HEAVENS:

Towards Distributed On-the-Fly Data Processing Archives

- **Legacy: a 30 years tribute**
- **SCIOPS does not end with a data archive**
- **HEAVENS**
- **Redesigning iSDC 15 years later**
- **On-the fly Data Processing Archives**

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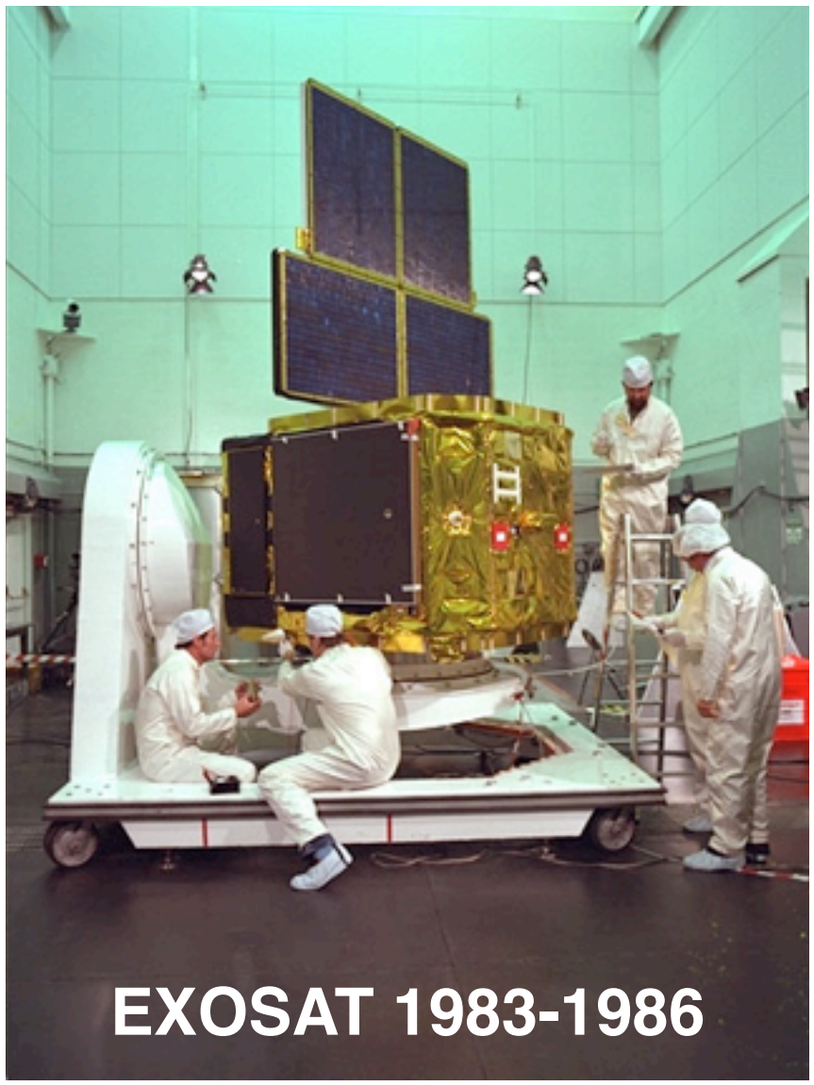
Legacy: a 30 years tribute


EXOSAT 1983-1986

«This mission brought not only new capabilities that resulted in unexpected discoveries, but also a pioneering approach to operations and archiving that changed X-ray astronomy...

The proven EXOSAT database system became the core of the HEASARC infrastructure. The HEASARC pioneered many concepts now taken for granted including standardized formats using FITS files, restoring data from earlier missions, multi-mission analysis tools and a searchable archive over the world wide web.»

Nicholas White (2013), AAS 221 113.18

1989: unreadable

Monthly Notices of the ROYAL ASTRONOMICAL S
MNRASL **430,** L49–L5 3 (2013)
doi:10.1093/mnrasl/sls048

Short time-scale AGN X-ray variability with *EXOSAT*: black hole mass and normalized variability amplitude

