COROT data treatment: Part II

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COROT data treatment

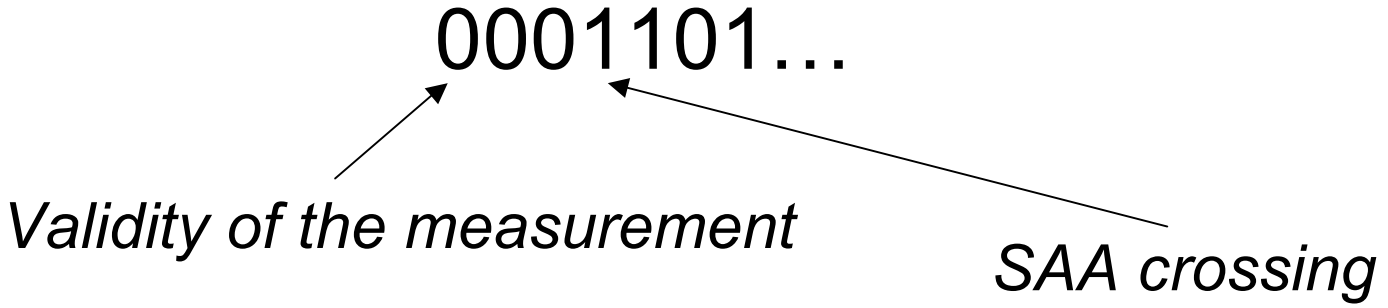
- N0 to N1 (Réza's talk):
  - aim: to correct instrument known effects ("a priori" corrections)
- N1 to N2:
  - aim: to correct remaining perturbation at N1 level = "a posteriori" corrections

…ideally,many "a posteriori" corrections should become "a priori"

COROT N2 data

General idea: to provide data (light curves) ready to use **plus** information on the data treatment.

=> Flag array associated to the light curve:



Rapid overview of the N1/N2 "pipeline"

- (predicted) Discontinuities correction
- Outliers replacement
- Temporal re-sampling

Soon on a computer screen near you:

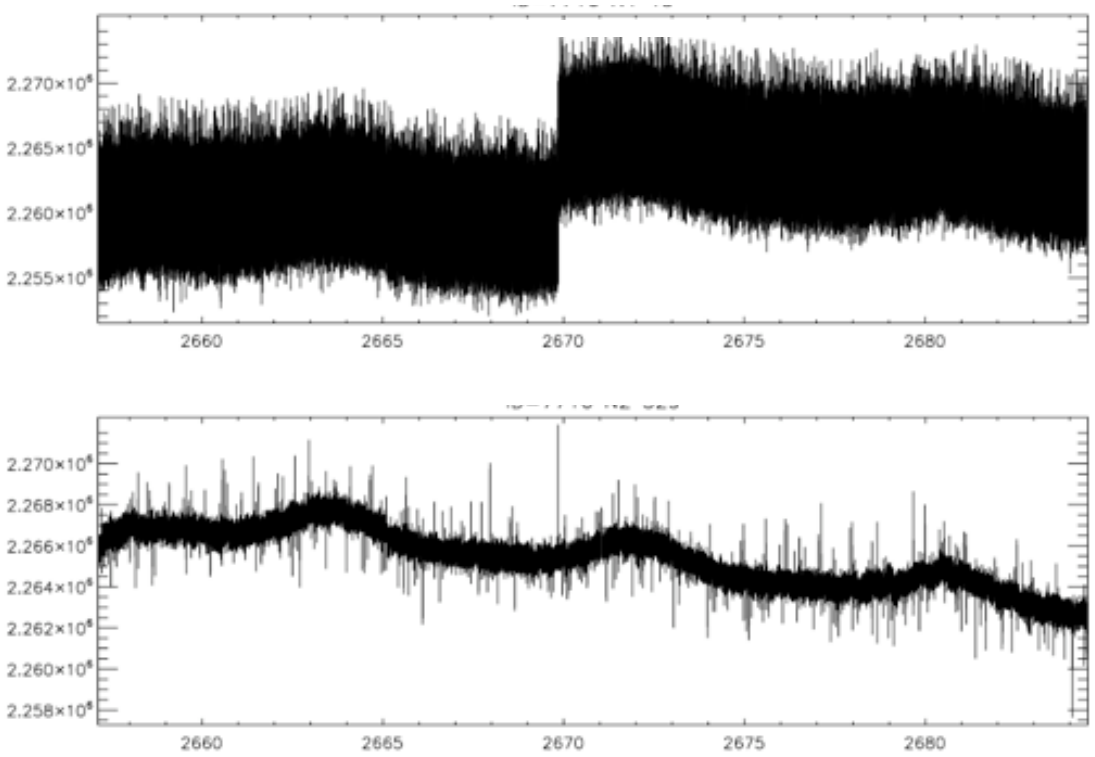
- PSF-fitting based-outlier replacement
- Long term trend correction
- Improvement of orbital perturbations correction (jitter)
- Unpredicted discontinuities ("hot pixels") correction

