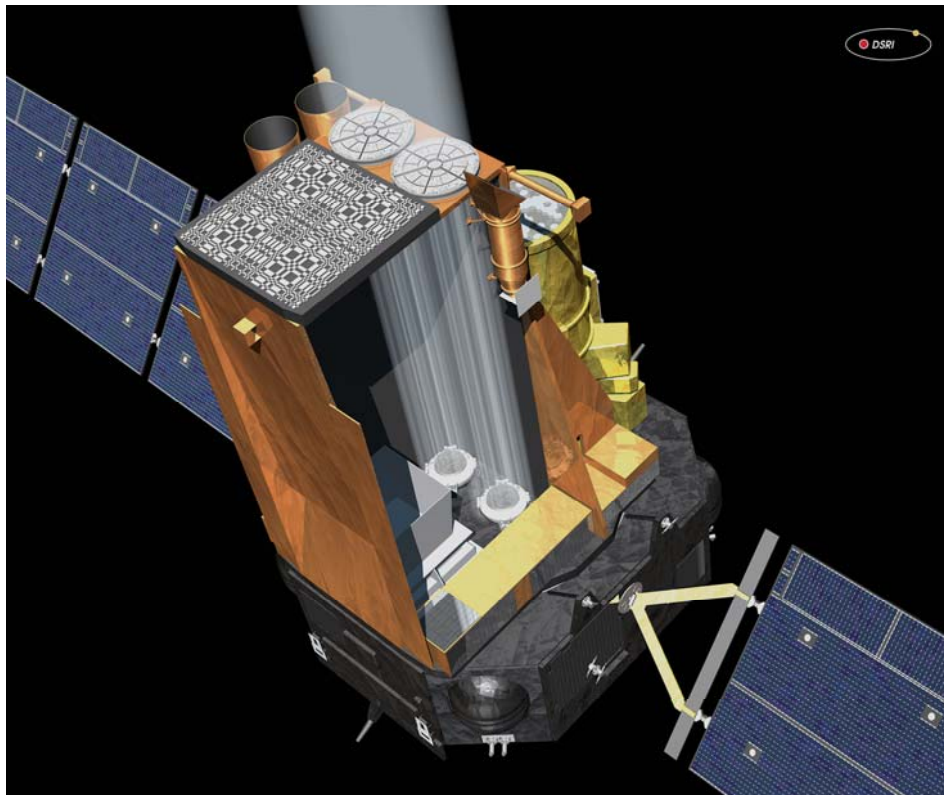


Technical University of Denmark

X- and gamma-ray astronomy with JEM-X and INTEGRAL

Søren Brandt



 **DTU Space**
National Space Institute

INTEGRAL

- INTEGRAL is ESA's high energy astrophysics observatory
- INTEGRAL was launched in 2002 and is expected to operate (at least) until the end of 2012
 - INTEGRAL and XMM-Newton are since 2008 jointly operated
- Coded mask technique
- 3-35 keV X-ray monitor provided by DTU Space