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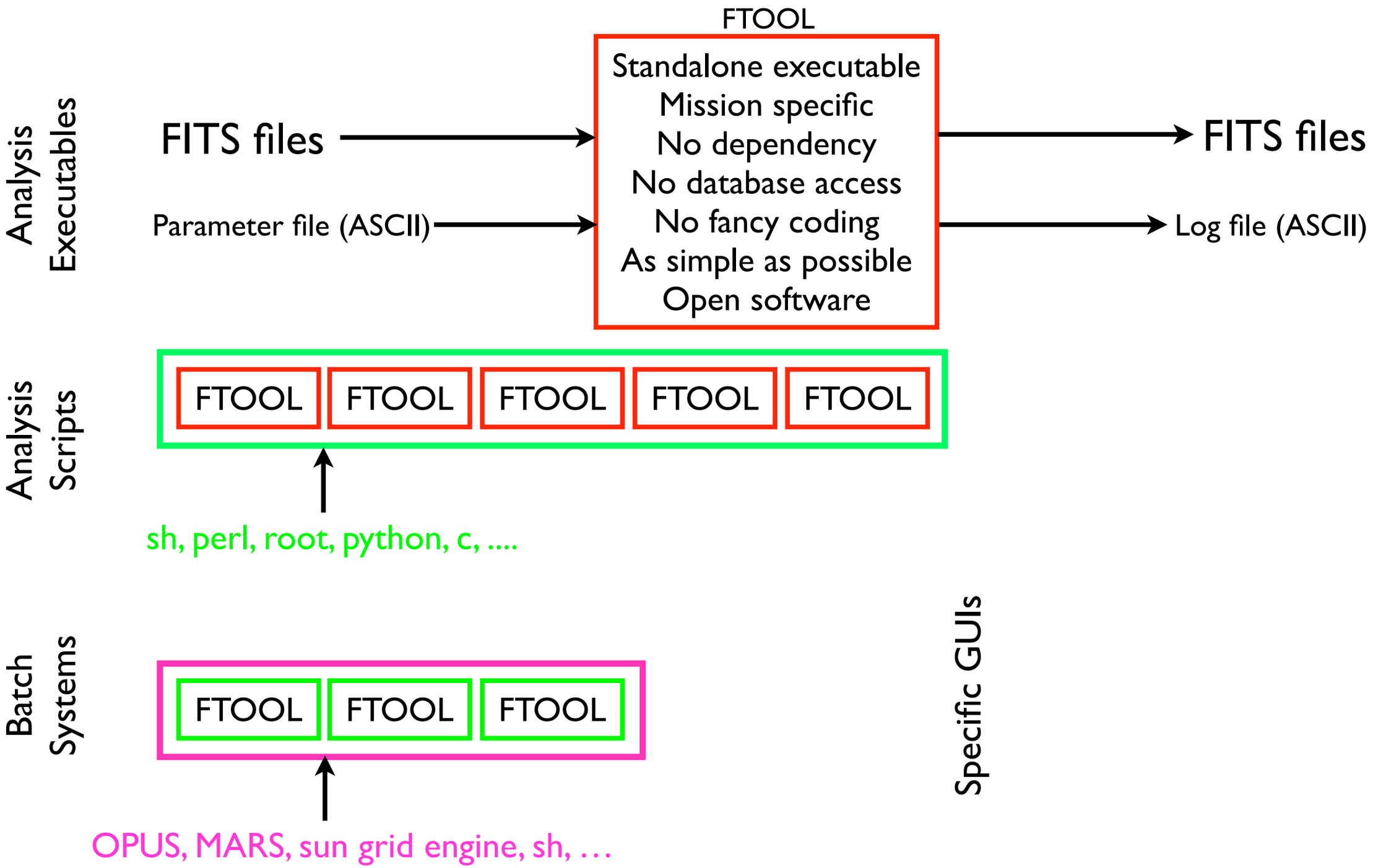
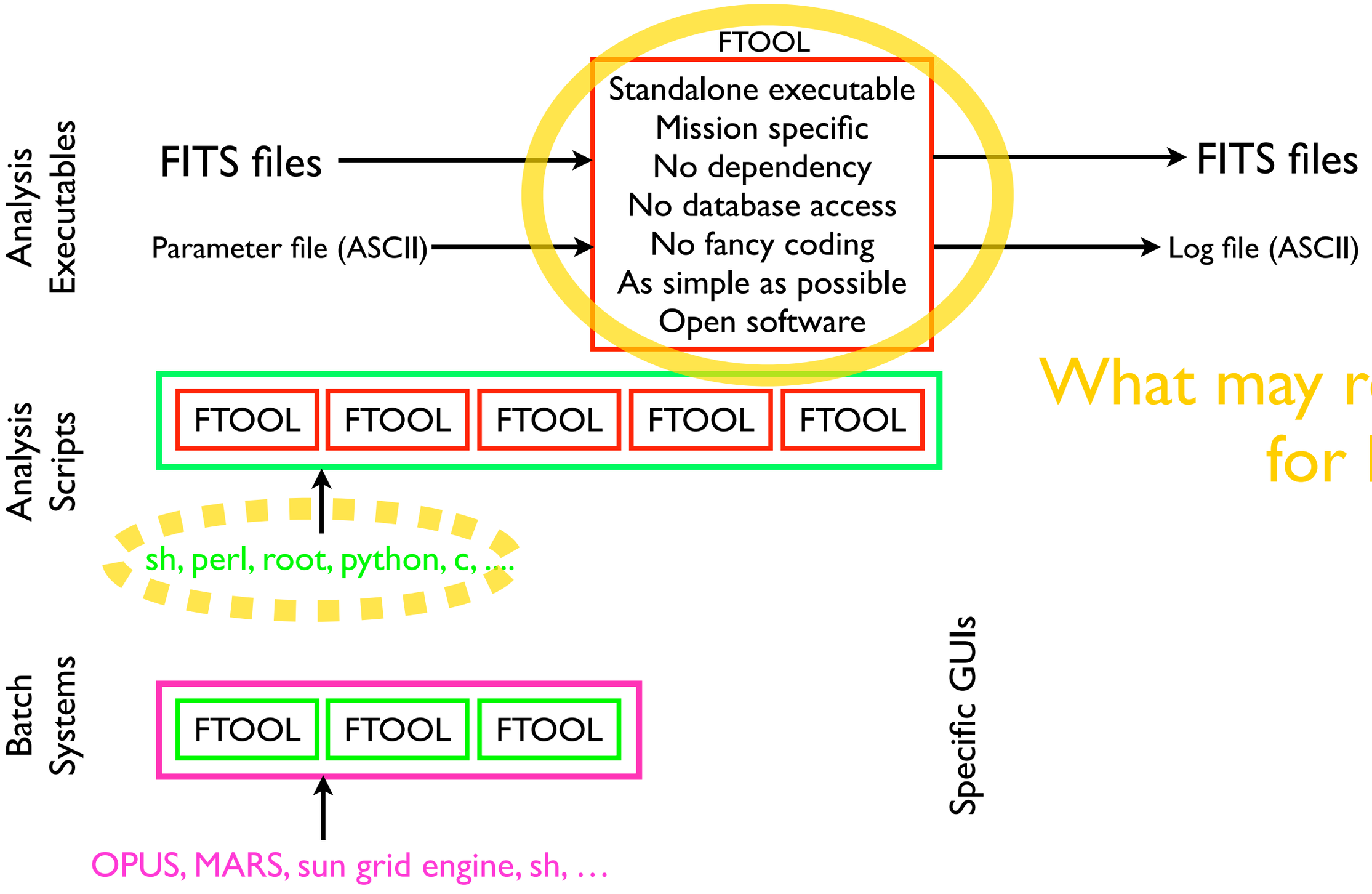
Legacy: made possible through very simple analysis software architecture