Discontinuities correction

On board "mask" photometry

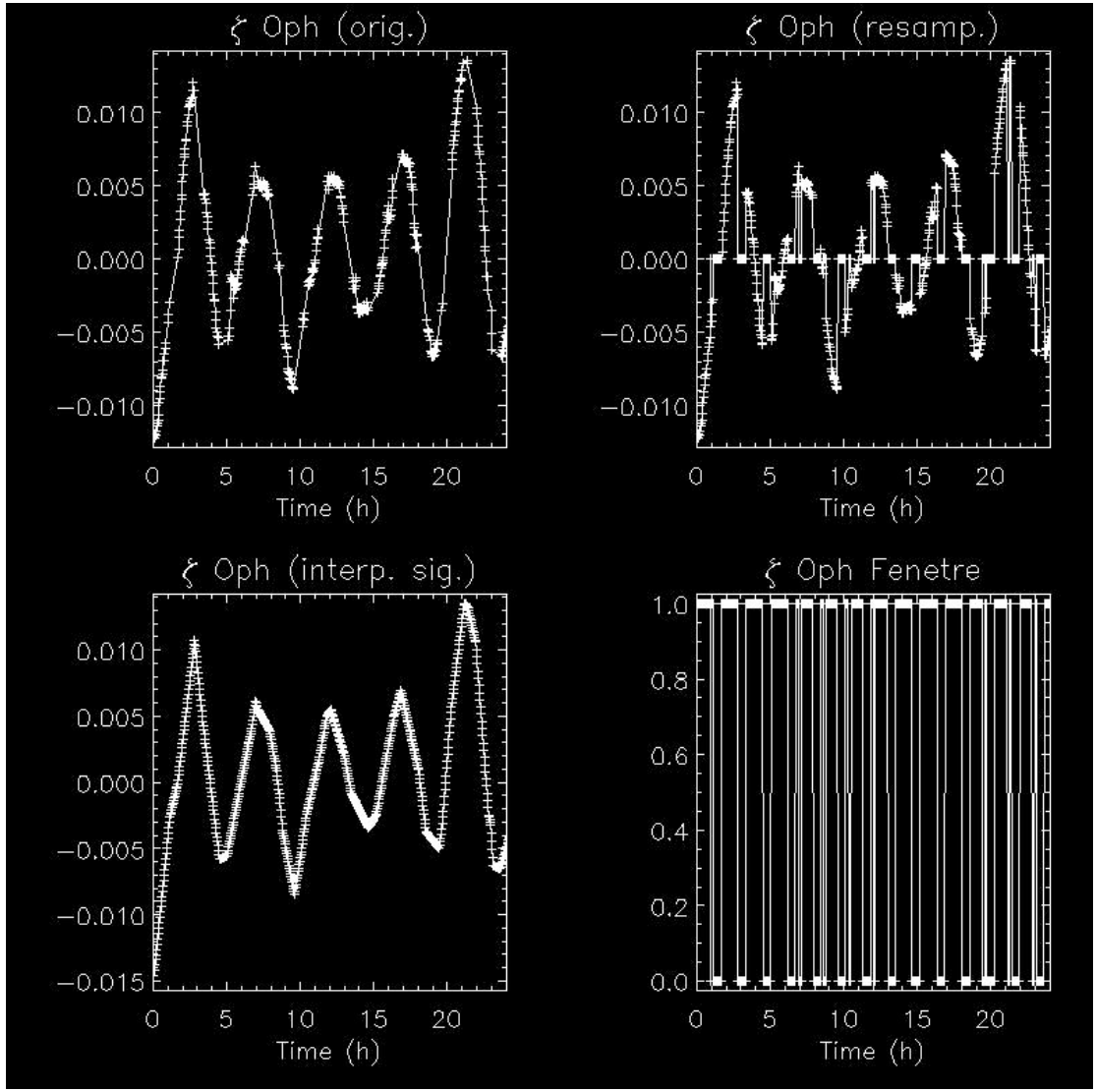
+ Mask change (optimization)

= predictable discontinuity (reference level?)



