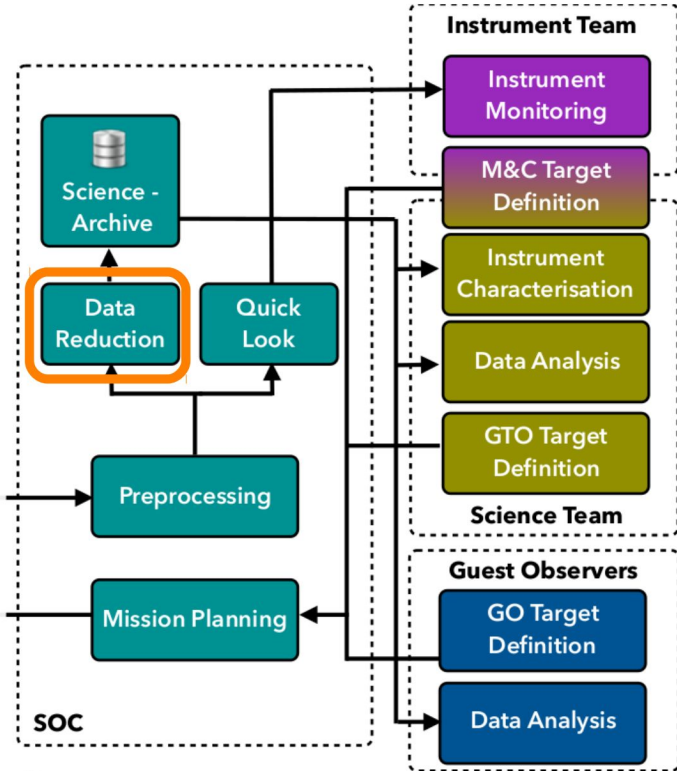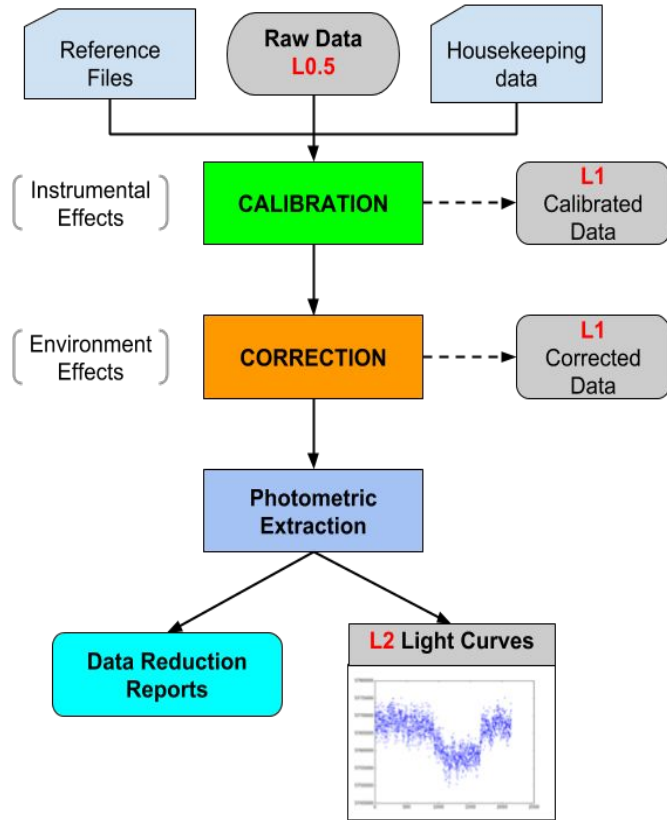# CHEOPS Data Reduction Pipeline