Legacy: made possible through very simple analysis software architecture



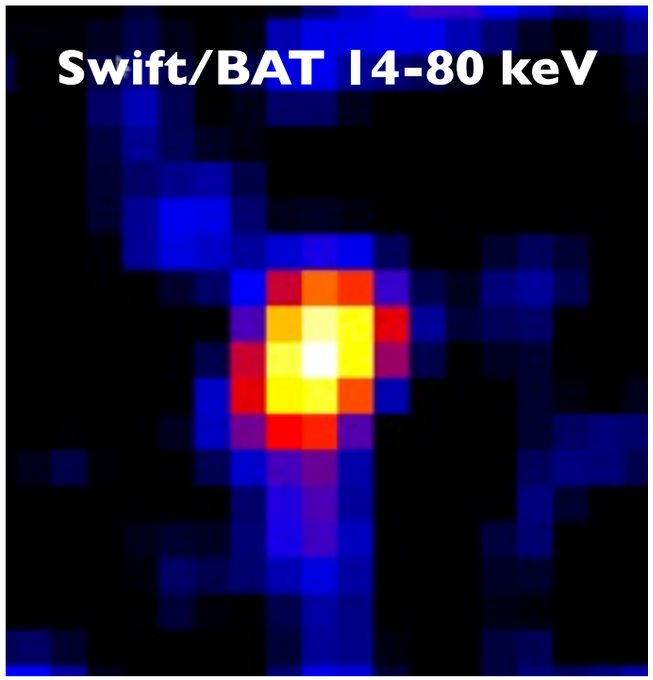
SCIOPS does not end with a data archive

- Close to the end of a mission, detailled analysis knowledge vanishes.
  New potential users do not invest the ressources to analyse data.
  ➙ **Use of archival data should not require mission specific knowledge.**

- Pre-generated high-level products do not reflect the potential - nor the limitations - of an instrument.
  ➙ **Need for generation of quality products tailored to the user's needs**.

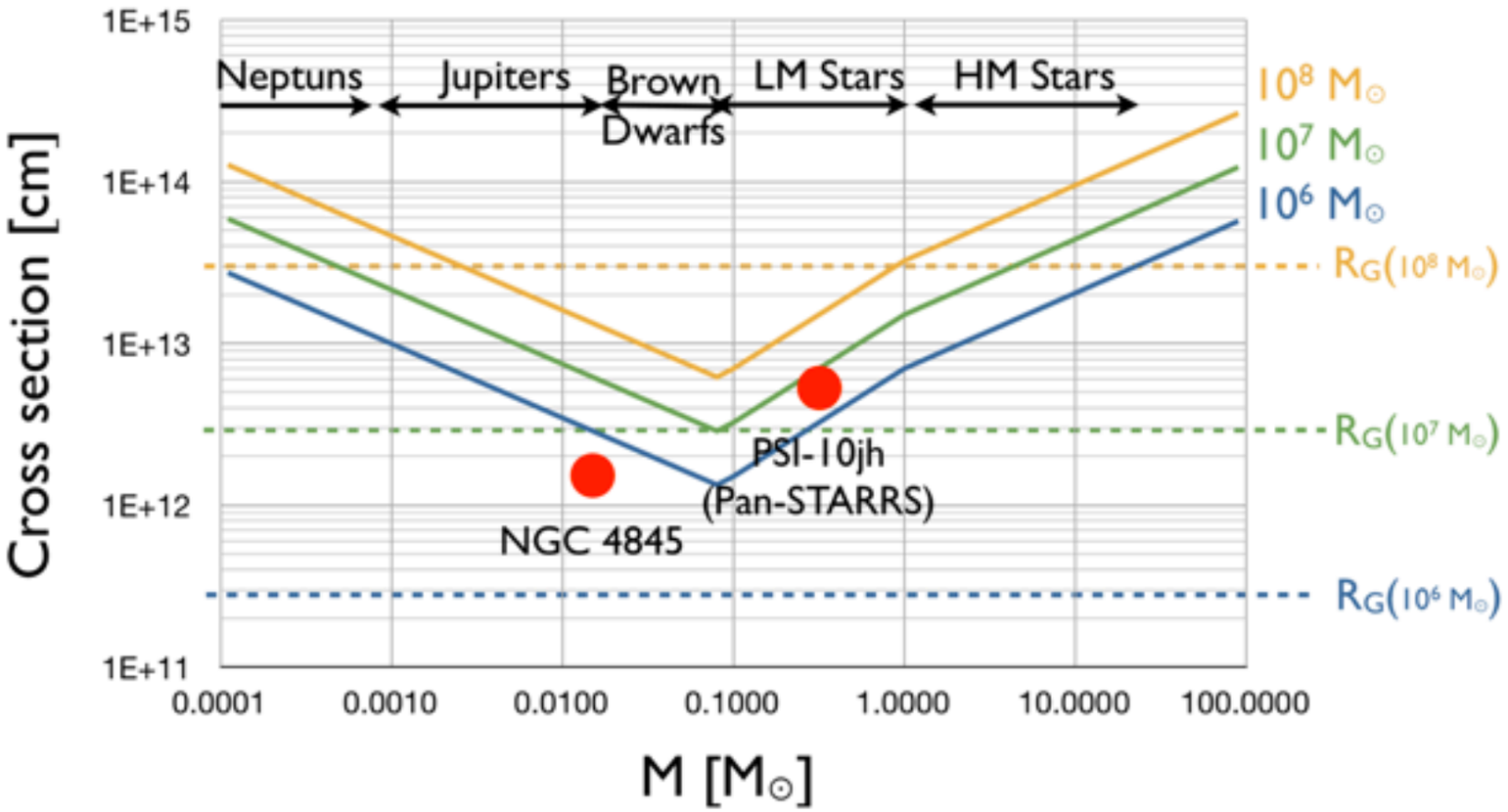
- Archive users are not interested by observations but by sources.
  ➙ **Products are needed for any sky position, time & energy interval**.

