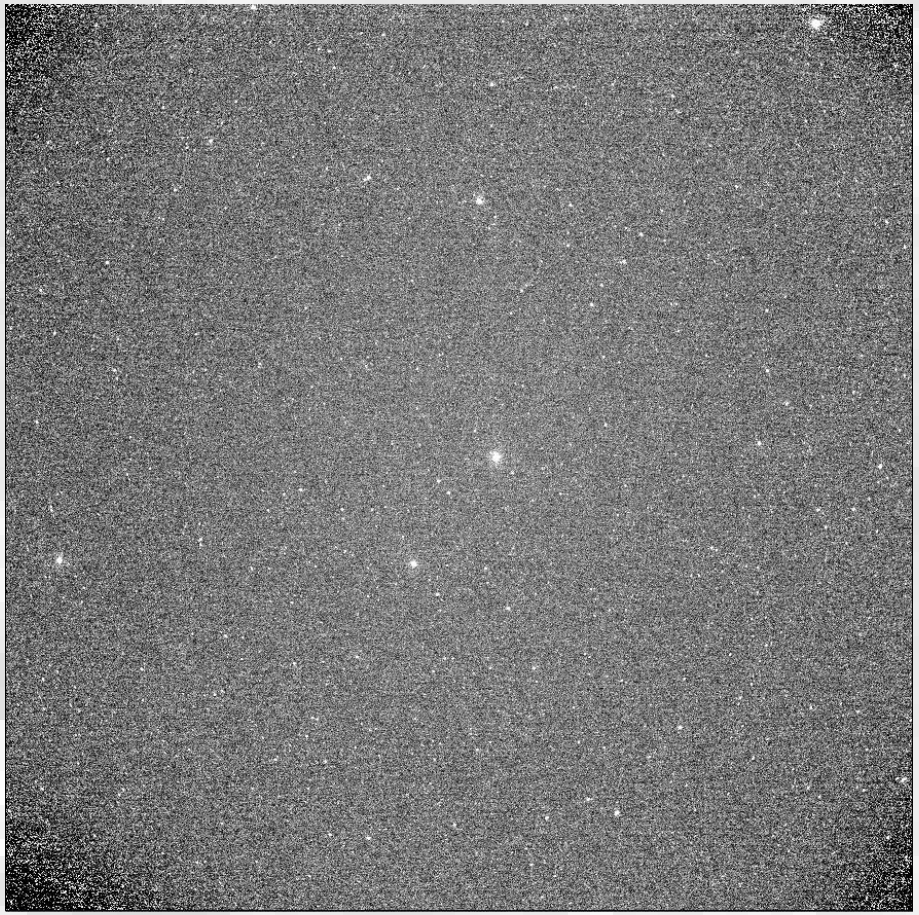


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Calibration

$$\mathrm{Image}_{cal} = \frac{\mathrm{Image}_{raw} - \mathrm{Masterbias}}{\mathrm{Masterflat}}$$