Sergio Hoyer, Pascal Guterman, Sérgio Sousa,
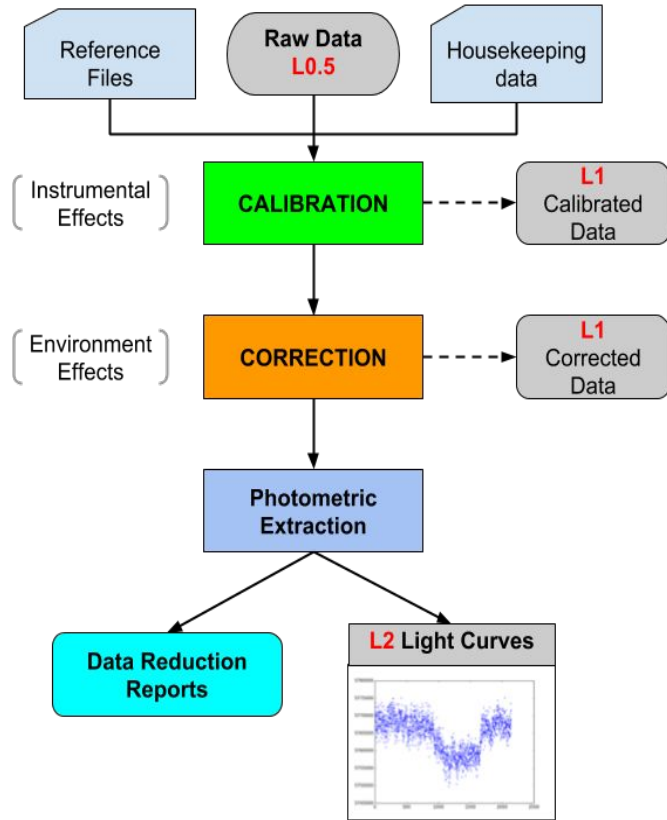Jean-Charles Meunier, Magali Deleuil

- DRP overview
- Calibration
- Correction
- Photometry
- Complementary products

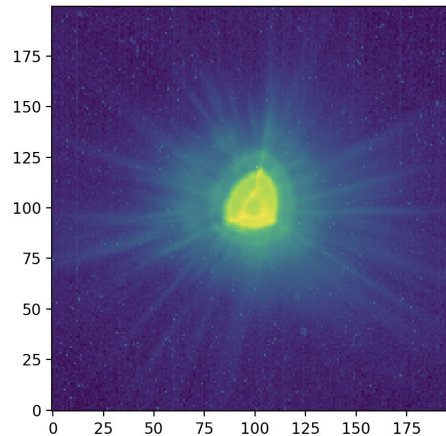- DRP processes each visit automatically.

- Raw+L1+L2 products are delivered to the scientific user.
- List of used reference files is reported within the final products.
- A complete DRP report is issued for each processed visit.
- Current version of the DRP is V13.1
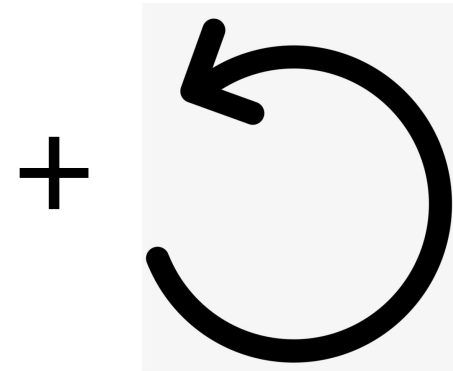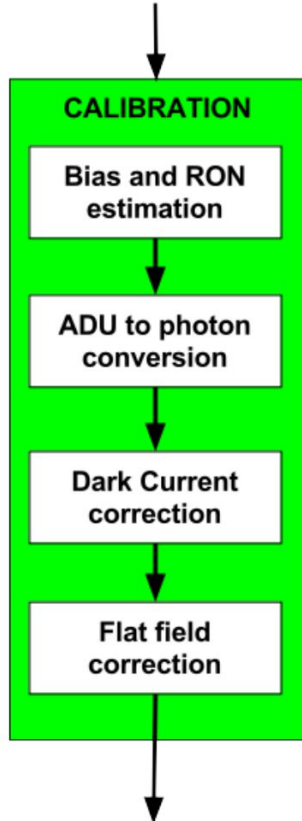- DRP paper: Hoyer et al. 2020