Outliers replacement

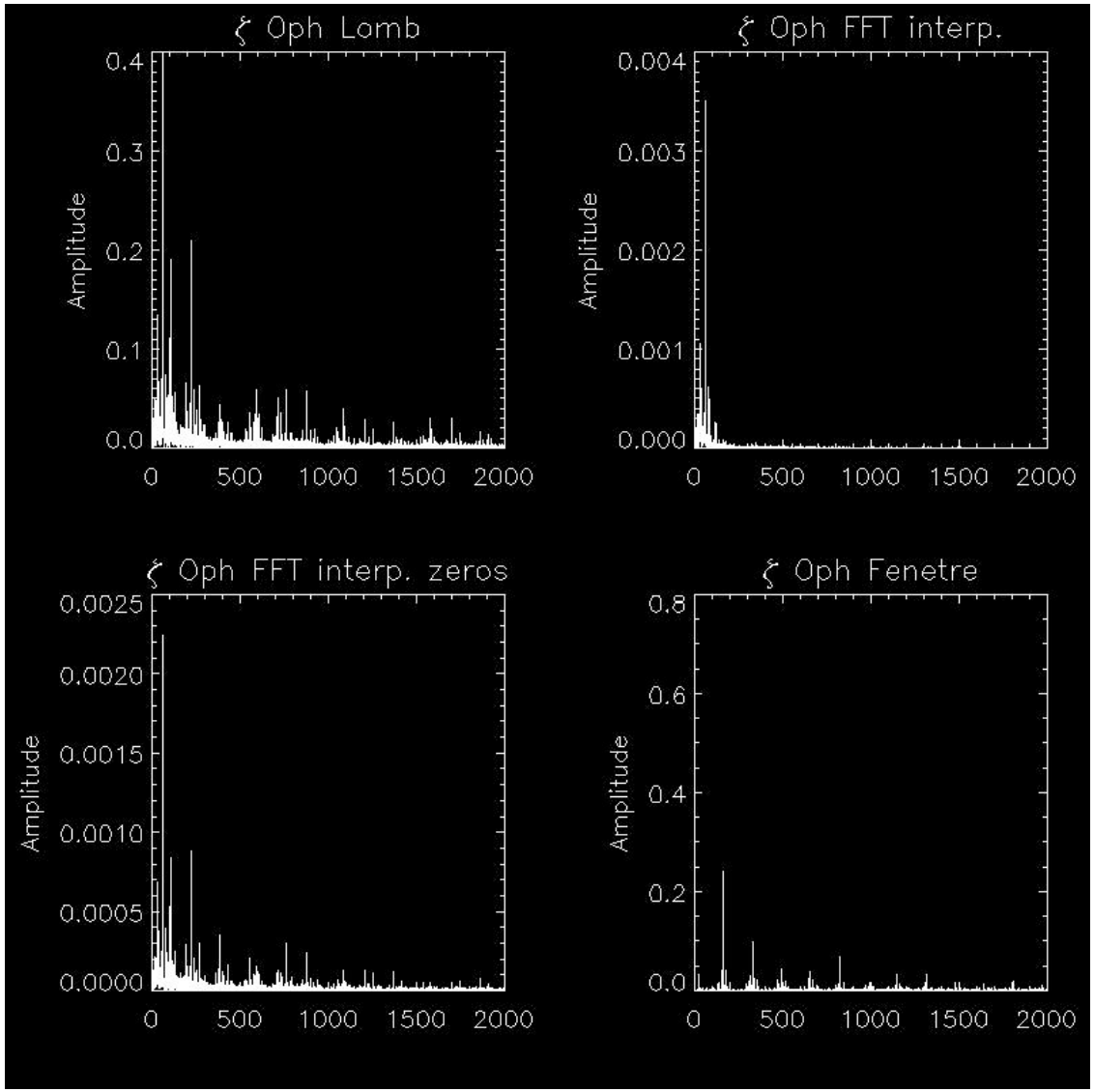
Nature abhors a vacuum, Fourier transform too.



MOST data,
thanks Jaymie

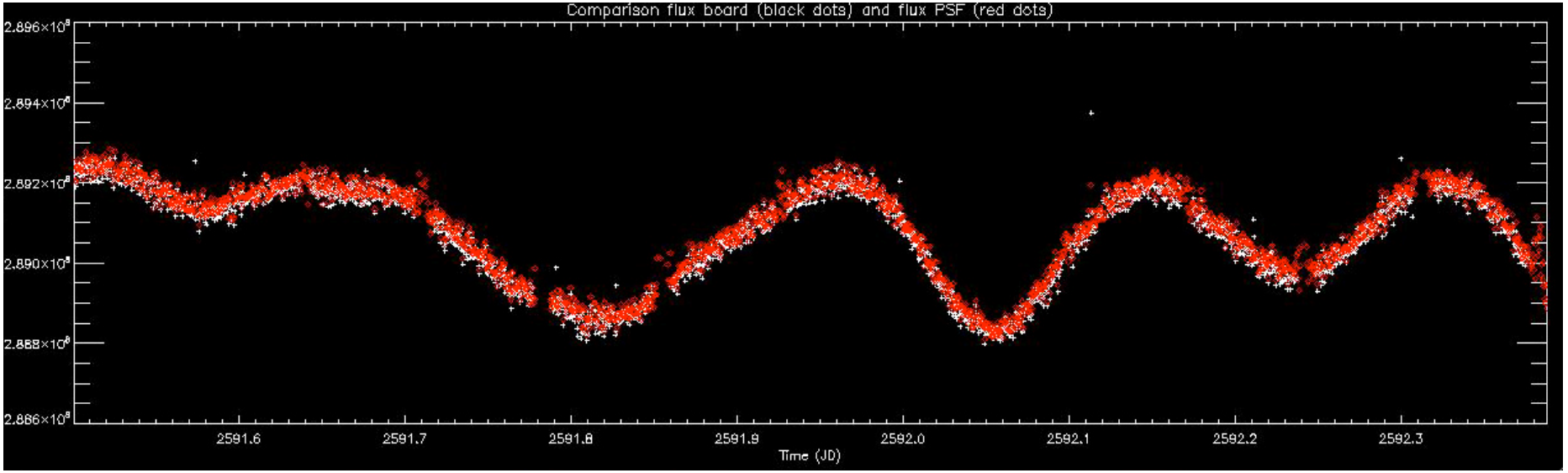
Outliers replacement

Nature abhors a vacuum, Fourier transform too.