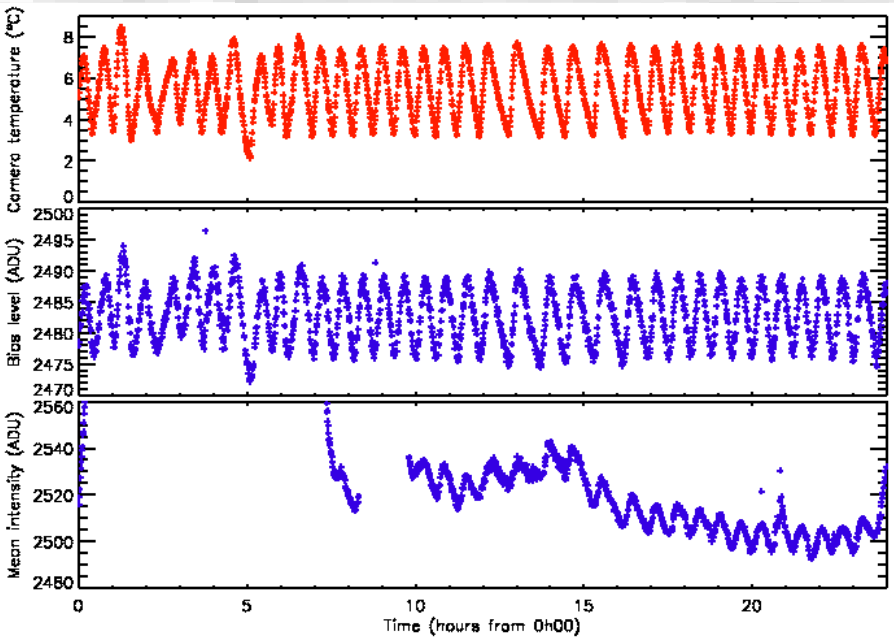


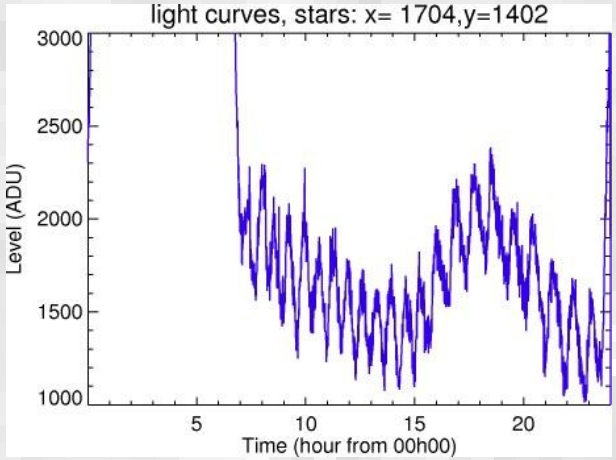
The ASTEP South photometric analysis

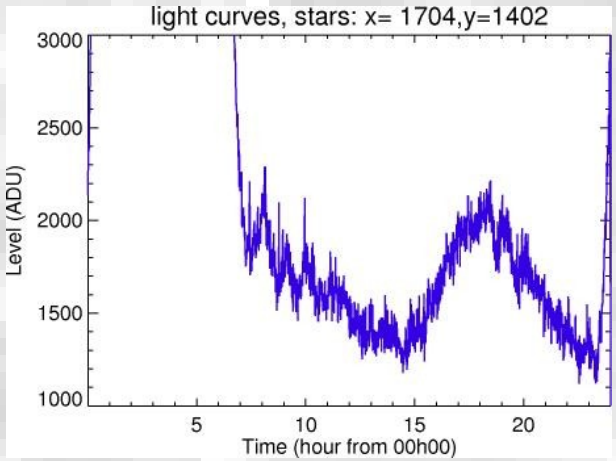
Calibration

$$\text{Image}_{cal} = \frac{\text{Image}_{raw} - \text{Masterbias}}{\text{Masterflat}}$$

Remark for 2008:
The bias oscillations are removed







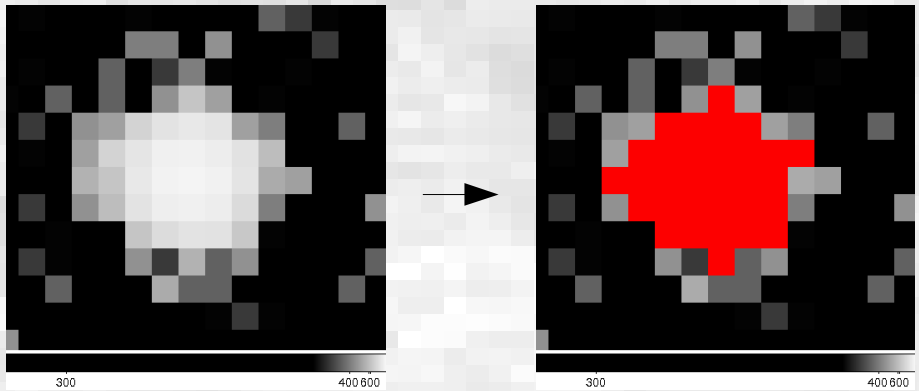


The ASTEP South photometric analysis

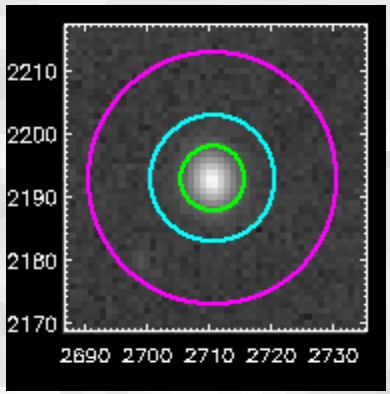
Lightcurve extraction

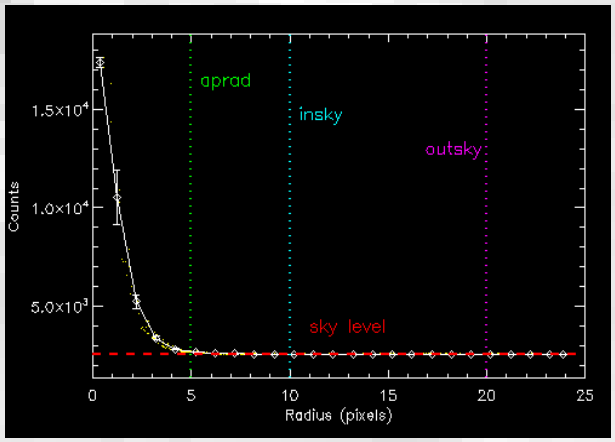
Methods:

1) Sum of the pixels above a given threshold $n \times \sigma_{sky}$



2) Sum of all the pixels in a circular aperture







The ASTEP South photometric analysis

Data analysis: Procedure

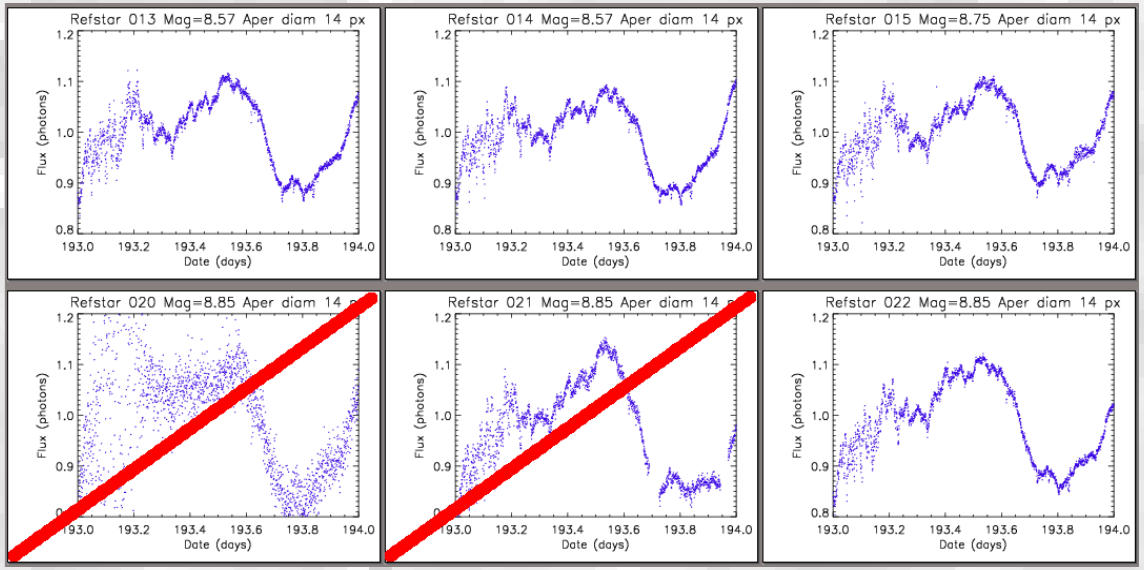
* Make calibration images (masterbias, masterdark, masterflat)
* Calibrate the images
* Build the 1-day lightcurves for all stars => 1 file / day with all the stars
* Eliminate the calibrated images (1 calibrated image = 64 MB)
* Optimize the lightcurves :
  - choice of the best aperture for each star using a day with good data
  - division by reference stars
  => 1 file / star with all the season



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Lightcurve extraction

* 7779 stars, R < 15, DEC < -88.06°
* Catalog: GSC2.2 (used only for star coordinates)
* Method 2: - Point source identification (DAOPHOT)
  - Field matching to identify the stars with respect to the catalog
  - Aperture photometry (DAOPHOT) on each star
    (placement from the field matching & optimization of the size)
  - Comparison with a median of 80 bright reference stars