SCIOPS does not end with a data archive



Tidal disruption of a 15 Jupiter object by a 10^5 $M_\odot$ black-hole in the core of NGC 4845

➡Not detected by the Swift/BAT QLA
➡Not detected by the Swift/BAT team
➡Not among the standard products
➡Not detectable by an archive user



Micro-lensing: unbound Jupiters are twice more common than MS stars (Sumi et al, 2011).

Solar-system formation: half of the planets are ejected (Veras et al, 2009)

HEAVENS (**H**igh-**E**nergy **A**strophysics **V**irtually **EN**lightened **S**ky)

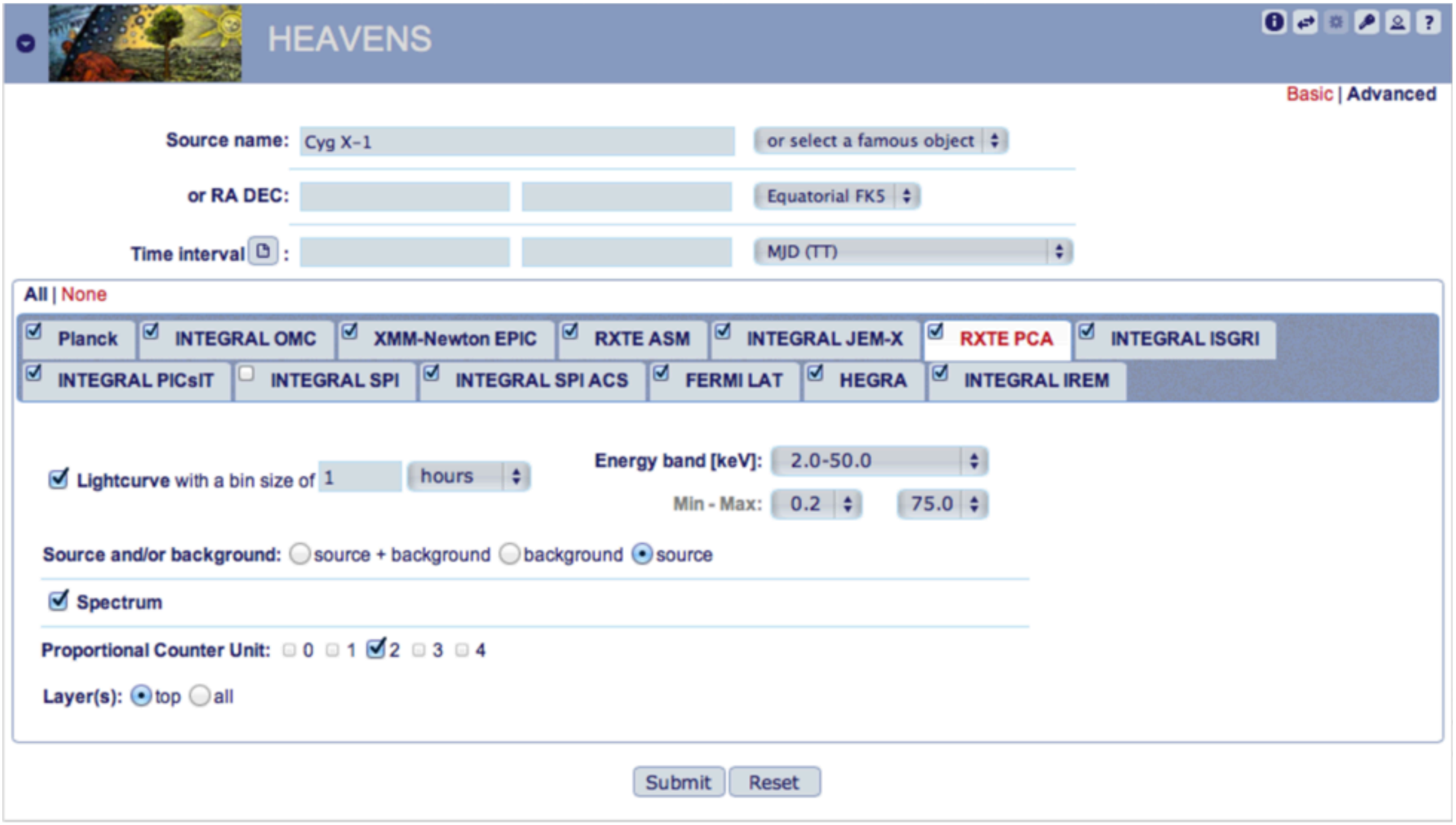
- HEAVENS provides analysis services for a number of recent high-energy missions.

- HEAVENS allows users to generate **on-the-fly** and **straightforwardly** high-level products for any **sky position, time** and **energy intervals** without requiring mission specific software or detailed instrumental knowledge.

- HEAVENS extends some Virtual Observatory concepts from pre-generated products to on-the-fly analysis.

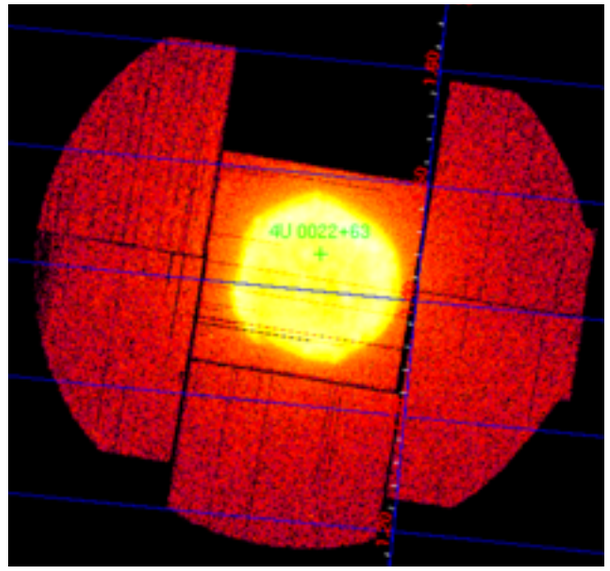
- HEAVENS makes the data and the process of generating science products available to higher education and the public.