- Not a standard DRP

CHEOPS extended and peaky PSF

Rotation of the FoV

CALIBRATION

- Bias and RON estimation
- ADU to photon conversion
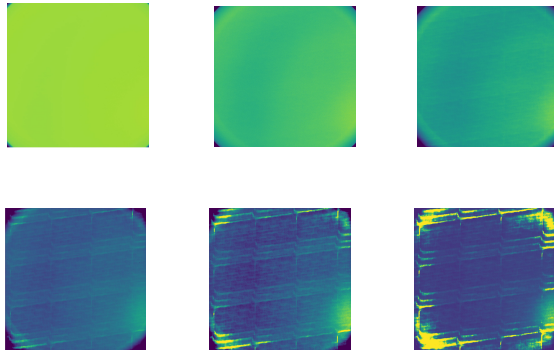- Dark Current correction
- Flat field correction

- During IOC (in-flight instrumental characterization).
- CCD margins were not fully usable.
- Great stability and very low instrumental noise

Several calibration parameters were fixed to accurate constant values (read from a REF file now).
No need for DRP estimations during each visit processing: BIAS, GAIN, DARK

- **Flat Field Correction**
  -     Depending on the target's Teff we create the FF frame from the interpolation of a library of FF (ordered as a function of Teff)

examples of the 196 individual reference FFs (as a function of Teff)

Deviation from normalized flux

T_{eff} = 2450 K

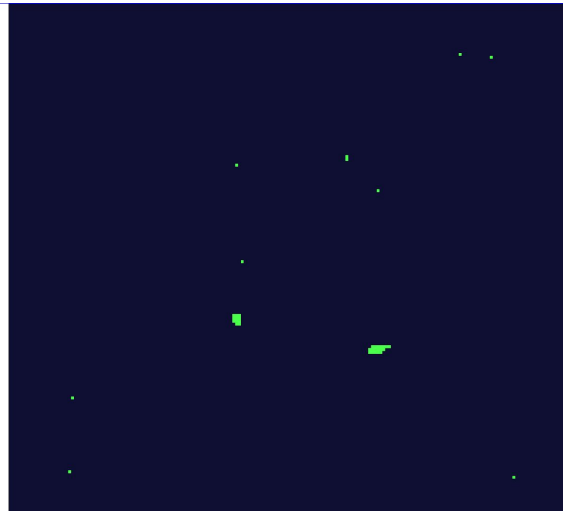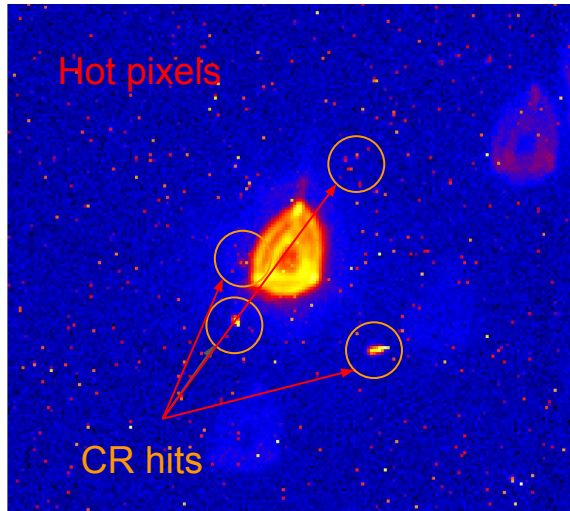T_{eff} = 6030 K

