



# INTEGRAL

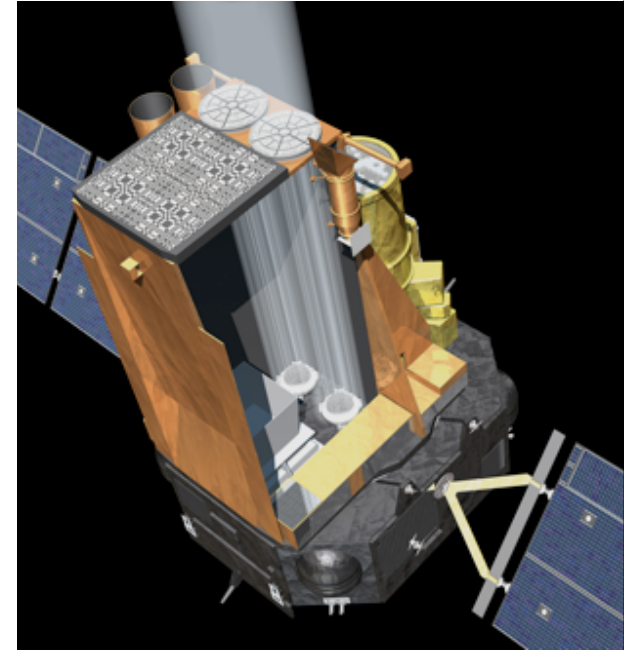
Launched in October 2002, could last for > 10 years

- Best spatial resolution at hard X-rays
- Best narrow-line sensitivity
- Large field of view i.e. long effective exposure
- Broadest energy range

	SPI	IBIS
Energy range	18 keV - 8 MeV	15 keV - 10 MeV
Detector	19 Ge detectors (each 6 × 7 cm), cooled @ 85K	16384 CdTe dets (each 4×4×2 mm), 4096 CsI dets (each 8.55×8.55×30 mm)
Detector area (cm <sup>2</sup> )	500	2600 (CdTe), 3000 (CsI)
Spectral resolution (FWHM)	3 keV @ 1.7 MeV	8 keV @ 100 keV
Field of view (fully coded)	16° (corner to corner)	8.3° × 8°
Angular resolution (FWHM)	2.5° (point source)	12'
Source location (radius)	< 1.3° (depending on source strength)	30"@100 keV (50 σ source) 3' @100 keV (5 σ source)
Absolute timing accuracy (3σ)	<200 μs <sup>b</sup>	<100 μs <sup>b</sup>
Mass (kg)	1309	746
Power [max/average] (W)	385/110	240/208

