



The puzzling thermonuclear burst behaviour of IGR J17473-2721

Chenevez, Jérôme

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Puzzling thermonuclear bursts from the transient low-mass X-ray binary IGR J17473-2721

Jérôme Chenevez

Diego Altamirano

Duncan Galloway

Jean in 't Zand

Erik Kuulkers

Nathalie Degenaar

Maurizio Falanga

Ettore Del Monte

Y. Evangelista

M. Feroci

E. Costa



$$f(x) = \sum_{n=0}^{\infty} \frac{f^{(n)}(x)}{n!} (x-x_0)^n$$

$$\Delta \int_a^b \varepsilon \Theta_{\infty}^{\sqrt{17}} + \Omega \int \delta e^{i\pi} = (2.7182818284)$$

$$\chi^2 \sum \gg \int$$

A paper submitted to MNRAS



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Complete List of Authors:	Chenevez, Jerome; Technical University of Denmark, National Space Institute Altamirano, Diego; University of Amsterdam, Astronomical Institute Galloway, Duncan; Monash University, School of Physics and School of Mathematical Sciences in 't Zand, Jean; SRON Kuulkers, Erik; ESA/ESAC Deqenaar, Nathalie; University of Amsterdam, Astronomical Institute "A. Pannekoek" Falanga, Maurizio; ISSI Del Monte, Ettore; INAF, IASF Evangelista, Yuri; INAF, IASF Feroci, Marco; INAF, IASF Costa, Enrico; INAF, IASF
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Nuclear burning regimes

Theoretical thresholds:

- $\dot{m} < 900 \text{ g/cm}^2/\text{s}$: Mixed H/He burning triggered by thermally unstable H ignition. Long burst duration ($> 100\text{s} - 1000\text{s}$) due to rp- process. $\alpha \approx 150$.

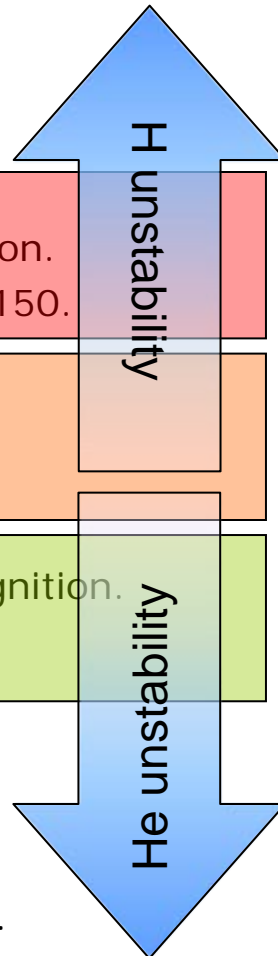
- $900 < \dot{m} < 2000 \text{ g/cm}^2/\text{s}$: H stable burning (hot CNO cycle) to He \Rightarrow Pure He flash ($3-\alpha$). Frequent PRE. $\alpha \approx 200$.

- $2000 \text{ g/cm}^2/\text{s} < \dot{m} < \dot{m}_{Edd}$: Mixed H/He burning triggered by thermally unstable He ignition. Burst duration $> 10\text{s}$ due to rp- process. $\alpha \sim 20-100$.