Teff = 2450K

Teff = 6030K
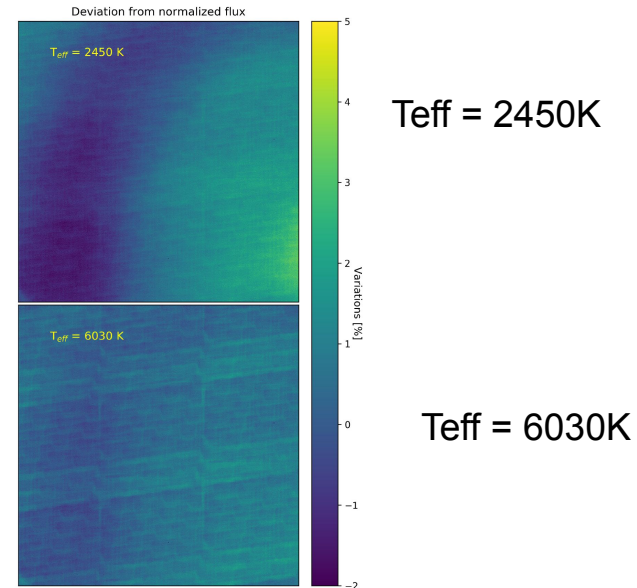
- COSMIC RAYS: Detection and Correction
  - Difficult tasks due to the inhomogeneous shape of the CHEOPS PSF.
  - More challenging when CR hits peaky regions of the PSF
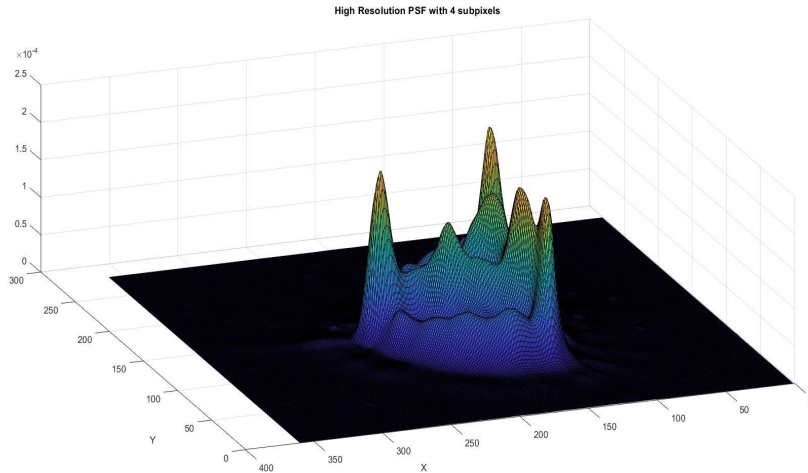
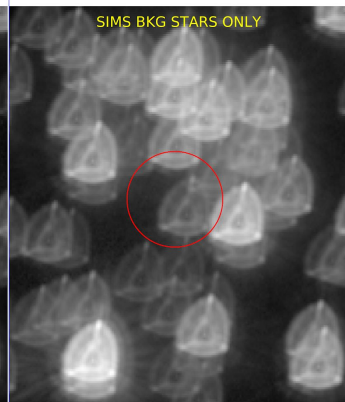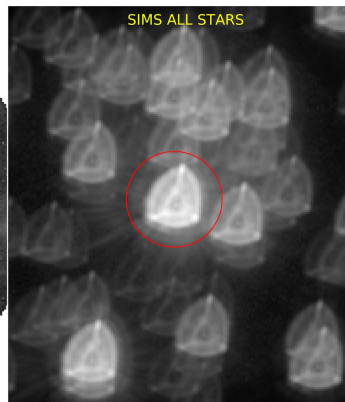
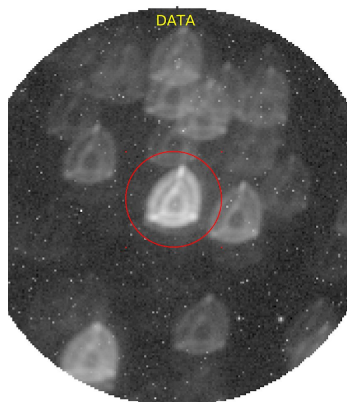High resolution representation of the PSF

- COSMIC RAYS: Detection and Correction
  - Efficiency is low within the PSF.
  - Not a big issue for bright targets (short exposures times).