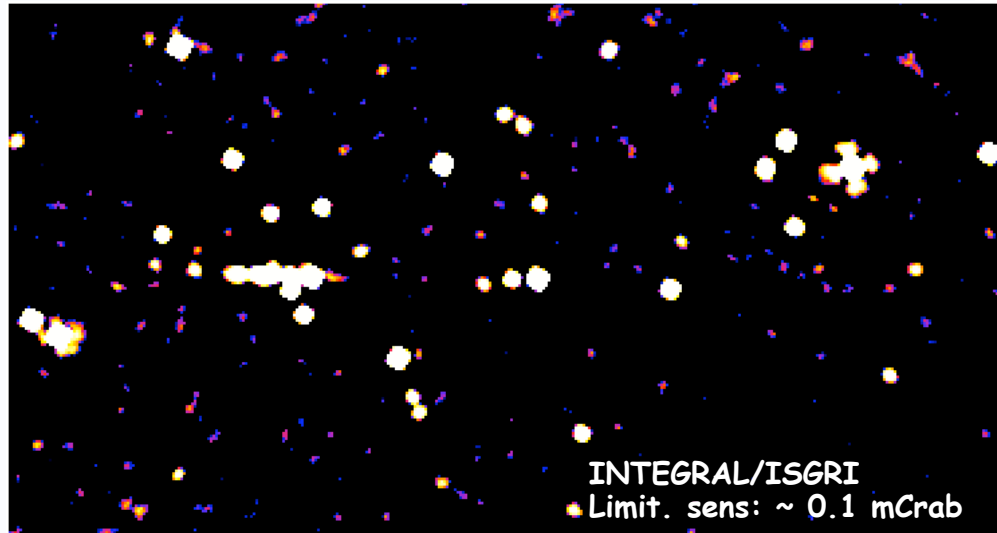
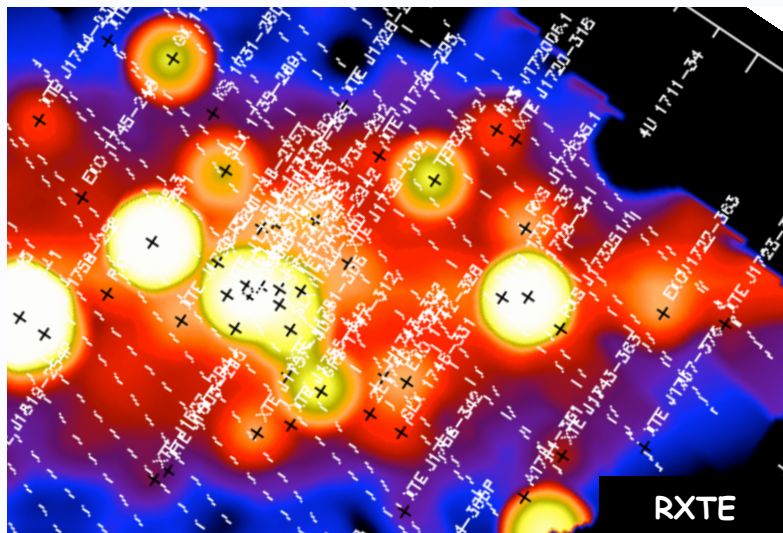
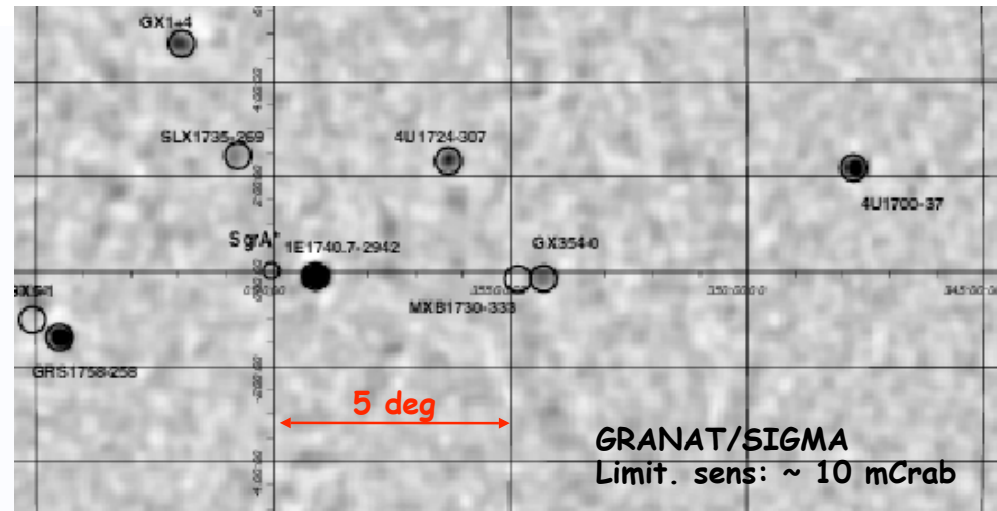
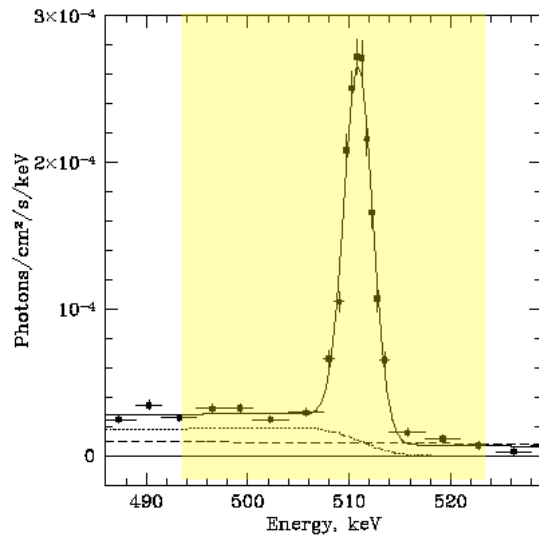
X-ray monitor (JEM-X) 3-35 keV