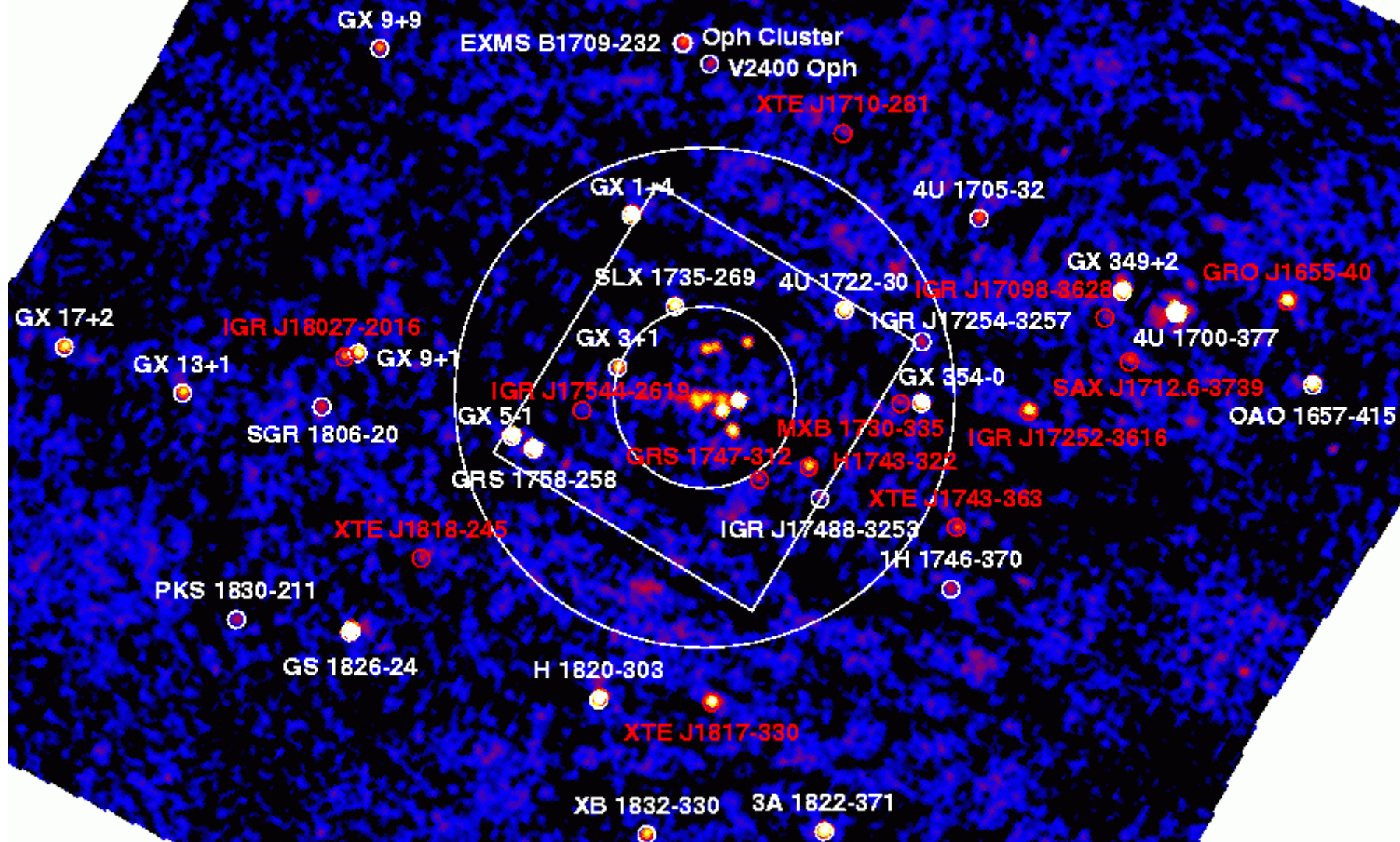
The Galactic Bulge Monitoring Program

- Perform 7 pointings of 1800 sec around the Galactic Center every 3 days during visibility periods
- Light curves and images in several energy bands in the 3-100 keV range
- Analyze in near-real time for transients, X-ray variability, X-ray bursters etc.
- <http://isdc.unige.ch/Science/BULGE/>