PSF fitting

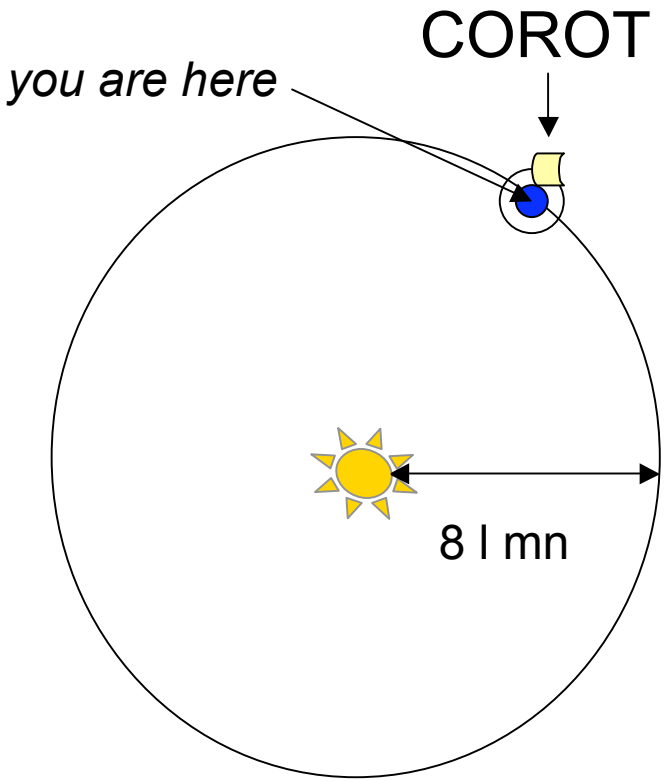
- SAA crossings = 10% of data lost with on-board photometry
- PSF fitting restores about 40% of lost data (for the moment)

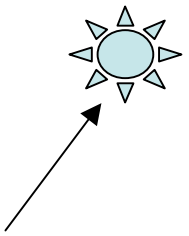


Work by Laure Lefèvre

Time re-sampling

Why?