Example of cosmics hits detection by the DRP

- Contamination by Background Sources
  - DRP estimates the contamination produced by rotating stars in the FoV.

Example of observations affected by contamination

CHEOPS observation   DRP Simulations of the FOV with/out the target

- Contamination by Background Sources
  - DRP estimates the contamination produced by rotating stars in the FoV.
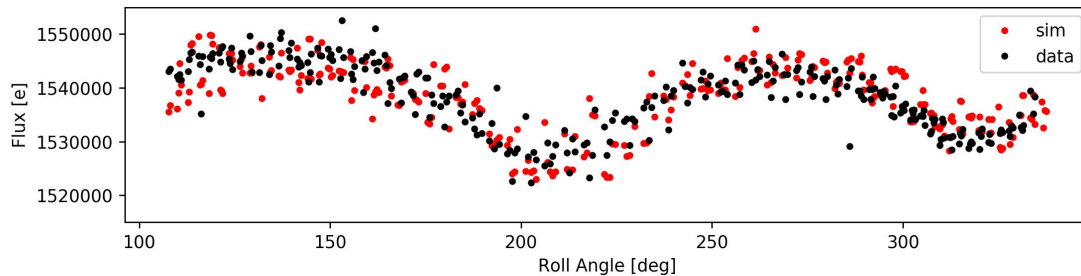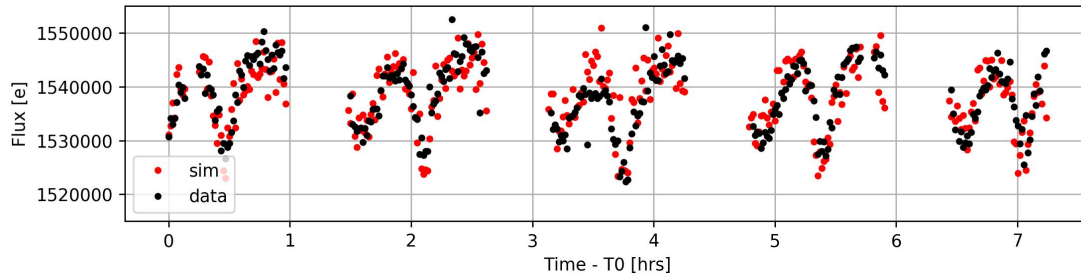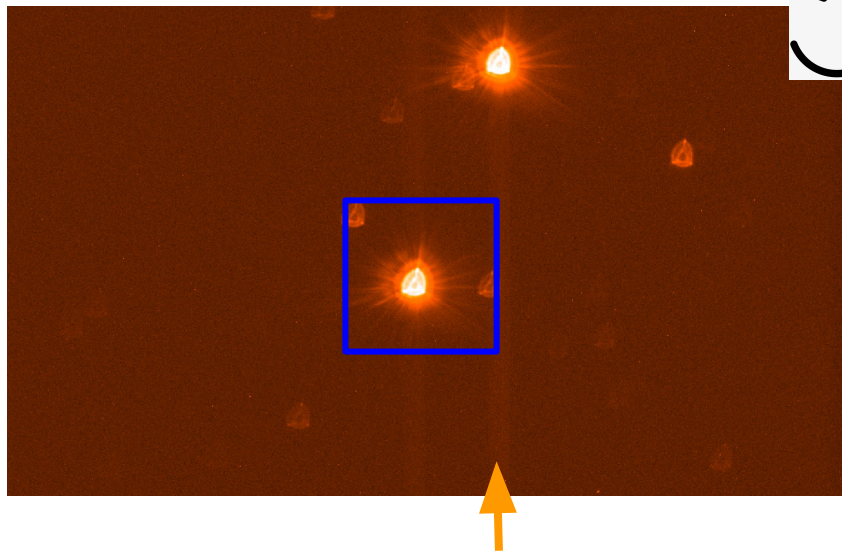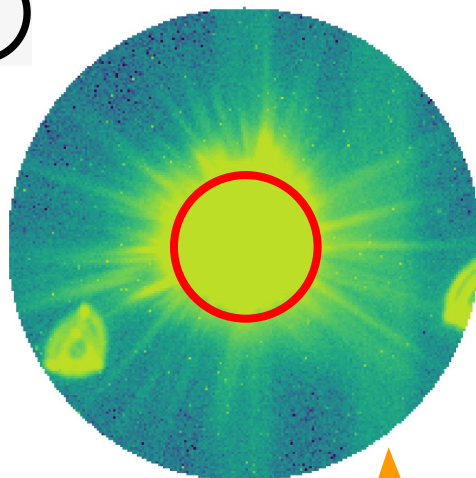