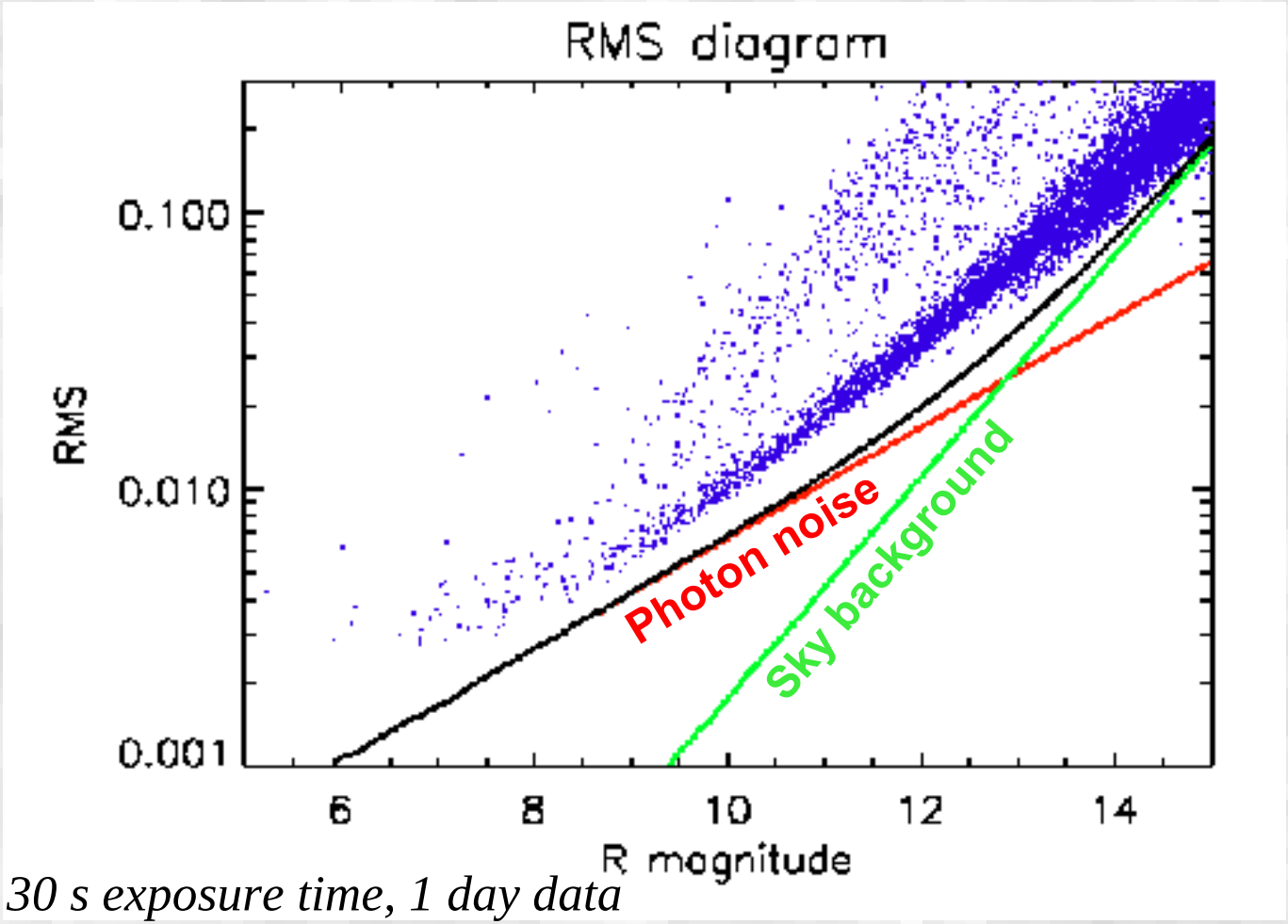




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Lightcurve extraction

Result over 1 day:



30 s exposure time, 1 day data

3-4 mmag for the brightest stars

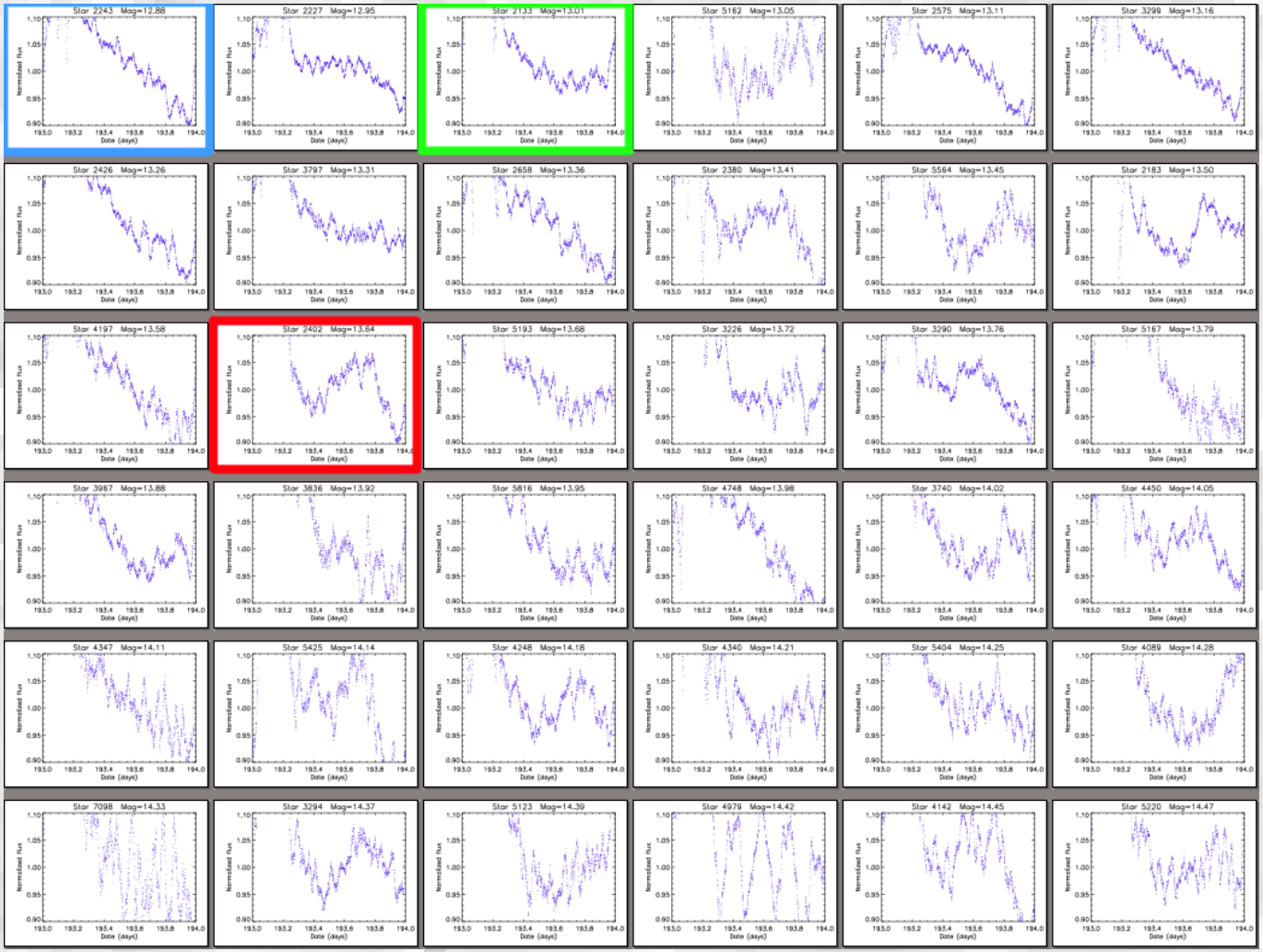
(The 2 methods are comparable)