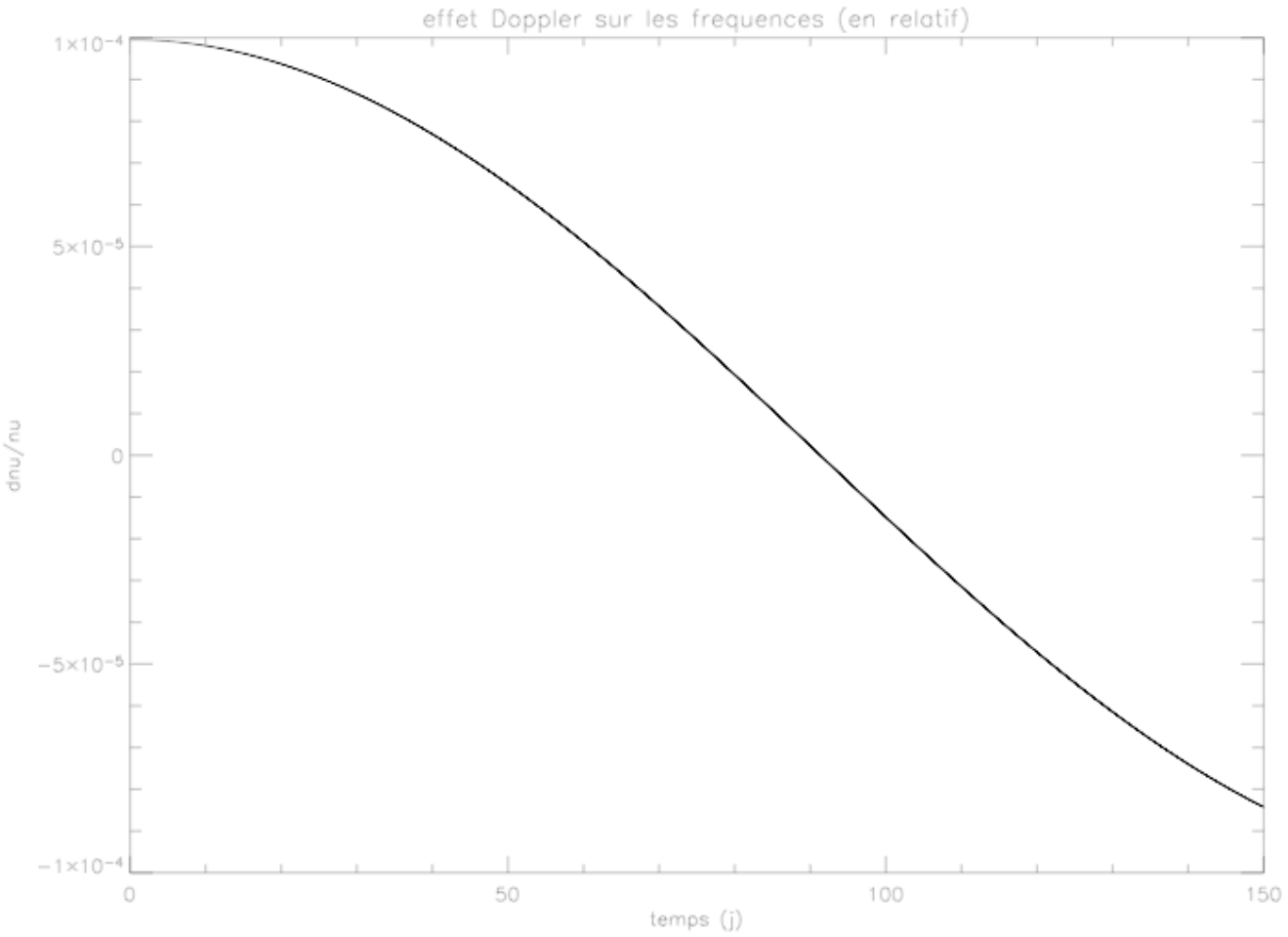




Observed star

Time in satellite frame ≠ Time in heliocentric frame

Time re-sampling



$\Delta\nu/\nu \leq 10^{-4}$

Work by P. Boumier & R. Samadi

Time re-sampling

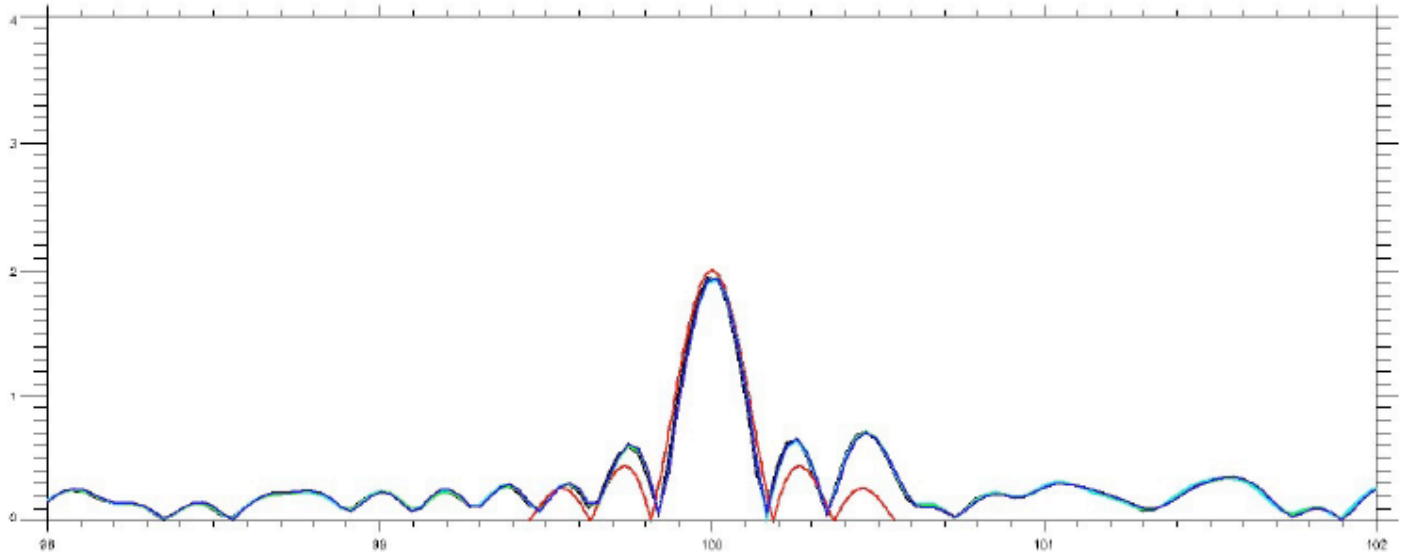
• Conversion from satellite frame to heliocentric frame: no problem but yields an irregular time sampling (not good for FFT aficionados)

• Several possibilities to solve this:
  - simple interpolation (method 1)
  - redistribution of 1s sampled data on 32s regular sampling in heliocentric frame (method 2)

Work by P. Boumier & R. Samadi

Time re-sampling

ν = 100 μHz



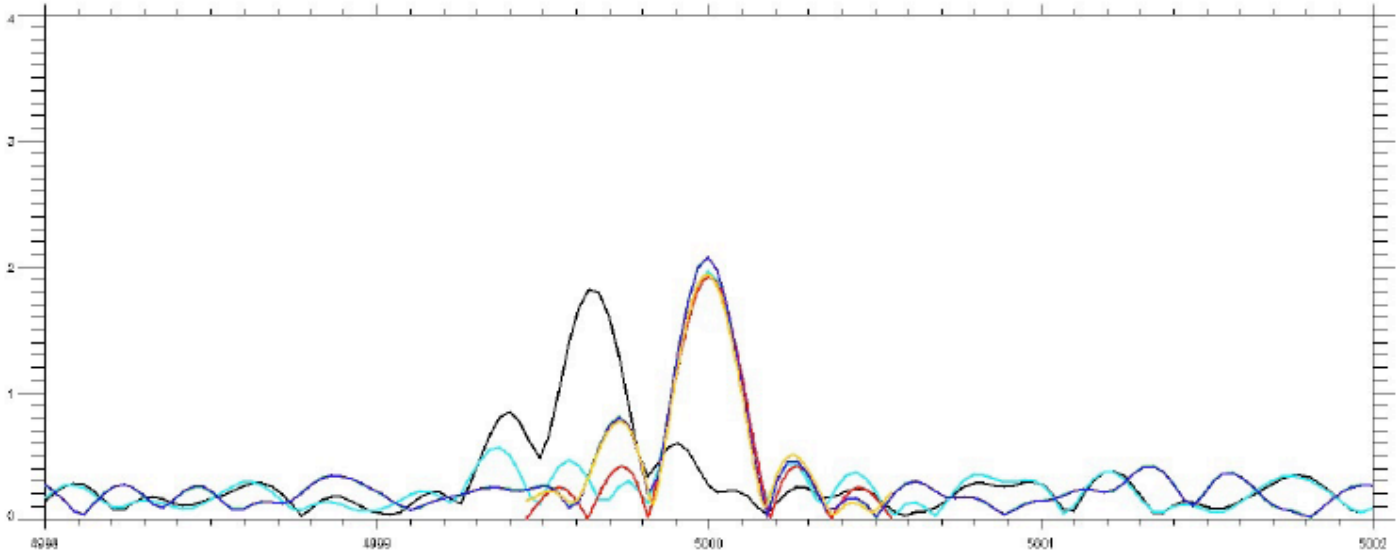
Red: analytical result Black: FFT of raw signal