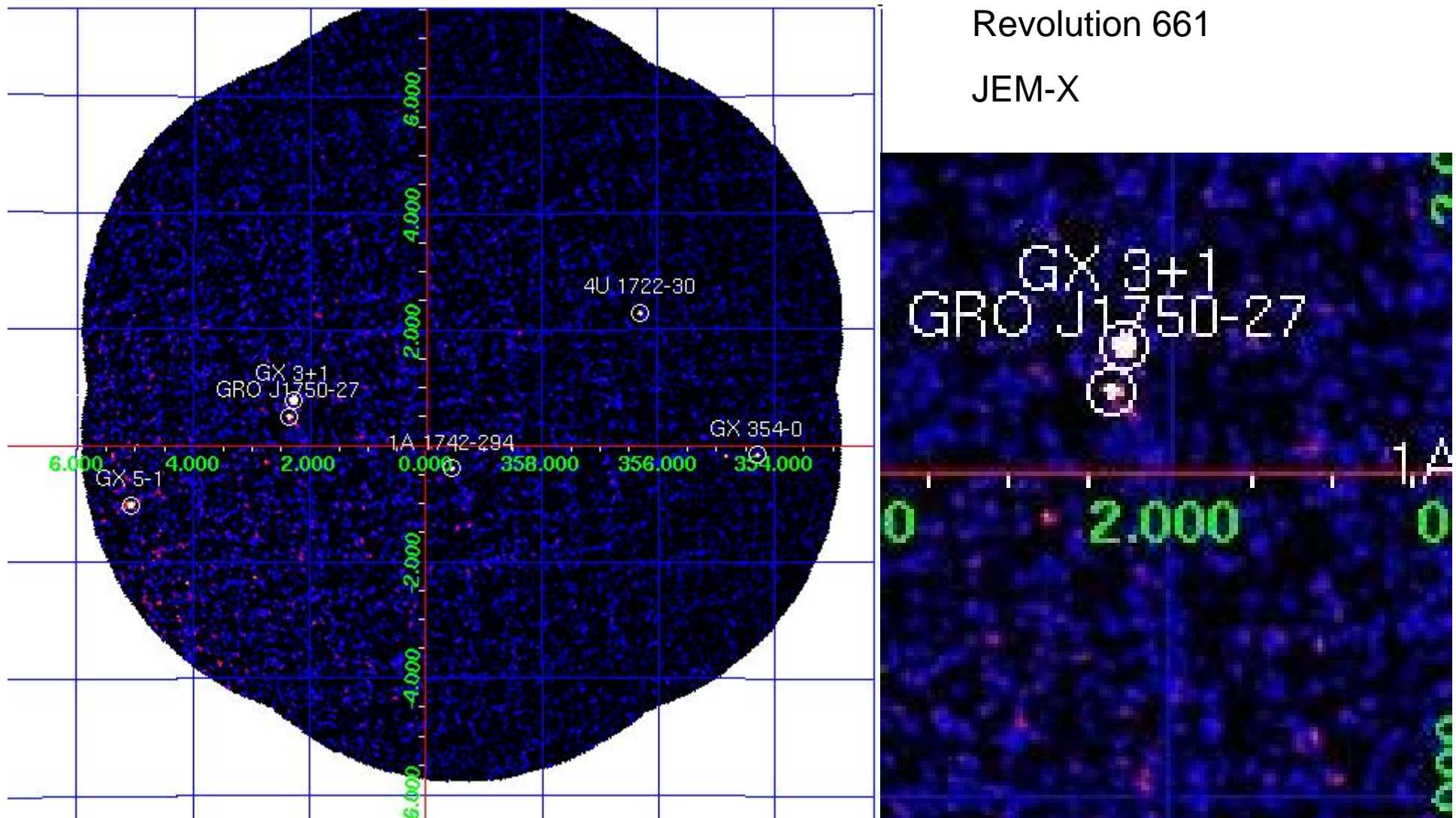
The team

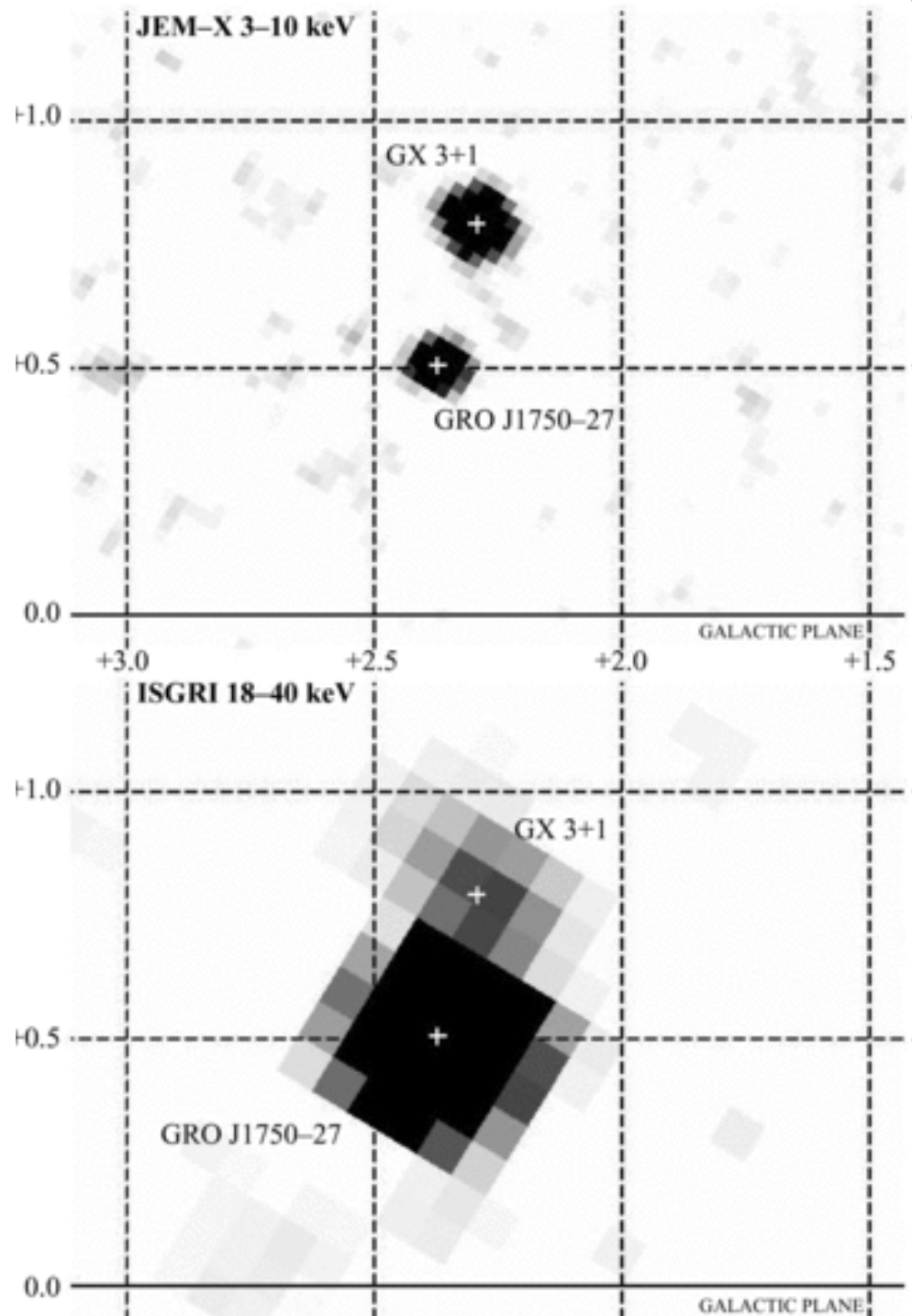
Erik Kuulkers (ESA/ESAC, Spain) PI
Volker Beckmann (ISDC, Switzerland)
Søren Brandt (DNSC, Denmark)
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Thierry Courvoisier (ISDC, Switzerland)
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Craig Markwardt (GSFC, USA)
Tim Oosterbroek (ESA/ESTEC, The Netherlands)
Ada Paizis (INAF-IASF, Italy)
Daniel Riskey (LAEFF/INTA, Spain)
Celia Sanchez-Fernandez (ESA/ESAC)
Rudy Wijnands (UvA, The Netherlands)

Revolutions 287-429
MJD 53419-53846, 2005/02/18-2006/04/21
IBIS/ISGRI 20-60 keV Mosaic



Outburst in 2008 of the transient pulsar GRO J1750-27





JEM-X 3-10 keV and
ISGRI 18-40 keV images

GRO J1750-27 is only 18
arcmin from GX 3+1 (but
easily resolved by JEM-X
with 3' PSF)