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Lightcurve extraction

Looking at 1-day lightcurves: long term variations (up to 10 %)

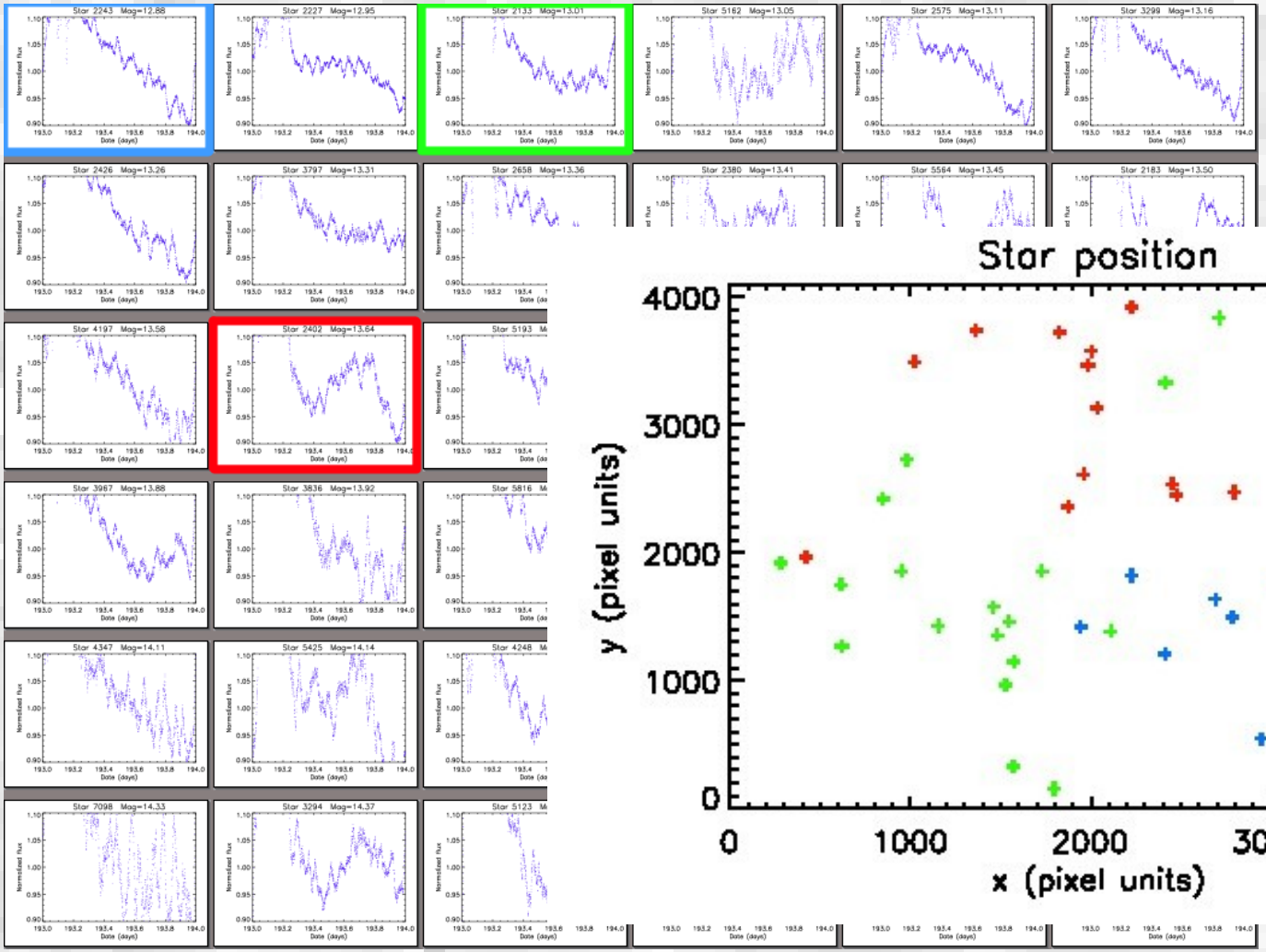




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Lightcurve extraction

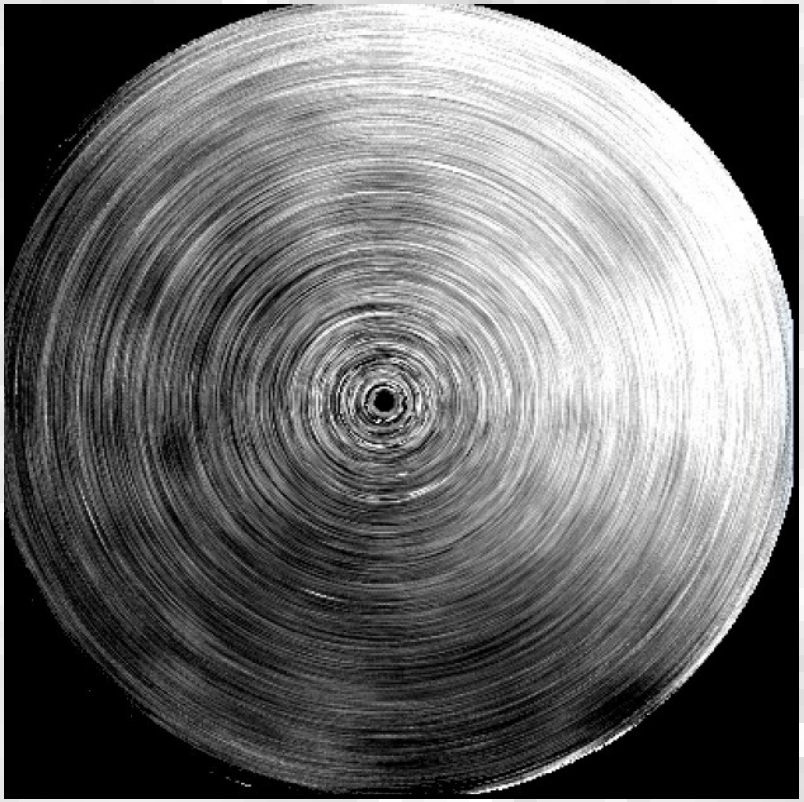
Looking at 1-day lightcurves: long term variations (up to 10 %)