Example of observations affected by contamination

Contamination estimate → to perform a more educated detrending/correction.
This contamination curve is provided to the users.
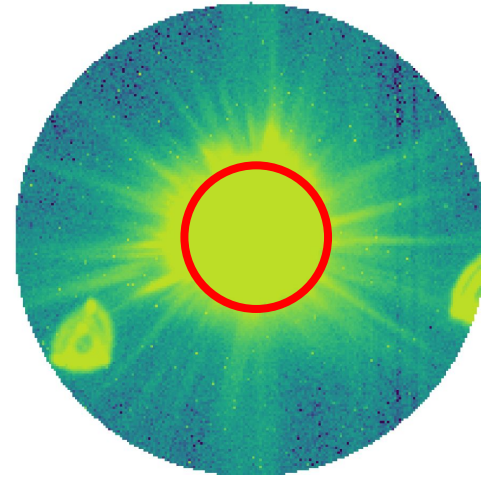
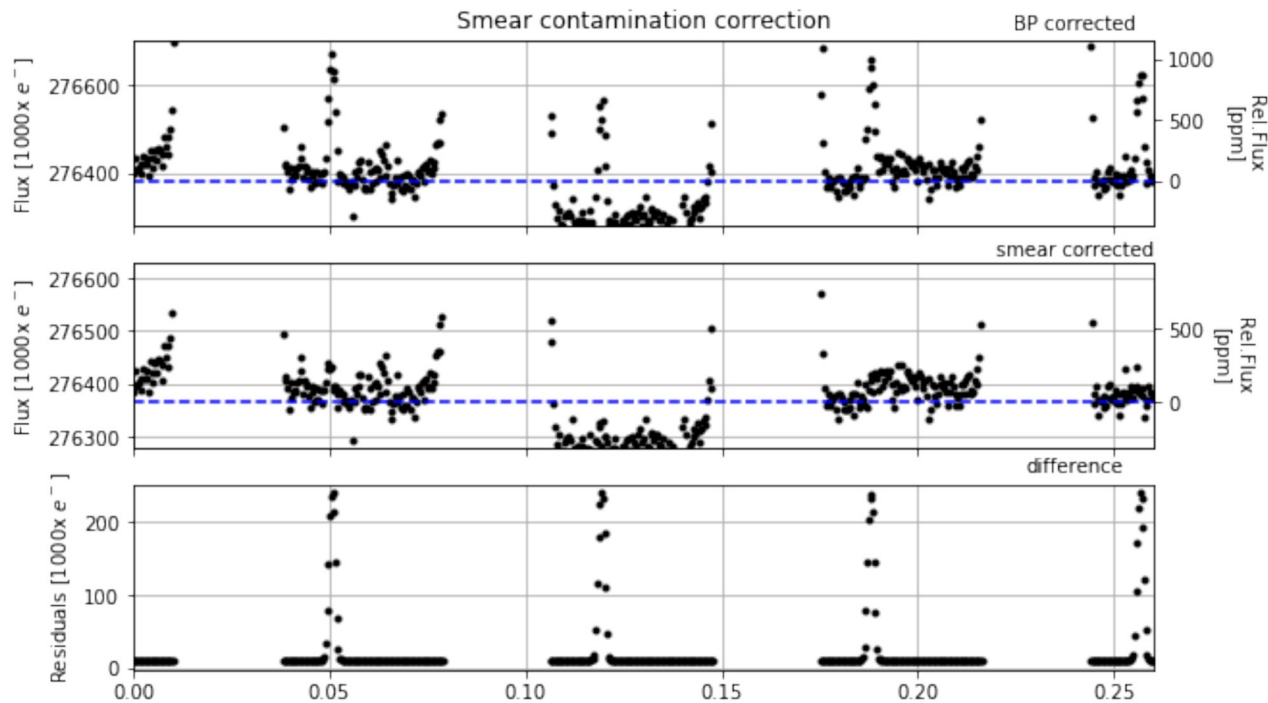- Smear Correction: also makes use of simulated FoV