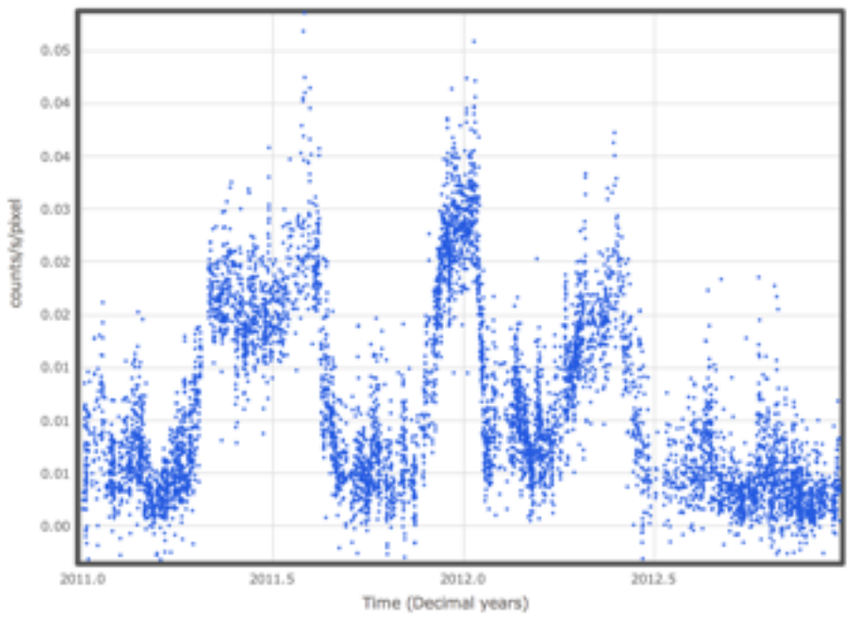
HEAVENS: the GUI



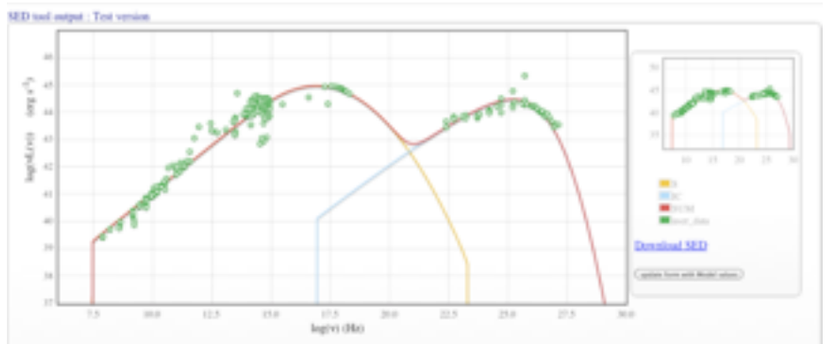
http://www.isdc.unige.ch/heavens/

HEAVENS: the GUI



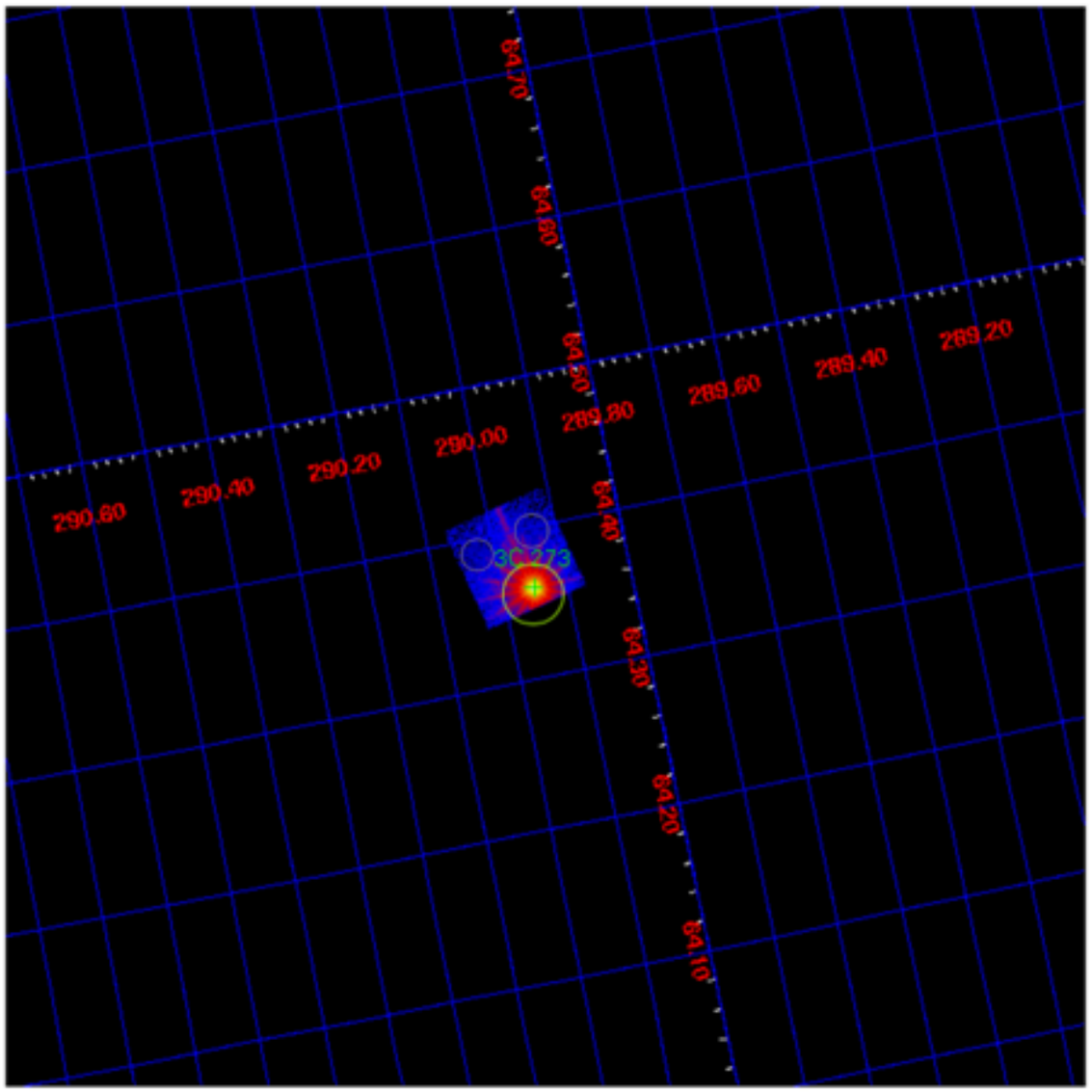


FITS files (incl responses)



XMM-Newton EPIC
0.1 - 15 keV
University of Leicester

Please define a source and a background region.