The ASTEP South photometric analysis

Lightcurve extraction

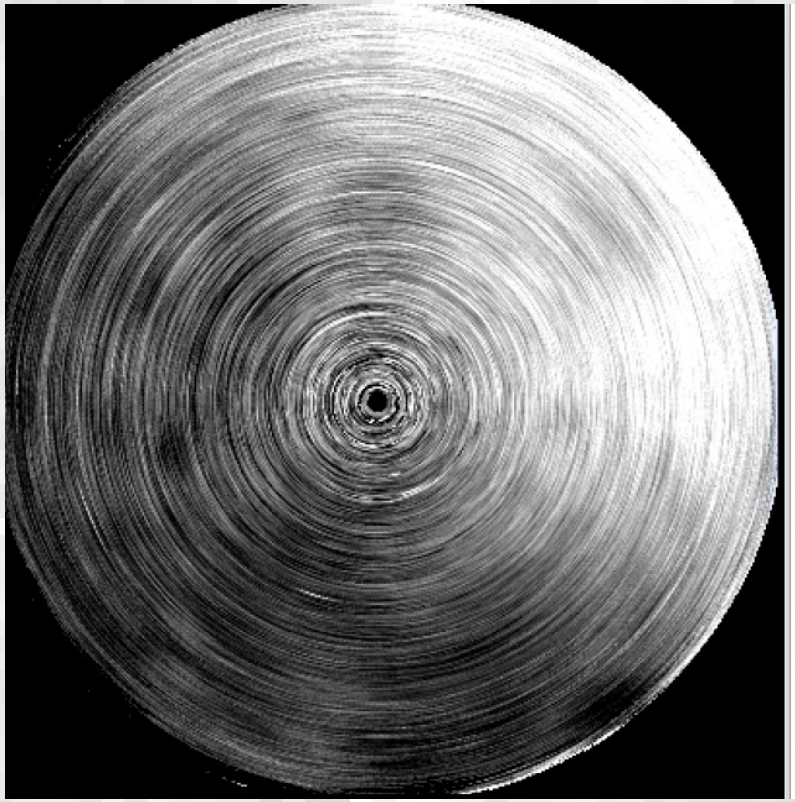


CCD map from the lightcurves

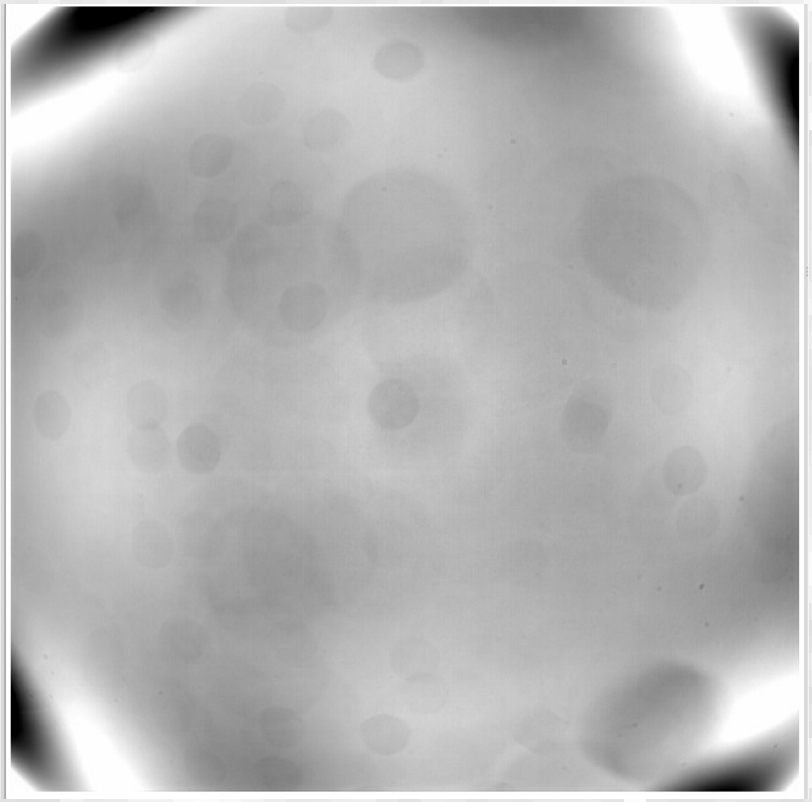


The ASTEP South photometric analysis

Lightcurve extraction



CCD map from the lightcurves



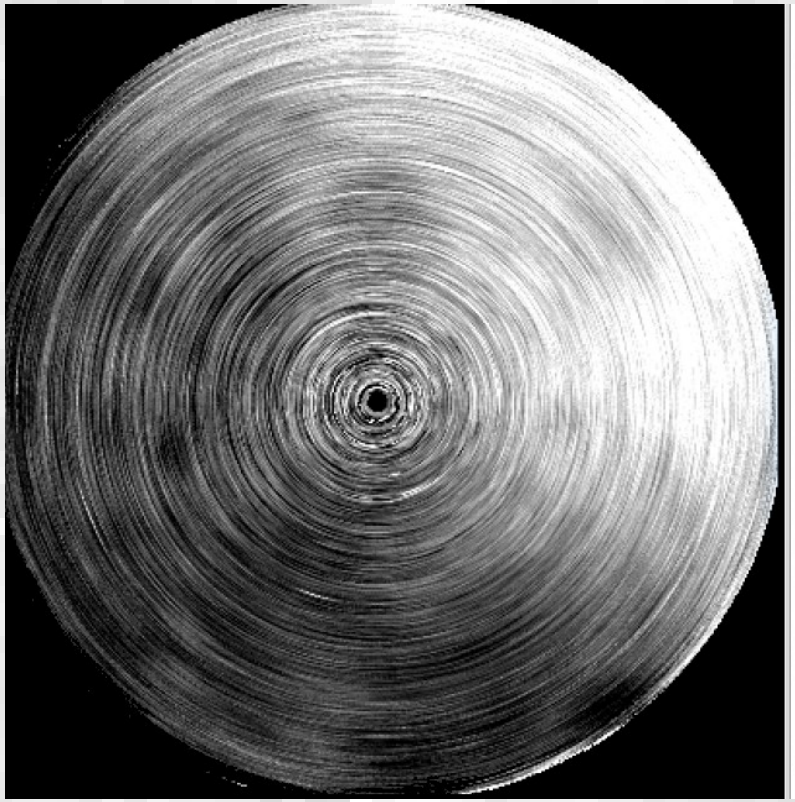
Flat

⇨ Variations due to the flat & parasitic light

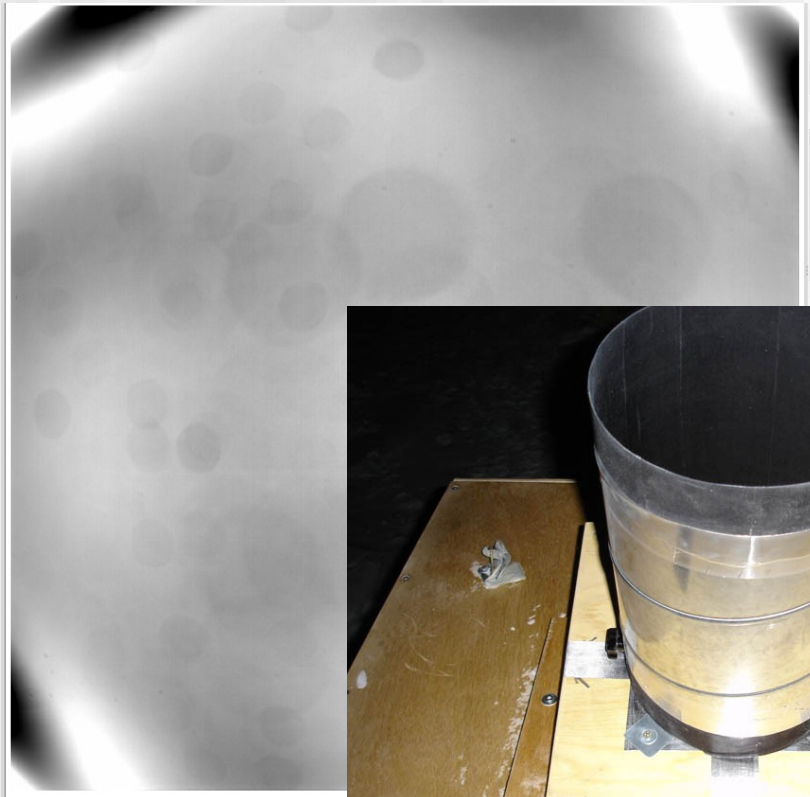


The ASTEP South photometric analysis