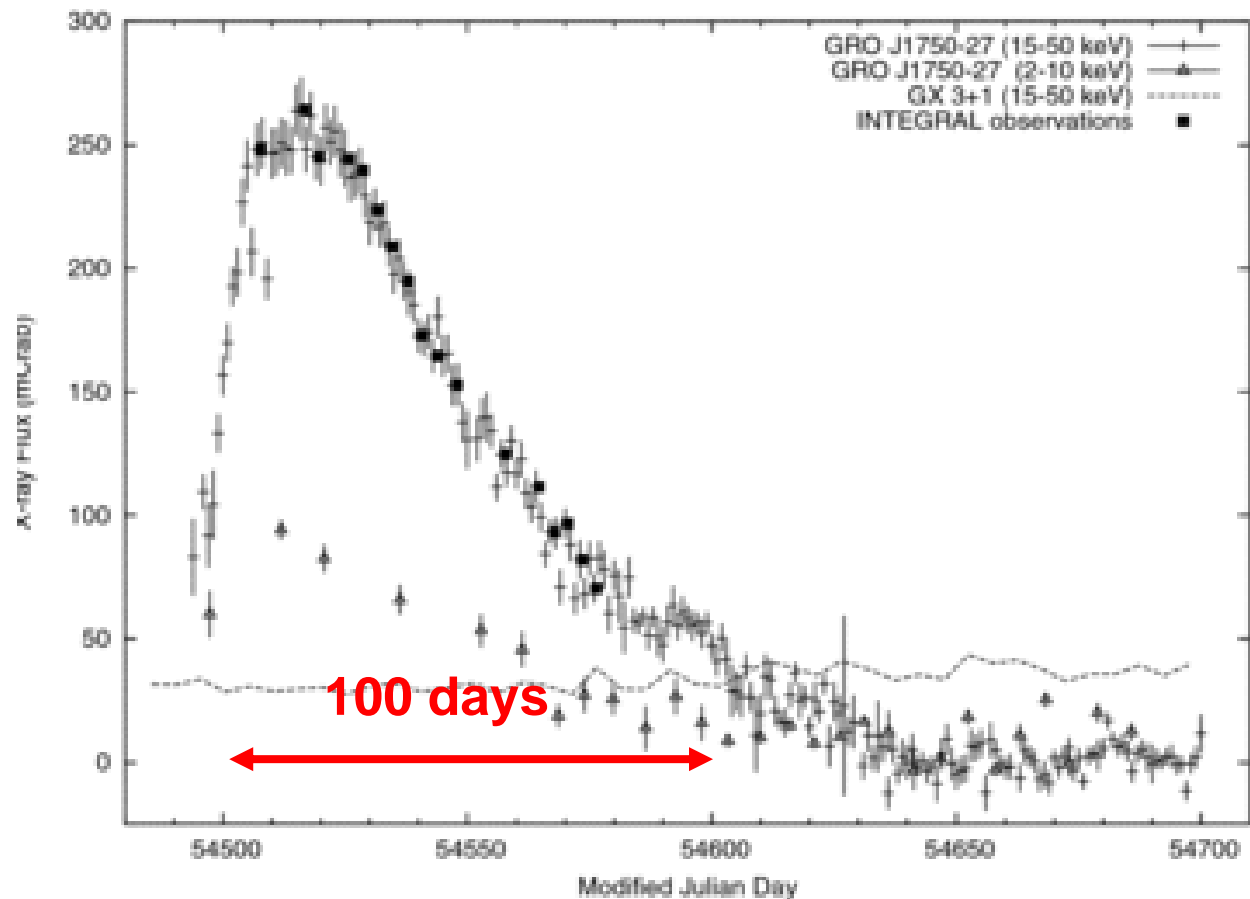
further detail, please see S.E.
Shaw et al., Mon. Not. R. Astron.
Soc. 393, 419–428 (2009)