Dark blue & light blue: FFT of corrected signal

Work by P. Boumier & R. Samadi

Time re-sampling

ν = 5 mHz



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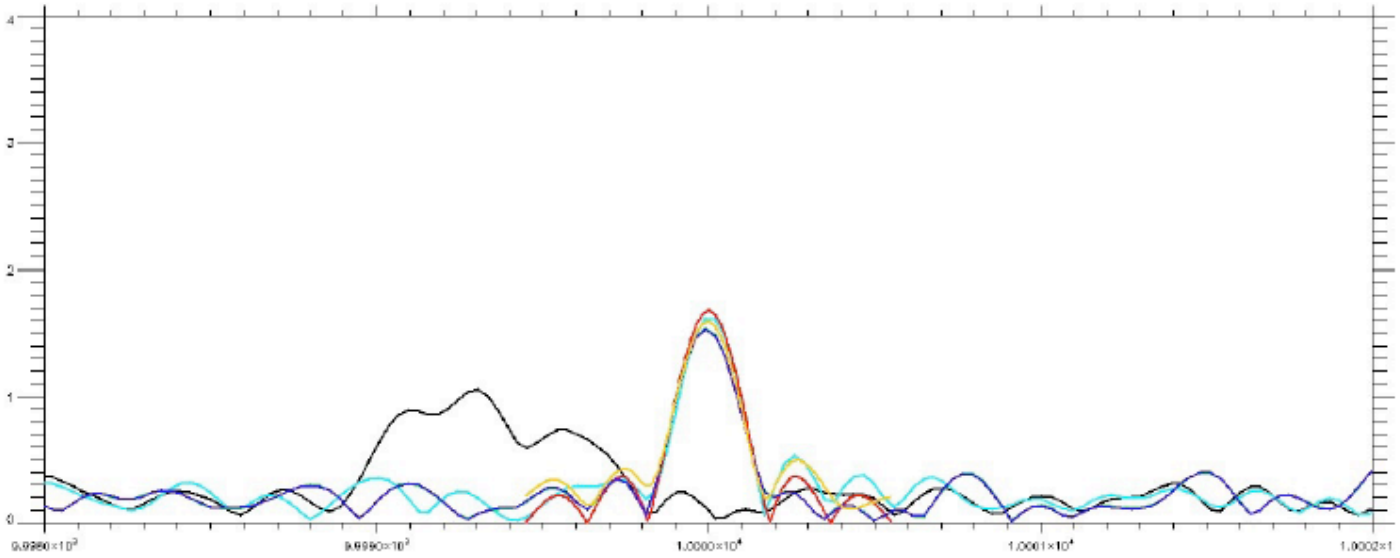
Work by P. Boumier & R. Samadi

Time re-sampling

ν = 10 mHz



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Work by P. Boumier & R. Samadi

Long-term trends/Multiplexing

$$S_i = \Sigma_j (r_{ij} - c_i a_j)^2 / \sigma_{ij}^2$$

r_{ij} = measurement for target i in image (or at time) j

a_j = systematic perturbation (air mass, instrument ageing…)

c_i = individual response of a target to a systematic perturbation

Long-term trends/Multiplexing

$$S_j = \Sigma_j (r_{ij} - c_i a_j)^2 / \sigma_{ij}^2$$

r_{ij} = measurement for target i in image (or at time) j

a_j = systematic perturbation (air mass, instrument ageing…)

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Long-term trends/Multiplexing