Section of the Full Array
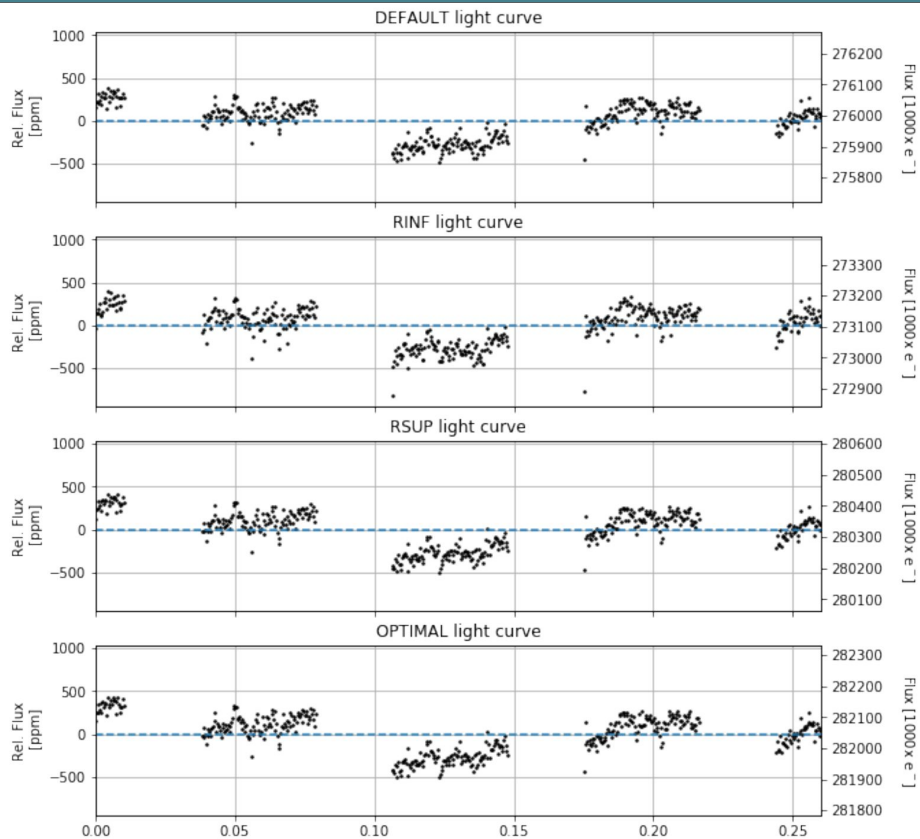
Uncorrected frame

Corrected frame

- ## Smear Correction

Uncorrected LC

Corrected LC

Smear LC → also provided to the user

Aperture photometry:

- 3 Fixed apertures: DEFAULT (25"), RINF (22.5"), RSUP (30")

- 1 OPTIMAL aperture: size depends largely on the contamination level and its variation as a function of roll angle estimated from simulations of the FoV.