The GRO J1750-27 system

- High Mass X-ray Binary system (HMXB) with neutron star and Be companion in eccentric orbit
 - Accretion from stellar wind
 - Type I outbursts are short and associated with orbital phase
 - Type II outburst are brighter and longer, lasting ~100 days
- Discovered by Compton-GRO-BATSE during an outburst in 1995
- X-ray pulsar with
 - $P_{\text{Orb}} = 28.817$ days
 - $P \sim 4.45$ s
 - $a \sin i = 101.8$ ls (projected major axis)
 - $e = 0.36$
- New outburst in February of 2008 observed by INTEGRAL and Swift
 - Astronomers Telegrams #1376, 1385, 1400, 1401



GRO J1750-27 outburst in 2008 lasting about 100 days

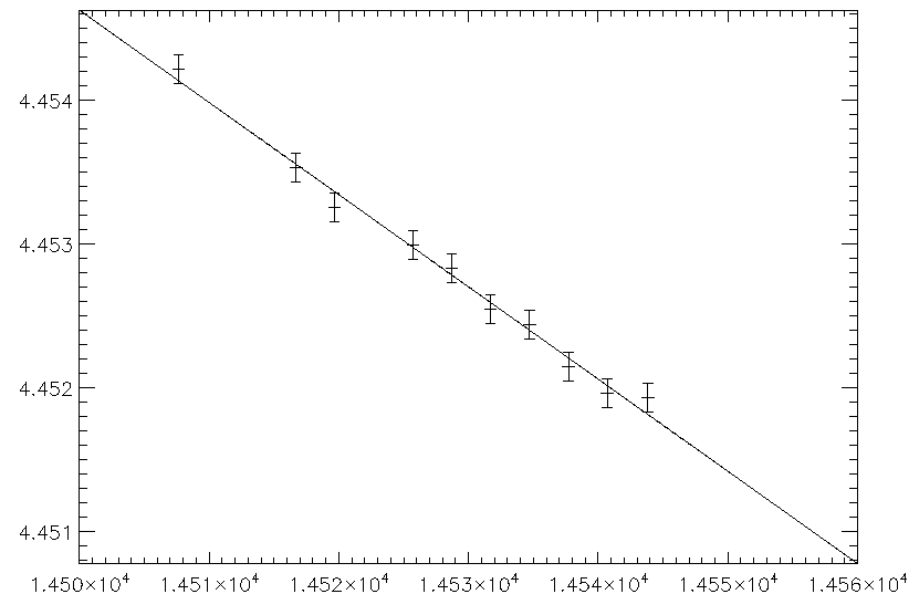
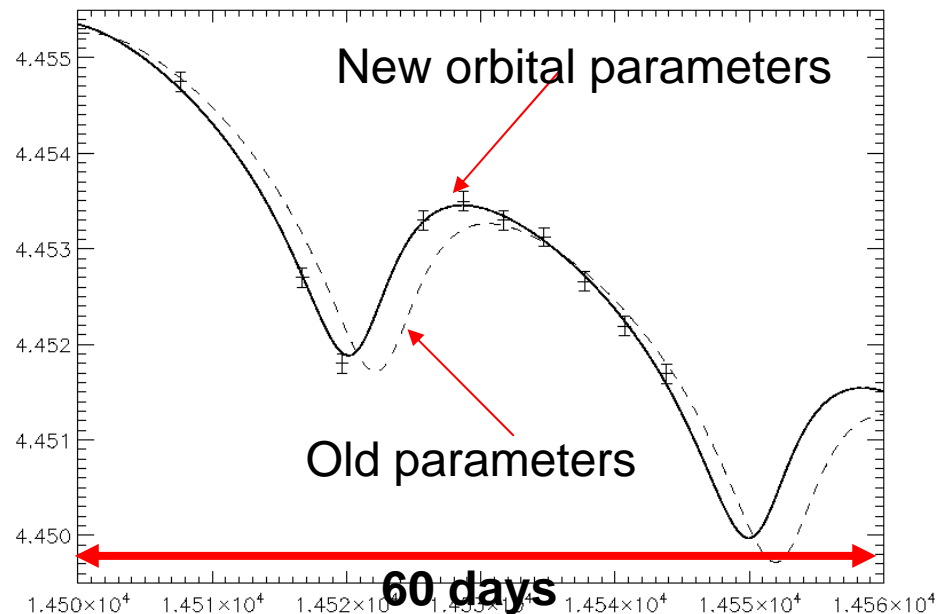