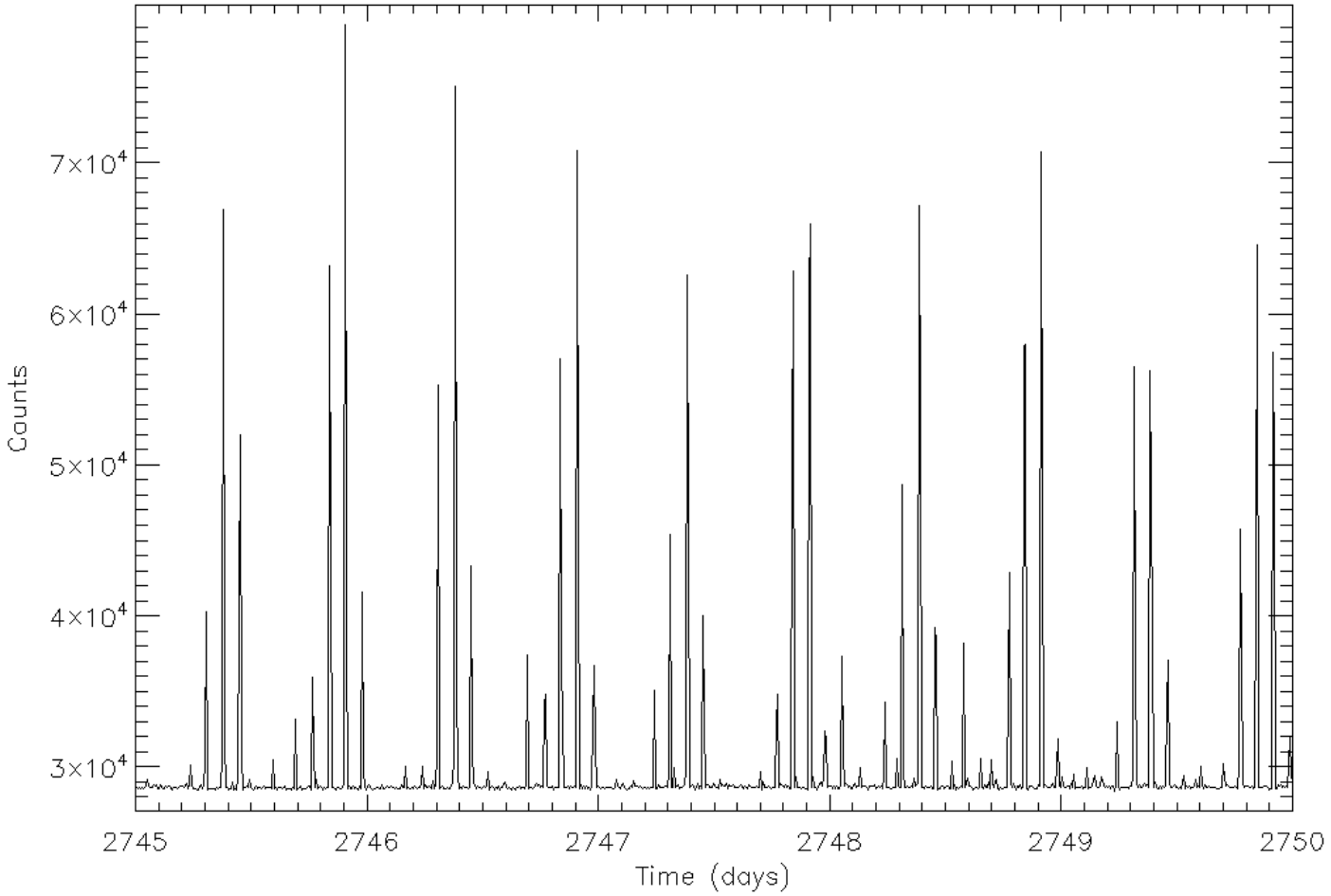
$$S = \Sigma_{ij}(r_{ij} - c_i a_j)^2 / \sigma_{ij}^2$$

Tamuz, Mazeh & Zucker, MNRAS (2005) 356, 1466:

a black (magic) box to find **a** and **c**.

