Lessons Learned after the First Ten Years of the INTEGRAL Science Data Centre

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Overview

- The INTEGRAL mission
- Unavoidable changes during ten years of operations
- Software updates as a function of time
- Transfer of software code and human knowledge to new missions
- Conclusion: Lessons learned

INTEGRAL, an ESA mission

1993 : INTEGRAL mission selected by ESA

1995 : The INTEGRAL Science Data Center was chosen by ESA as an ESA external entity. It was considered as important as the mission instruments.

2002 : Launch by a Russian Proton rocket

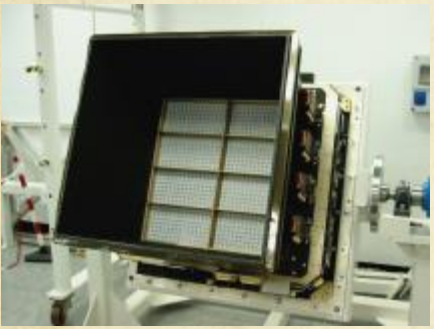
2016 : Current end of approved budget

The INTEGRAL satellite

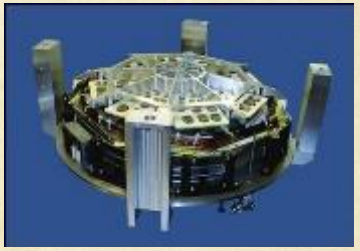
The INTErnational Gamma-Ray Astrophysics Laboratory (INTEGRAL) has 5 Instruments and 1 Science Data Center (ISDC).

The assembled INTEGRAL satellite

The imager IBIS

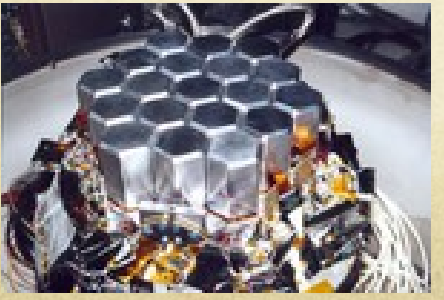


The X-ray monitor JEM-X



The optical camera OMC

The spectrometer SPI

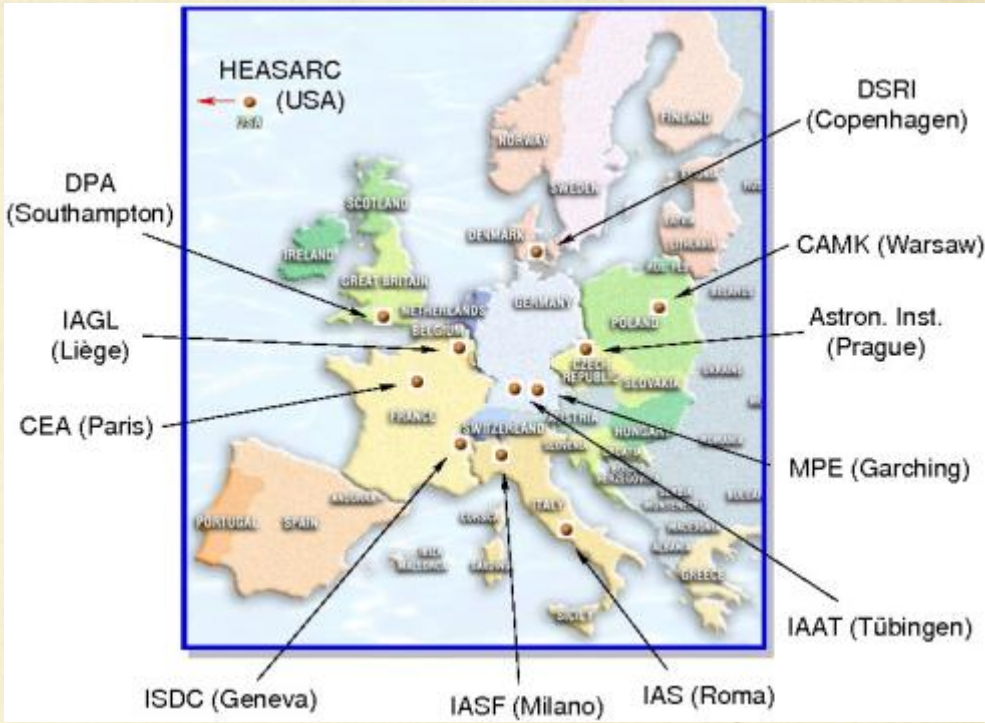


The INTEGRAL Science Data Centre processes the data of all 5 instruments

The environment monitor IREM

INTEGRAL Science Data Centre

At launch time :
Consortium of 12 Institutes :



Main responsibilities:

- Process the INTEGRAL data.
- Archive the data.
- Provide Analysis Software (OSA) to the astronomical community.
- Alert the community in case of GRBs and for sources which change their state (see talk by Carlo Ferrigno).

A Science Data Centre can be successfully organized, developed and can be operated, even for long - duration projects, by a consortium.

Changes during ten years of operation

- REMARKABLE: No redesign of the software was needed.