Pulse analysis

Accretion powered spin-up

- Deriving pulse period by period folding (corrected for satellite and Earth motion) for each observation epoch
 - Neutron star spinning up by about 0.75 nano-sec per second
- Fit new binary orbital period and pulse period derivatives (compare to 1995 ephemeris)

$$P(t) = P(t_0) + \dot{P}(t - t_0) - \frac{\ddot{P}(t - t_0)^2}{2}$$



New orbital parameter fits

Table 2. The orbital parameters for GRO J1750–27 derived from Scott et al. (1997) and from the analysis of ISGRI 20–40 keV data.

Scott et al. (1997)		
Orbital period	P_{orb}	29.817 ± 0.009 d
Projected semimajor axis	$a_x \sin i$	101.8 ± 0.5 lt-s
Eccentricity	e	0.360 ± 0.002
Longitude of periastron	ω	$206^\circ.3 \pm 0^\circ.3$
Orbital epoch	$T_{\text{periastron}}$	MJD 49931.02 ± 0.01
This work		
Orbital period	P_{orb}	29.806 ± 0.001 d
Spin period (@ MJD 54516.635)	P	4.45349 ± 0.00002 d
First derivative of P	\dot{P}	$-7.5 \pm 0.3 \times 10^{-10}$ s s $^{-1}$
Second derivative of P	\ddot{P}	$1.0 \pm 0.1 \times 10^{-16}$ s s $^{-2}$

INTEGRAL AO-7

7th Announcement of Opportunity (AO-7 Data Rights)

AO-7 Milestones

Call for data right proposals **25 May 2009**

Due date data right proposals: **03 July 2009**

Associated targets selected: **early September 2009**

Start AO-7 observations: **mid October 2009**

Also:

**large public data archive covering 2003-2007,
<http://isdc.unige.ch>**

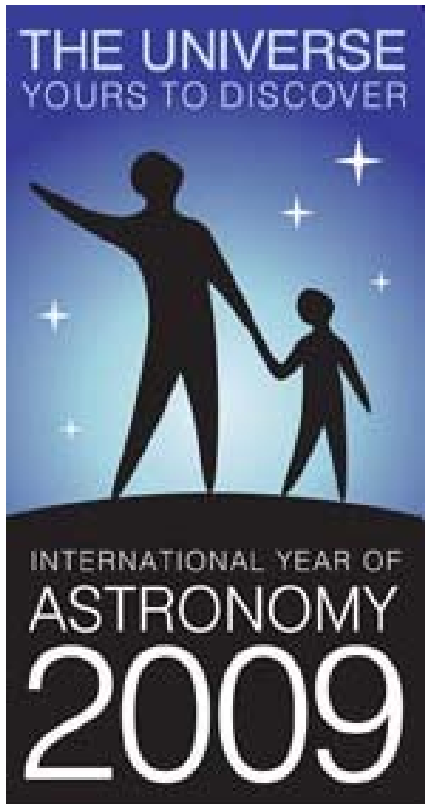


Closing date: 14 August 2009
Details at: astronomy2009.esa.int

**Be an
INTEGRAL
astronomer**

From Planets to Big Bang

(what to do in Copenhagen Thursday afternoon?)



- Exhibition at Frederiksberg Townhall, June 18-23
 - Planck planetarium, open 10-20
 - Exhibition with X-ray astronomy hardware and Year of Astronomy posters, open 10-16
- Organized by:
 - DTU Space
 - Dark Cosmology Center, NBI
 - Tycho Brahe Planetarium

DTU Space
National Space Institute