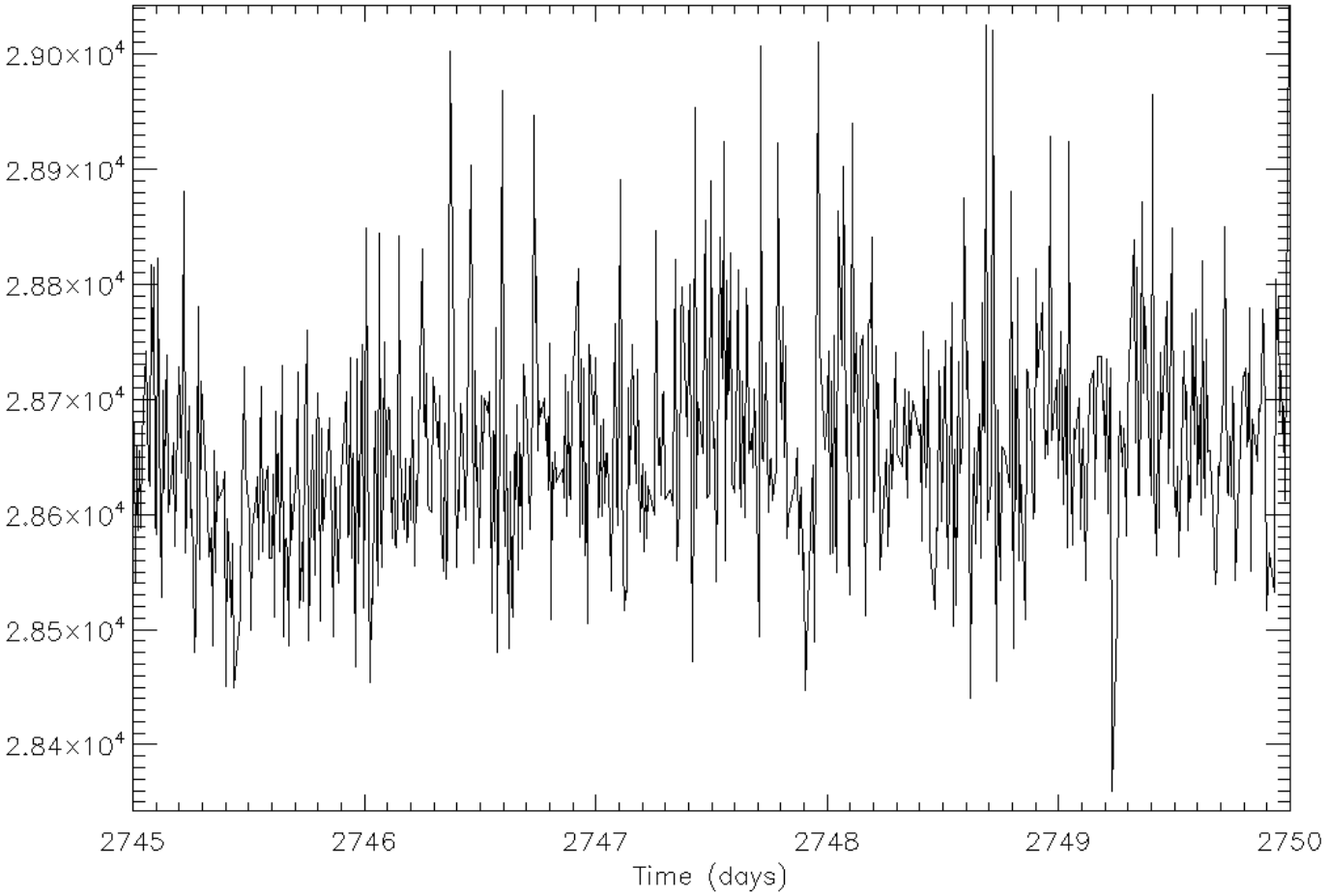
Work in progress by R. Alonso & L. Jorda

The problems Kepler should not have



Periodic "outliers", "proton impacts"… alias the SAA perturbation

The problems Kepler should not have



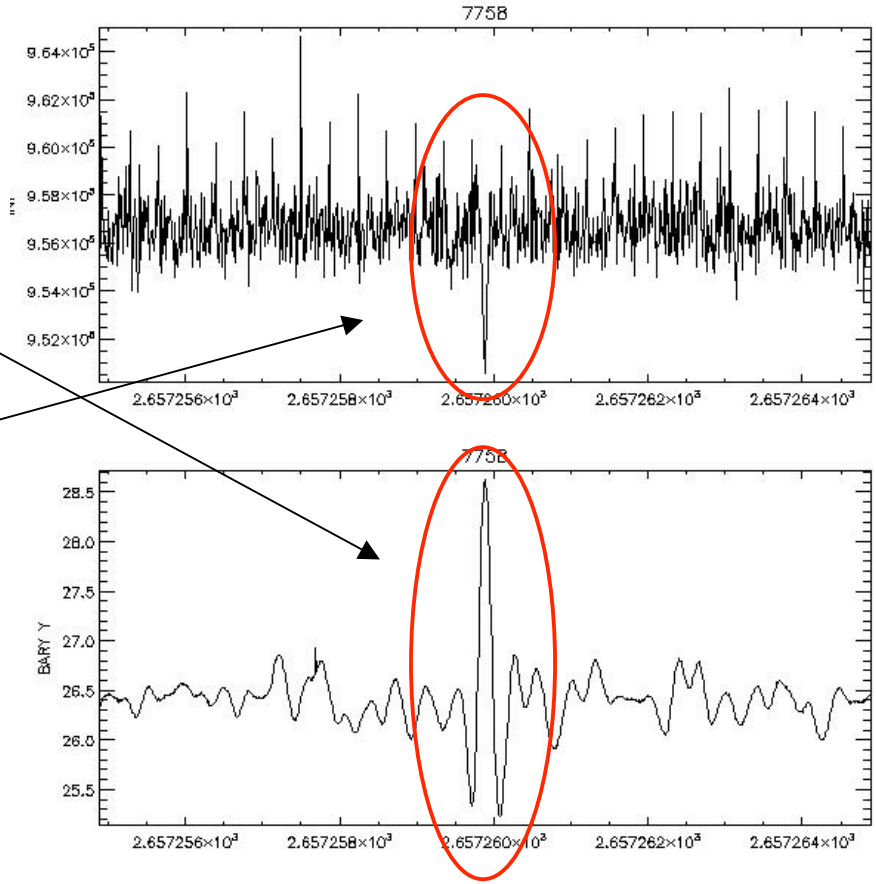
Duty cycle without SAA periods: 90%

The problems Kepler should not have

Eclipse perturbation

Consequence on the photometry

Position of the star on the CCD



Conclusion

Heliocentric orbit

$\Rightarrow$ much less work for data treatment!

…but be sure you'll have a lot to do anyway.