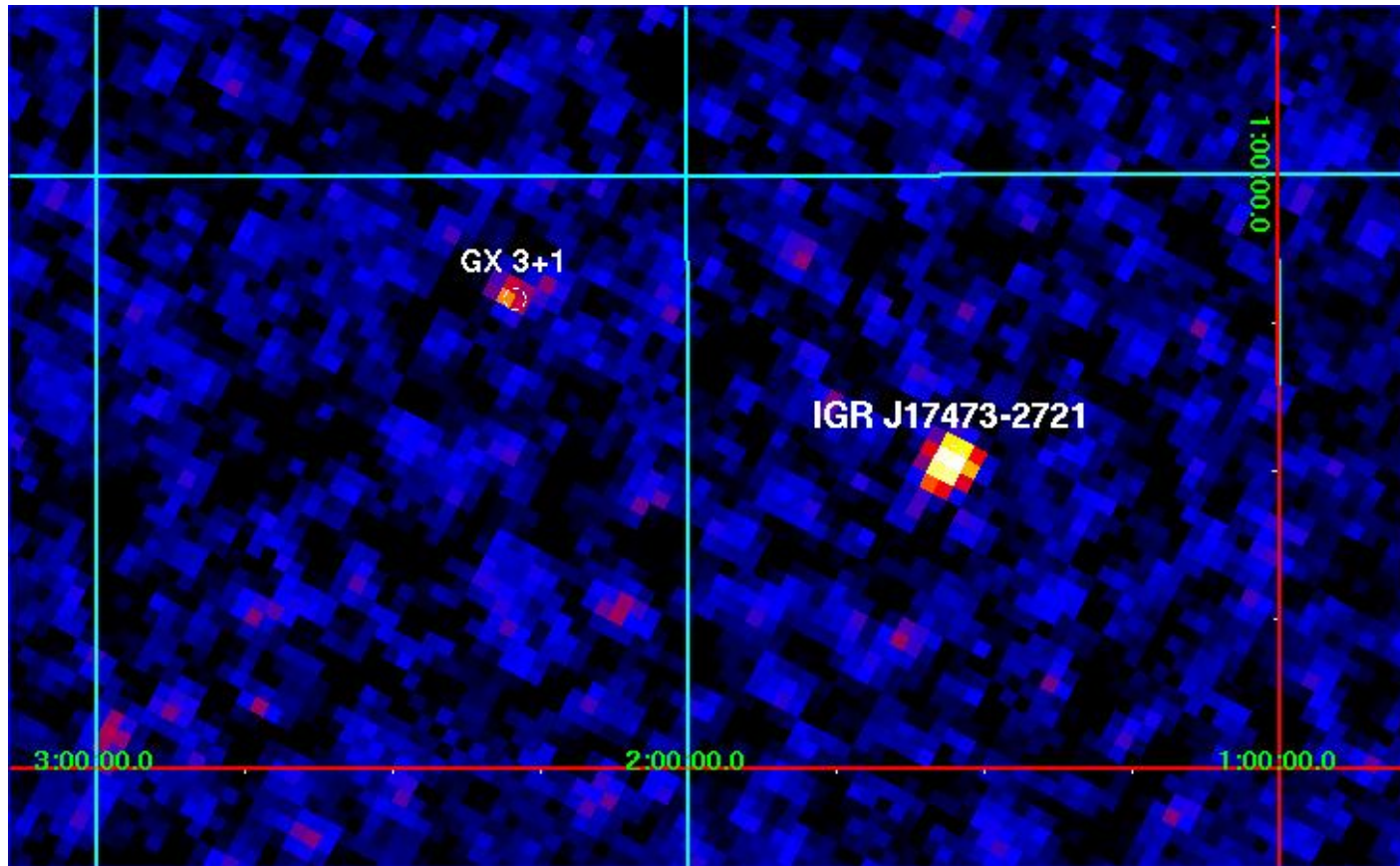
- $\dot{m} \geq \dot{m}_{Edd}$: No bursts (e.g. pulsars). $\dot{m}_{Edd} = 10^5 \text{ g/cm}^2/\text{s}$

- Thick He burning (e.g. pure He accretion in UCXB) \Rightarrow Long He bursts ($\sim 10^{41}$ ergs).

- Deep Carbon burning in superbursts (duration \sim hours, released energy $\sim 10^{42}$ ergs).