Lightcurve extraction



CCD map from the lightcurves



Baffle in 2009

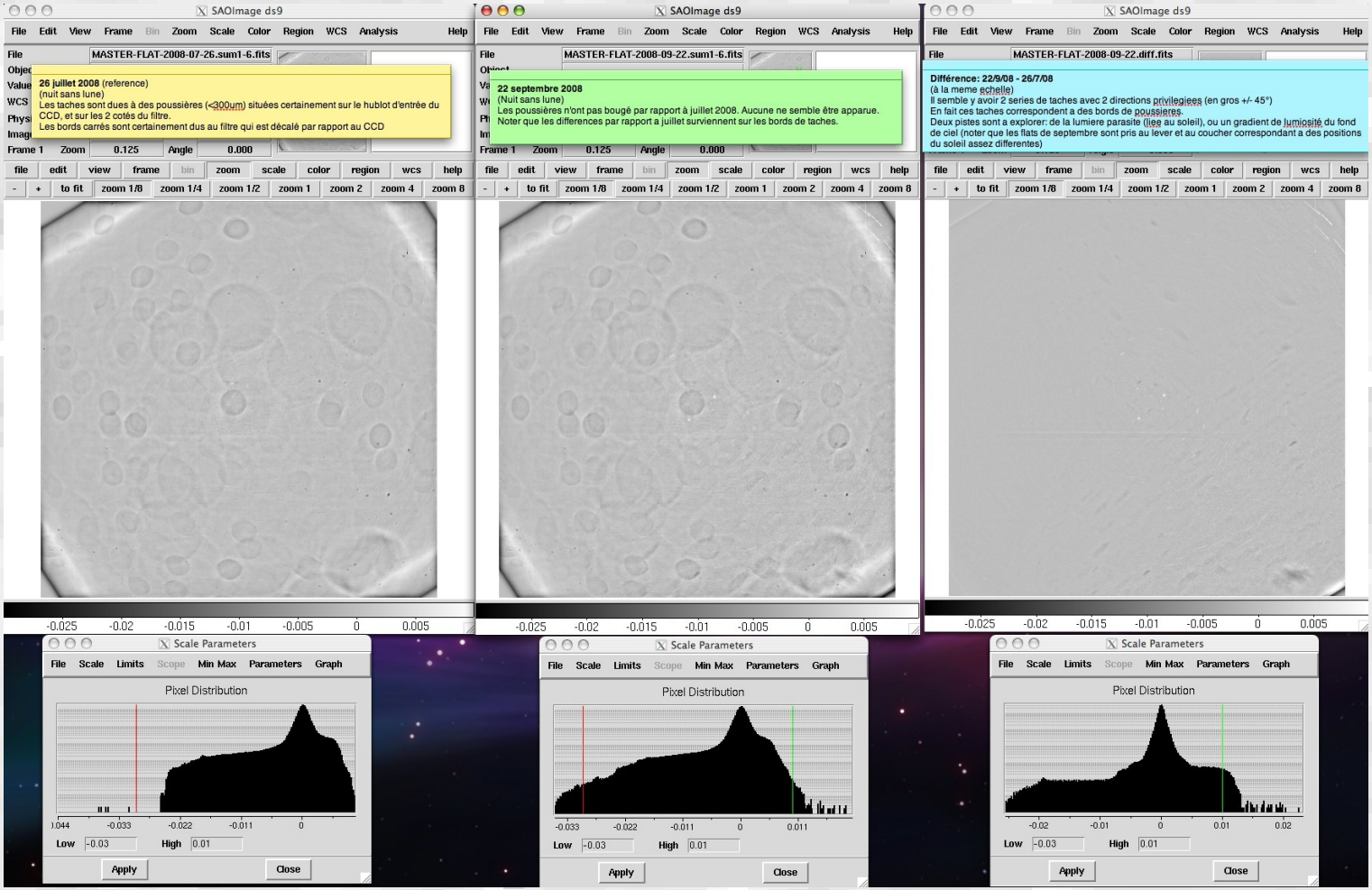
⇨ Variations due to the flat & parasitic light



The ASTEP South photometric analysis

Lightcurve extraction: where we are now

Tries to improve the flat: - 1 super-masterflat for all the season
- spatial frequency analysis (parasitic light *vs* real flat)





The ASTEP South photometric analysis

Lightcurve extraction: where we are now

Tries to improve the flat: - 1 super-masterflat for all the season
- spatial frequency analysis (parasitic light *vs* real flat)

Lightcurves built for all 2008, almost done for 2009 using 1 super-masterflat
BUT I am not sure of the quality

A solution: removing the trends directly in the lightcurves (Judit)



The ASTEP South photometric analysis

Lightcurve extraction



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