Additional information (for each aperture)

TIME | ROLL_ANGLE | FLUX | FLUX_ERR | EVENT |
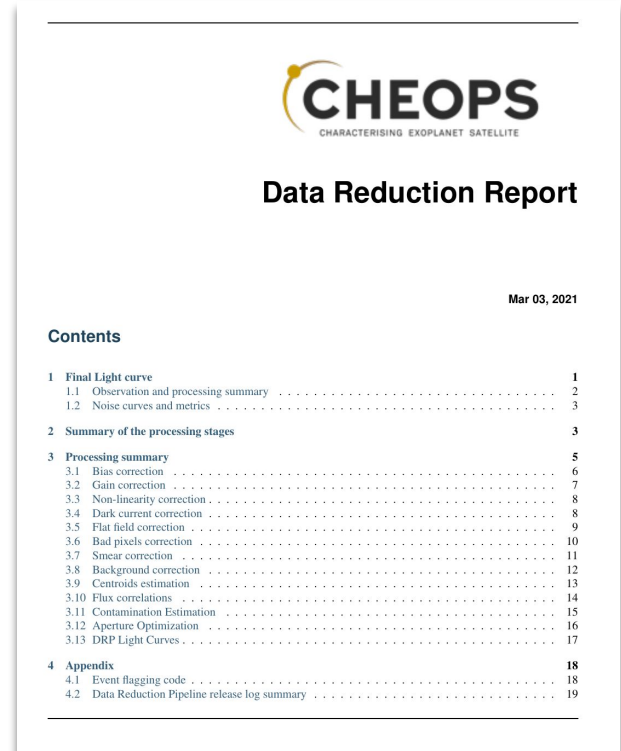BACKGROUND | CONTAMINATION_LC | SMEARING_LC | CENTROID_X | CENTROID_Y

Useful for further analysis and/or detrending of the light curves

Ready to be used with *pycheops* (Maxted et al. 2022)

Information of the step by step processing of the data.

Relevant figures and info to identify origin of outliers and main correlations between target's flux and DRP estimated quantities.
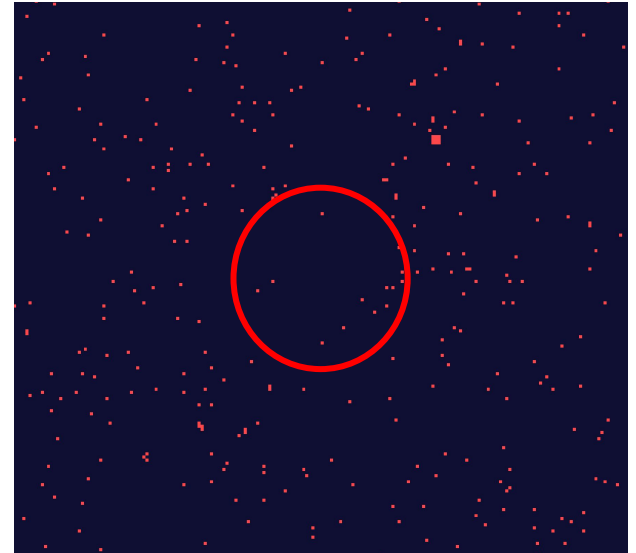
(Raw) Statistics of all the apertures light curves

CHEOPS
CHARACTERISING EXOPLANET SATELLITE

Data Reduction Report

Mar 03, 2021

Contents

- Detect/Correct for Hot and telegraphic pixels.

- Adapting Optimal aperture definition to meet real life performance.

- Fine tune of existing modules.

Example of Hot pixels detection