IGR J17473-2721 aka XTE J1747-274

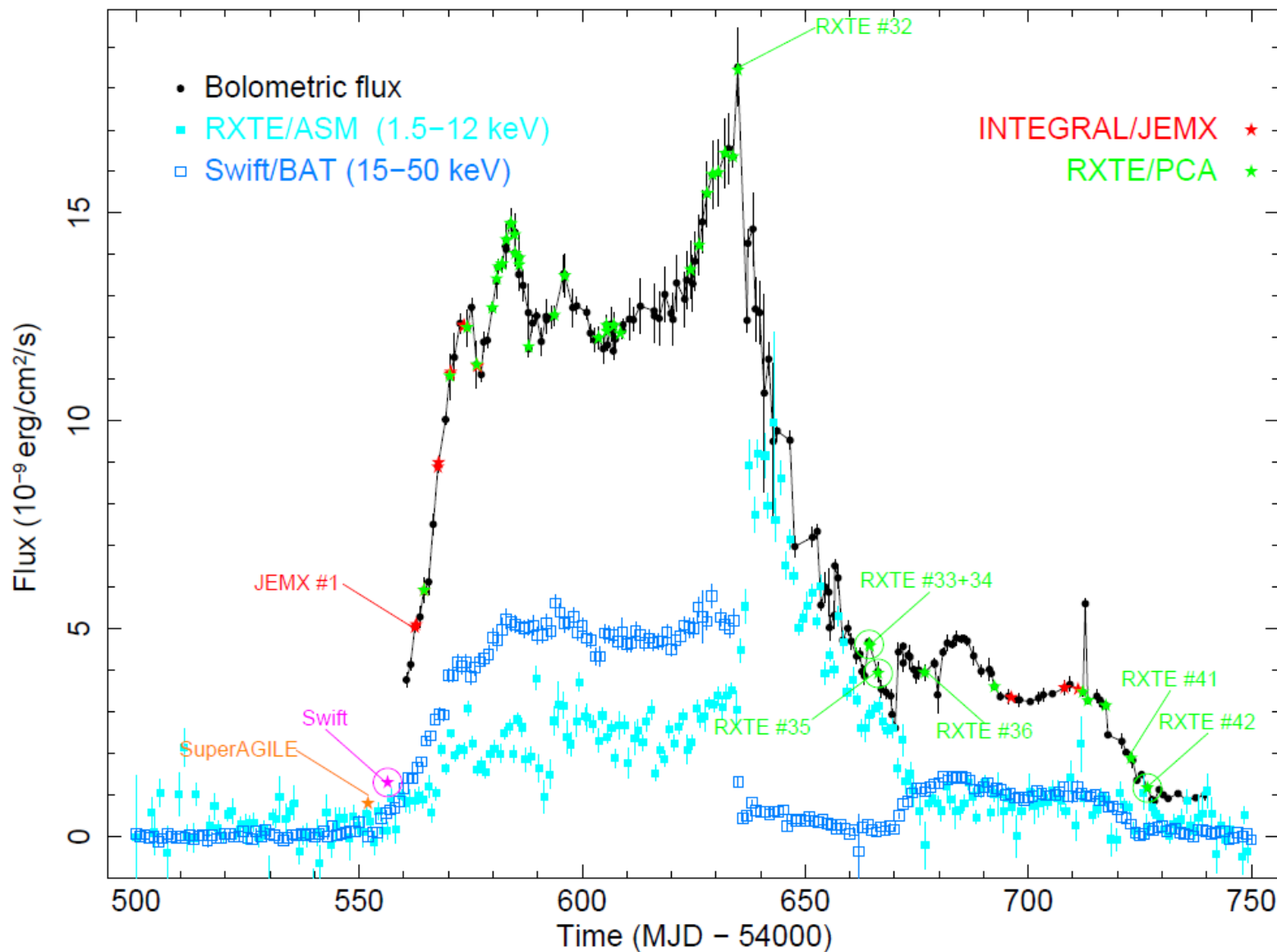


JEM-X
5-10 keV
6/4/2008

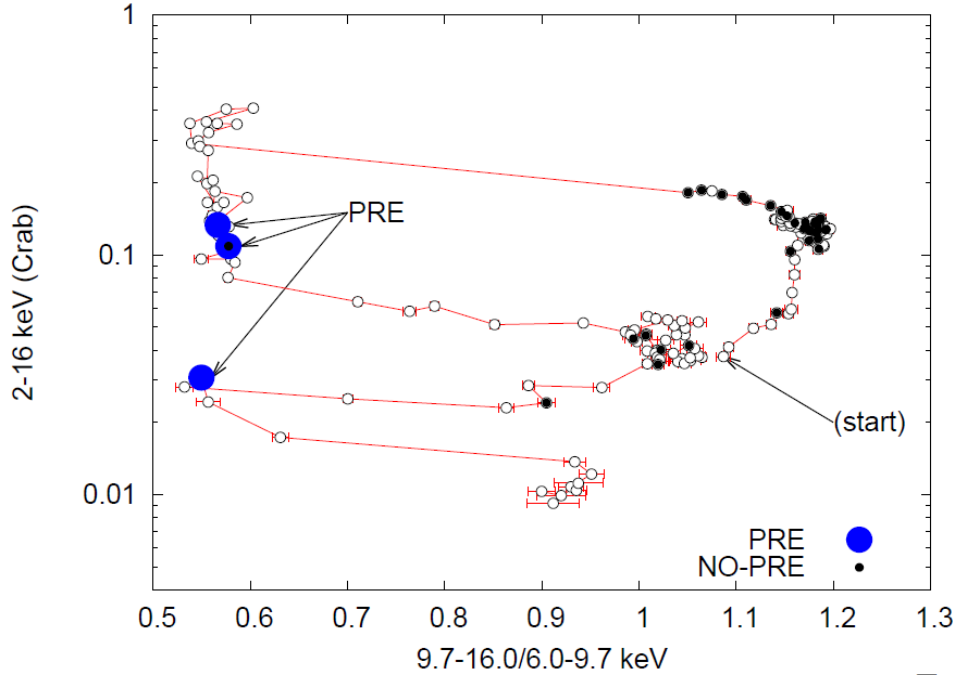
- Located in the Galactic Bulge, 0.8° from GX 3+1
- Transient X-ray source, discovered in 2005 (Grebenev et al., ATel 467)
NIR counterpart (ATels 521, 634) - 2 (unpublished) X-ray bursts in RXTE
- 2nd outburst March – September 2008 (ATels 1445, 1459, 1460, 1461, 1468, 1651)
INTEGRAL + RXTE + Swift coverage (57 X-ray bursts)