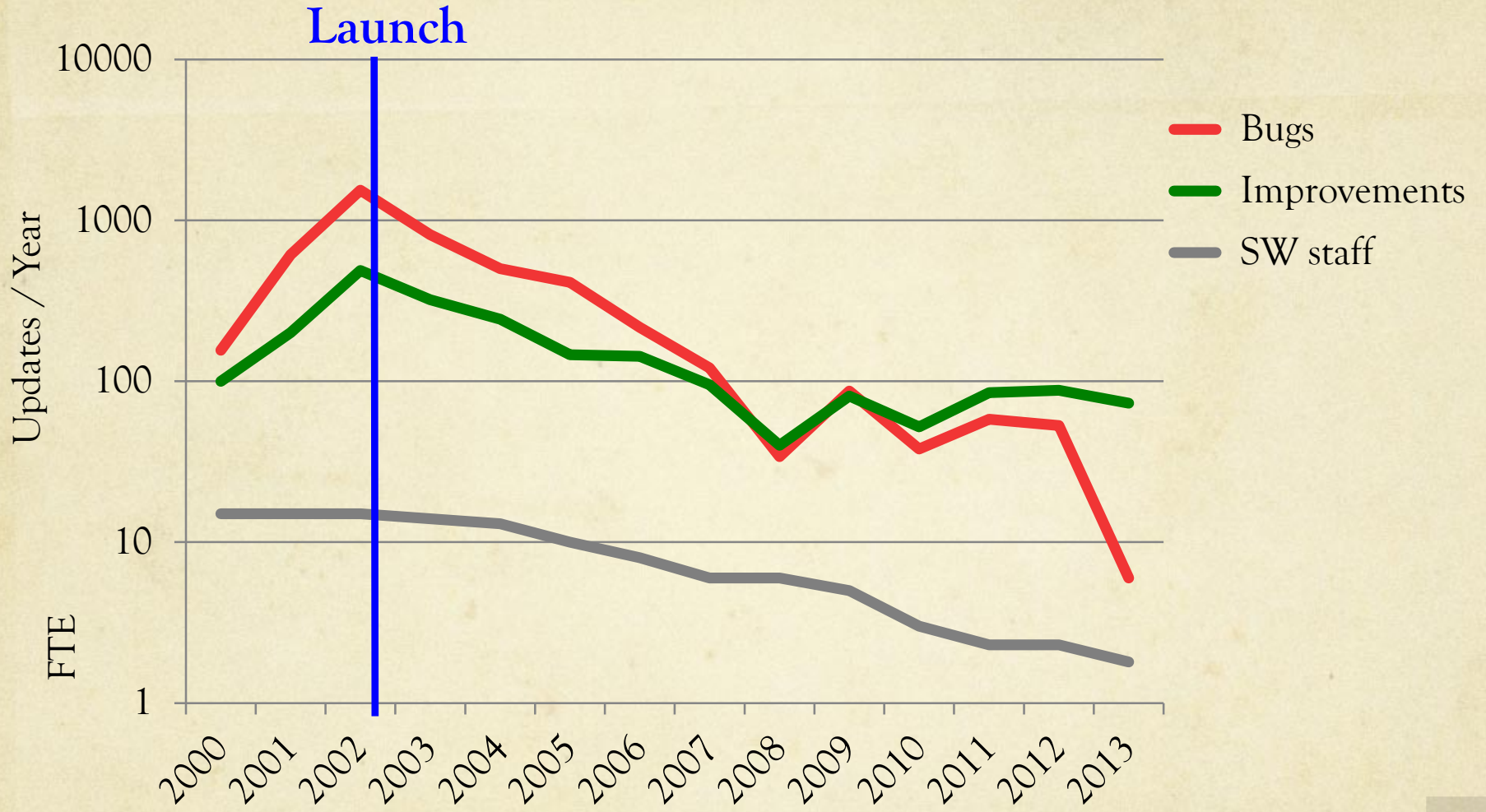
  The same software (with improvements) from the first days is still in operation and has been always used to analyze the INTEGRAL data.

- BUT: The hardware changed dramatically:
  - First version of OSA software was released for SUN Solaris and Linux 32 bit.
  - Current version of OSA software is released for MAC OS and Linux 64 bit.

  - Operations hardware at launch time: About 12 SUN boxes.
  - Operations hardware today: 3 SUN boxes, 4 Linux boxes.

Software must not use hardware specific routines.

Software and calibration files updates



Number of updates stays almost unchanged since 2008, but the SW staff is continuously decreasing.

Perspective

- INTEGRAL archive will be maintained during post operational phase, thanks to the support of the hosting institutions.
- Analysis software will be available for non standard INTEGRAL data processing.
- The access to the data can be achieved through high level products. (HEAVENS, see talk by Roland Walter)

SW and human knowledge transfer

INTEGRAL software consists of 524 components
5 of them are used in other projects.

15 years ago :

- FORTRAN was a often used language
- Object Oriented design was exceptional
- Scripting language – nowadays PYTHON replaces PERL

The hope to reuse software in next generation projects could not be realized.

Almost everybody of the software team members, who already left the INTEGRAL mission is still working for an other astronomical mission.

An essential core of SW experts followed INTEGRAL development since the early times until now. A smooth share of resources is operated with other projects.

A continuously trained team is the best investment for new projects.

Conclusions: Lessons learned

- The hope to reuse software in next generation projects could not be realized.
- A continuously trained team is the best investment for new projects.
- Number of updates stays almost unchanged since 2008, but the SW staff is continuously decreasing.
- Software must not use hardware specific routines.
- A Science Data Centre can be successfully organized, developed and can be operated, even for long - duration projects, by a consortium.