Click and drag on the image to select an area then click on "Add region" or press the "enter" key.

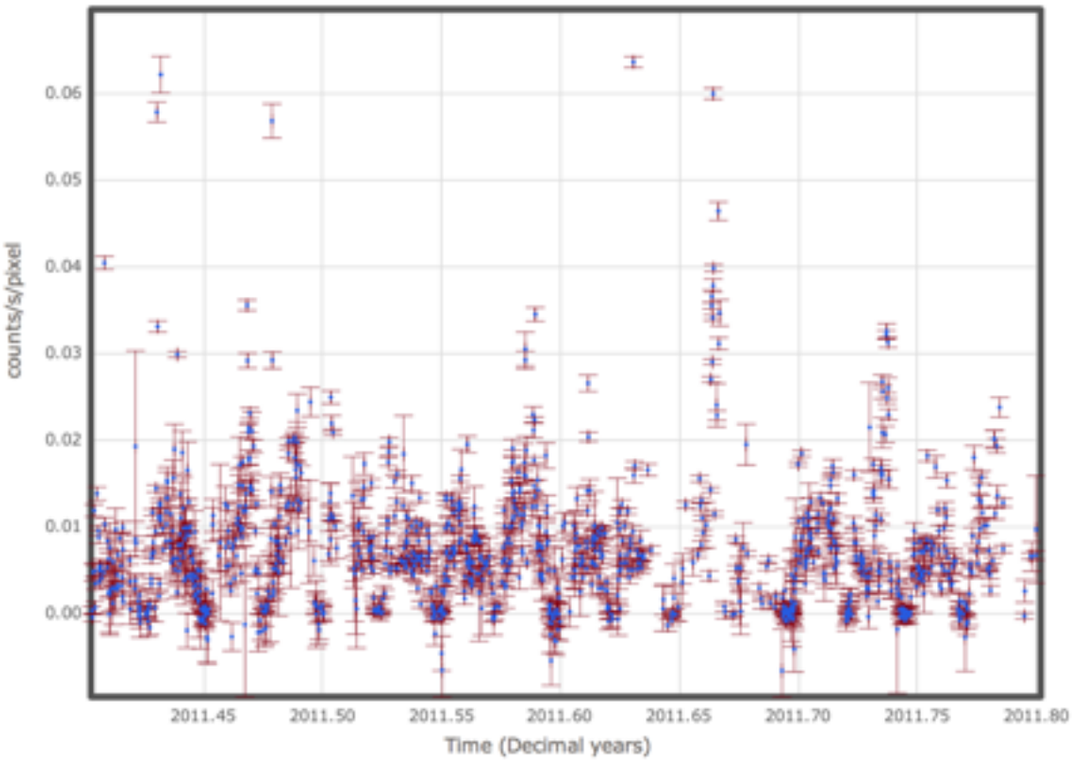


Add region | Delete all regions

Regions selection

Source/Background	Exclusive/Inclusive	X	Y	r	
Background	Inclusive	282	320	9.0	✖
Background	Inclusive	315	335	9.5	✖
Source	Inclusive	316	297	17.5	✖