Outburst with sudden spectral transition

IGR J17473-2721 outburst 2008 and burst times



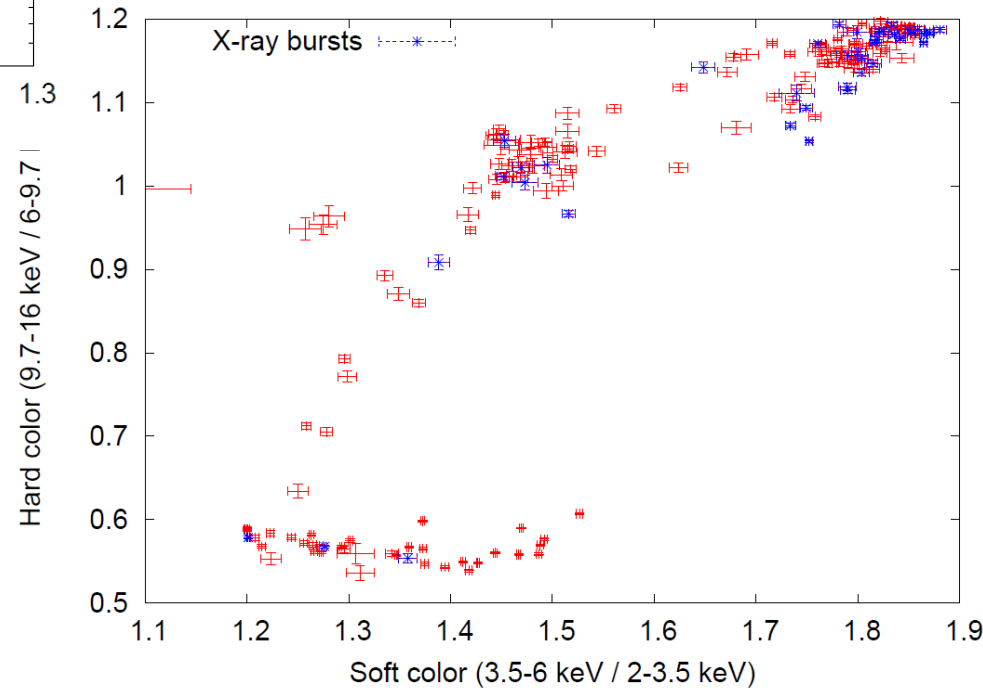
Diagrams of the 2008-outburst