Optical monitor (OMC) V band





# INTEGRAL performance





# In flight calibration strategy

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## Performance verification (12.11.02-29.12.02)

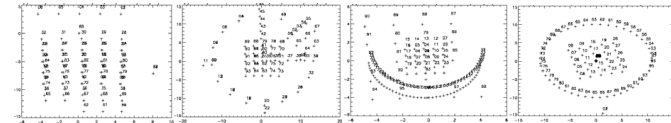
- Instrument tuning

## Continuous calibration (instr. background)

- Gain calibration
- Spectral resolution
- Noisy pixel handling

## Crab observations (2-3 days every 6 months)

- Spectral response
- Geometrical calibration
- Absolute/relative timing calibration  
(absolute timing limited to  $40\mu\text{s}$  by systematics of the radio ephemeris)



## Empty field & earth observations

- Background modeling
- OMC flat fields



## Calibration status (OSA 6 - Sept 2006)

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- SPI is a very stable instrument. Systematics on results are linked with analysis assumptions rather than calibration issues.
- IBIS/ISGRI: the calibrations have improved to a level adequate for scientific analysis of all types of sources excepting in a few areas:
  - ARF to be adjusted to new LUT2/RMF and agreed Crab model
  - PSF modeling still to be improved
- IBIS/PICSIT calibration effort is limited because of the small number of detected sources (4 compact objects and about 35 GRB)
- JEM-X calibration and modeling effort need to be pursued to match various instrumental instabilities. Specific calibrations have been performed recently
- Standardized high energy Crab spectrum would be very useful



# JEM-X calibration

JEM-X is affected by some instabilities which affect software and calibrations:

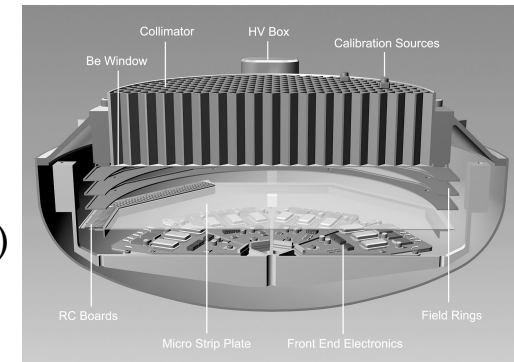
- microstrip erosion (→ decreased HV and S/N)
- microstrip ions diffuse into glass plate (→ HV adjustments)
- gain variation (→ electronic efficiency to be determined on short time scales)
- memory effect on microstrips
- transient hot spots

Observations are used to calibrate the

- instrument geometry:
  - detector and mask alignment vs star tracker (thermal effect),
  - collimator tilt (effect underestimated before launch)
  - photon detection accuracy
- instrument background: collimator effect
- ARF: physical properties understood above 15keV. Below 15keV the electronic efficiency is important and it can be determined by observations at different gains. This has been performed recently.

Issues:

- Crab is an extended source that requires special treatment.
- Instrument characteristics evolve faster than the frequency of Crab observations

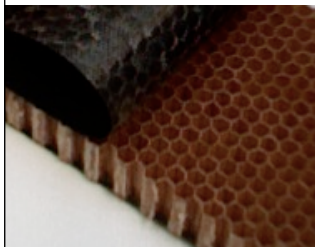




# IBIS/ISGRI geometric calibration

- Instrument geometry: detector and mask alignment vs star tracker  
Current systematics: **10''**
- Nomex geometrical model. Current systematics on flux measurement: **2-3%**

- Image defects indicate that the instrument modeling is not yet perfect  
Systematic error on the PSF: **1%**



0422 observing pattern