Submit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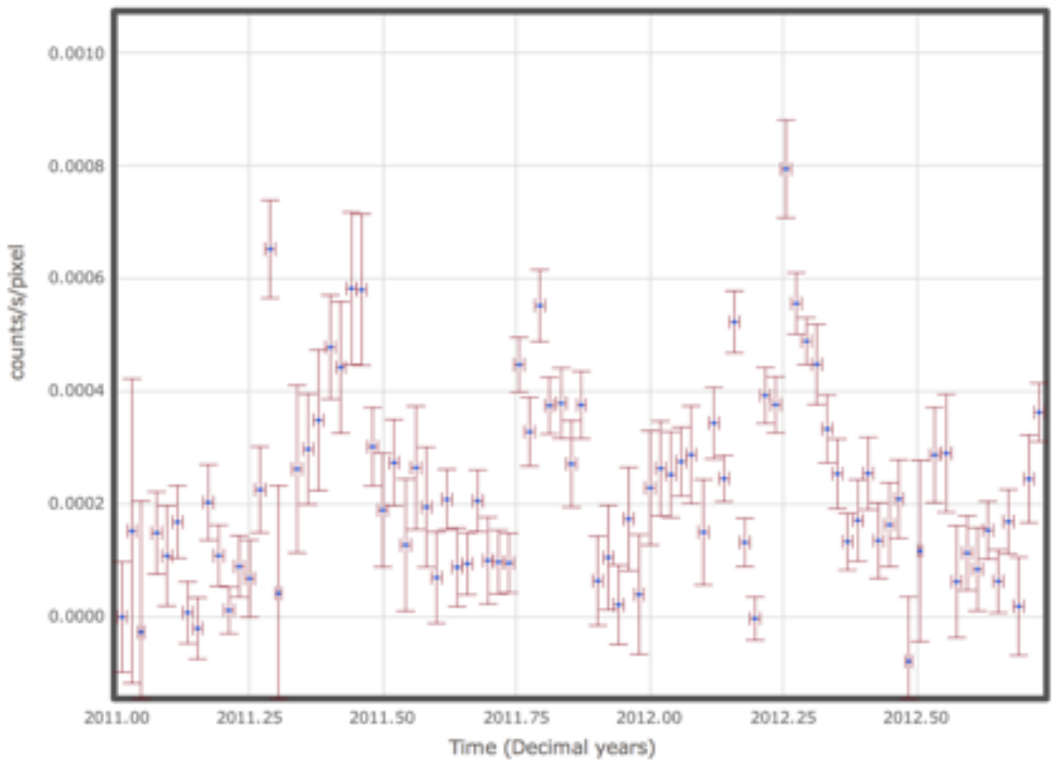
Time (Decimal years)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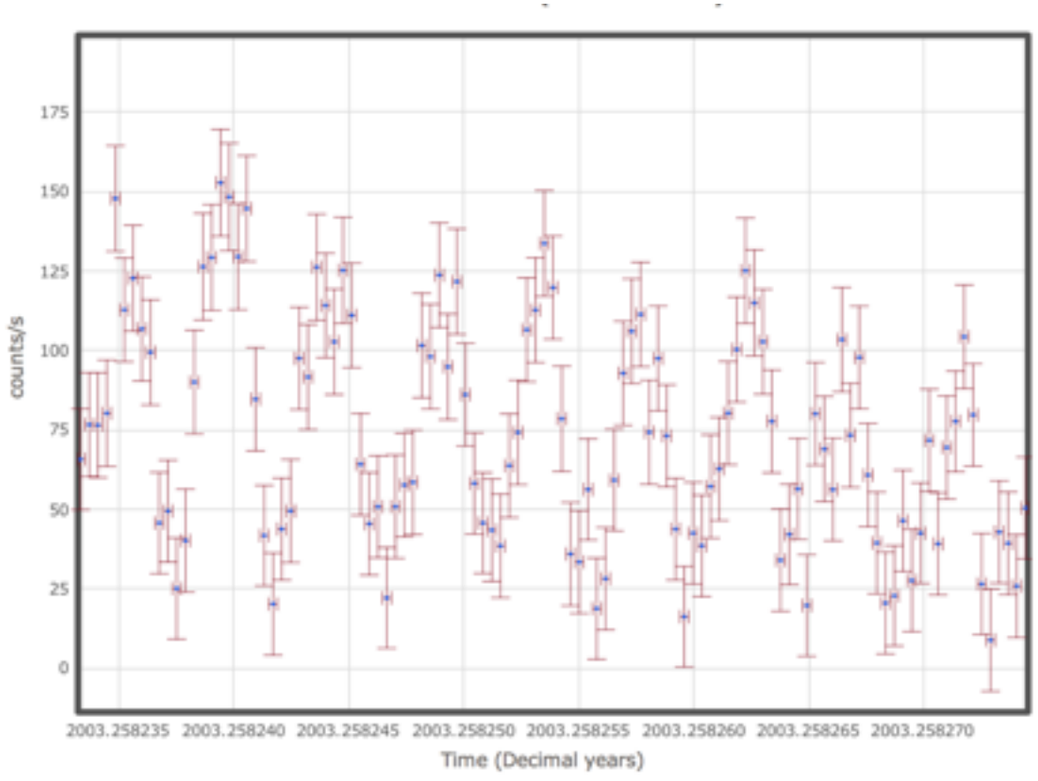
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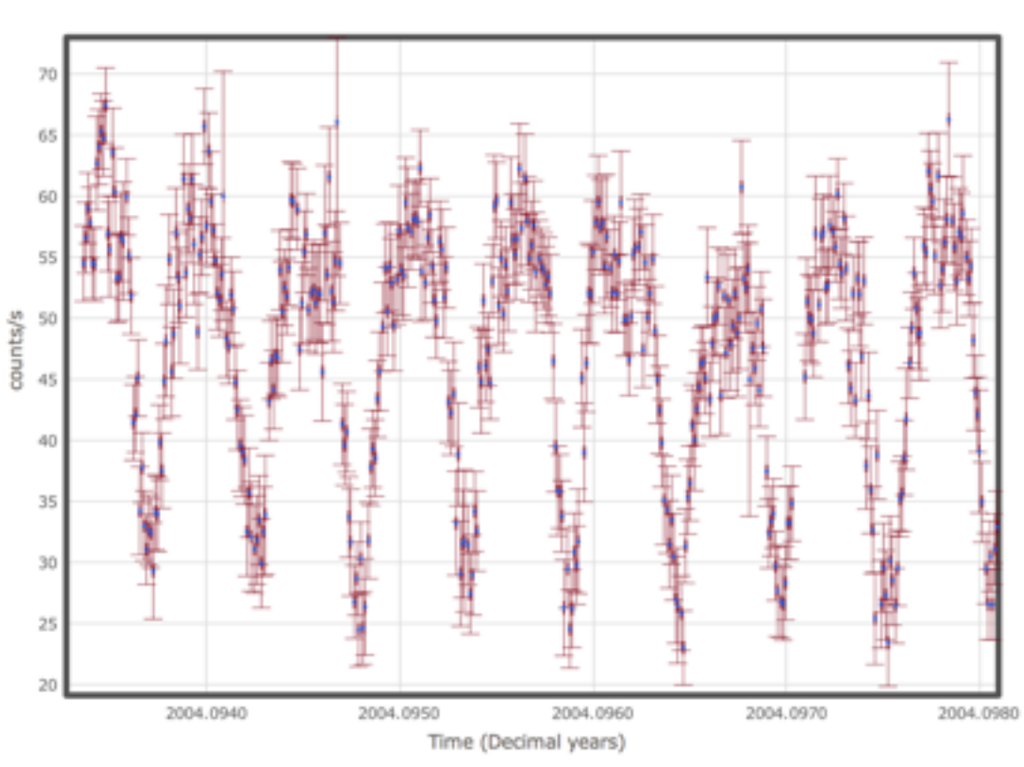
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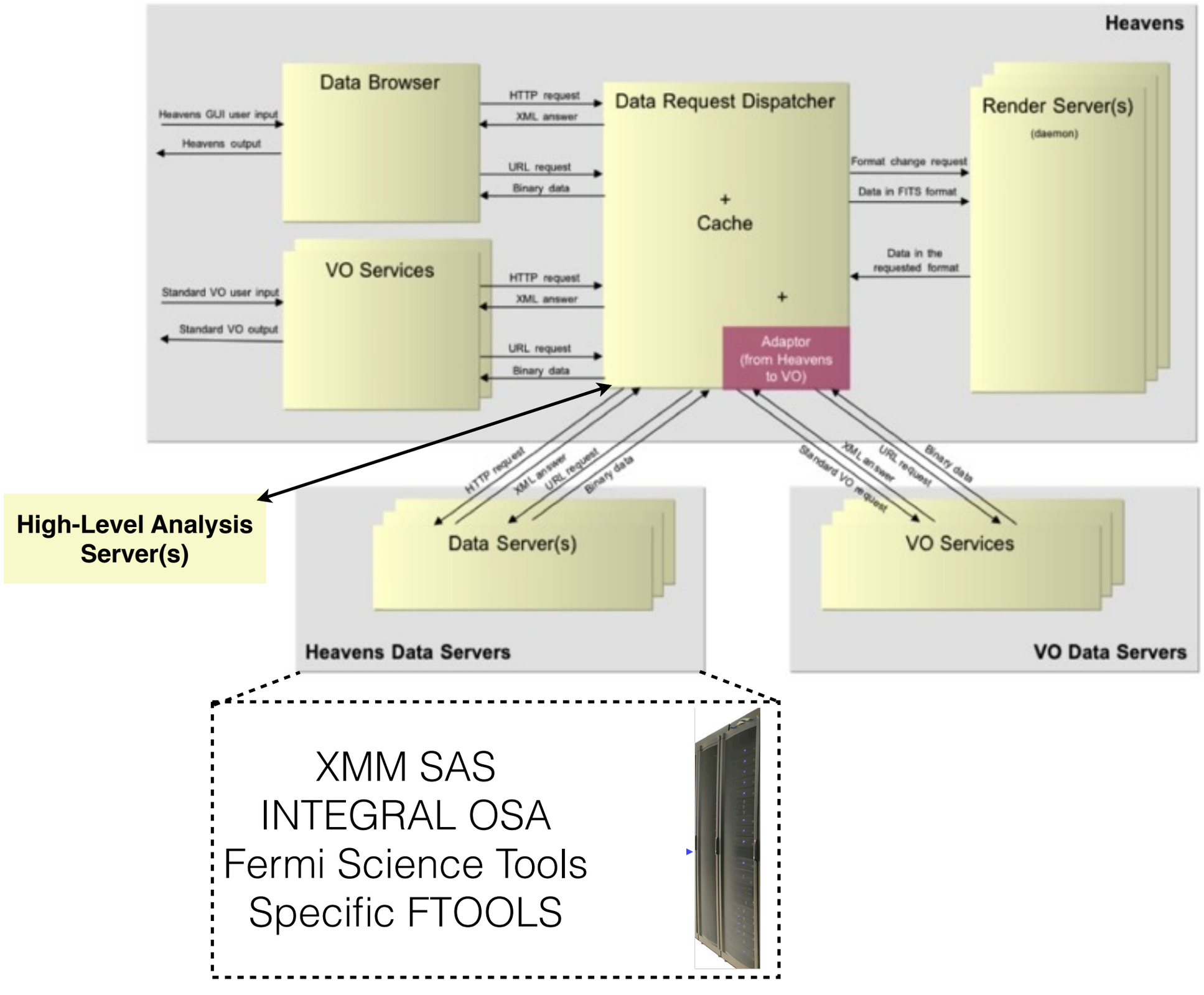
Time (Decimal years)

HEAVENS: how it works



Redesigning iSDC: Quick-Look Analysis

- **Quick-look analysis** can be performed by observers (and the community at large) through an HEAVENS interface. The observer could be virtually sitting in the data center and access data in near real time, at any time.

- **Scientists on duty** could be scattered around the world, keeping all involved partners (instr teams) in science operations.

Redesigning iSDC: Observatory Operations

- **Standard analysis** can also be made available through an HEAVENS interface (important for missions with large data sets).

- Move from distributing data and software to **distributing services**.

- Thanks to the **distributed architecture**, services can be offered/maintained by various partners.

- Services can easily be moved.

Distributed On-the-Fly Data Processing Archives

- Same interface from QLA to post mission archive
- Observers virtually sitting at the SOC/SDC
- Data competition ➔ easier collaboration
- Keep analysis flexibility long after the mission
- Small s/w overhead on top of essential analysis tools and data

When designing SCIOPS, start by thinking about legacy !