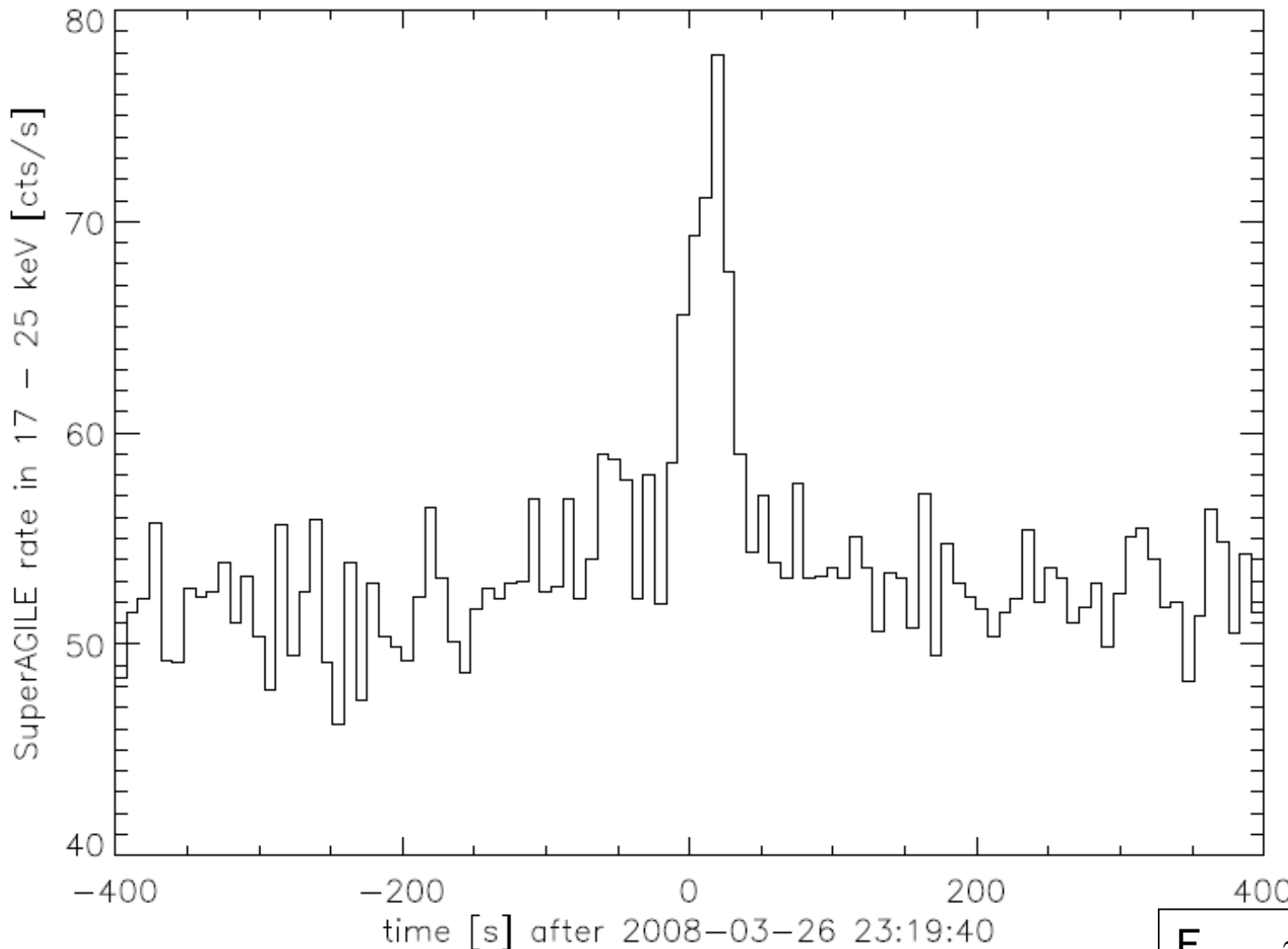
HID

From RXTE/PCA measurements

CCD



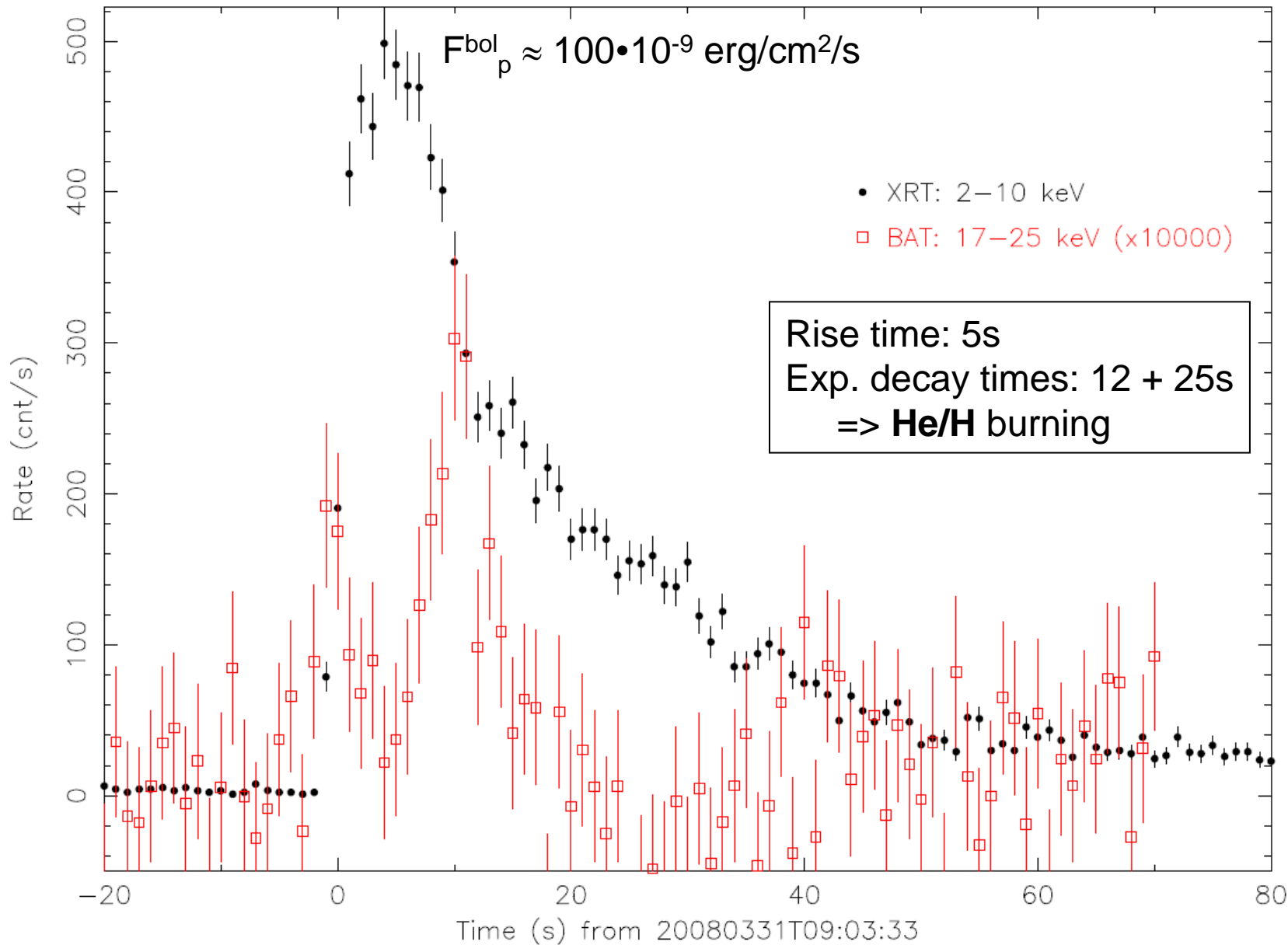
Burst as precursor of outburst?



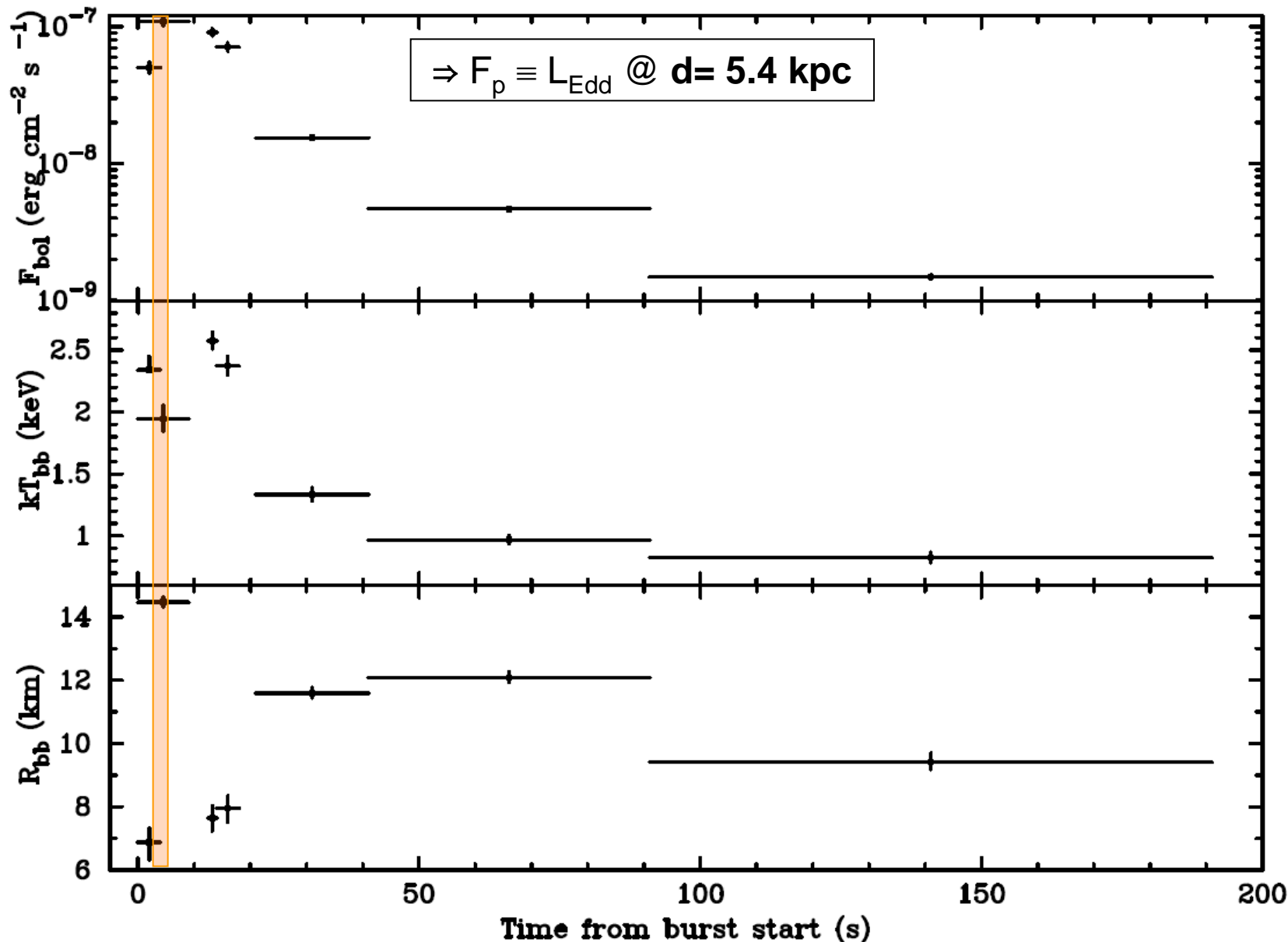
$F_{\text{pers}} \sim 10^{-10} \text{ erg/cm}^2/\text{s}$

$F_{\text{peak}} \approx 0.5 \text{ Crab}$
Duration $\approx 44\text{s}$

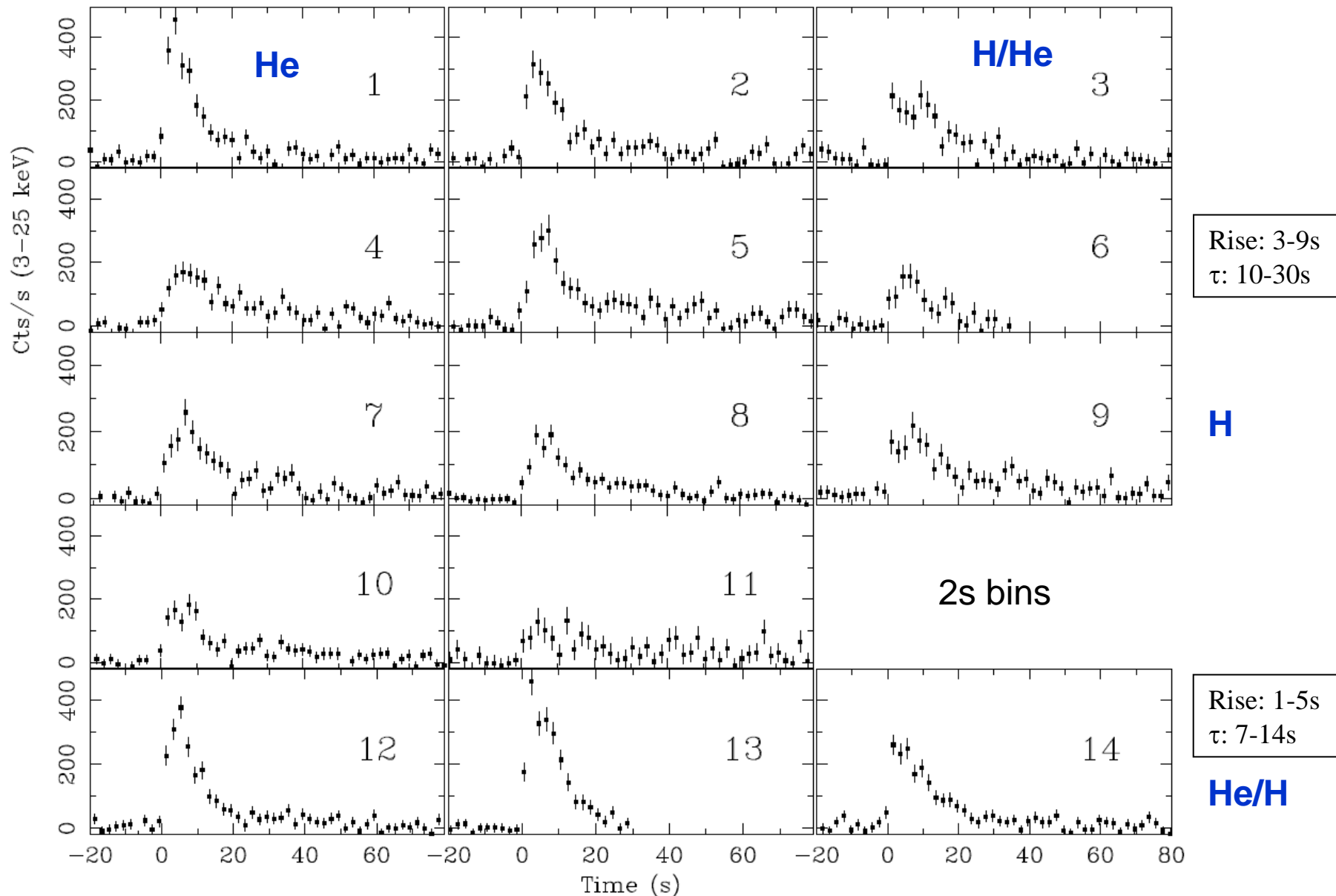
The burst observed by *Swift*



Time-resolved spectral analysis of the *Swift* burst

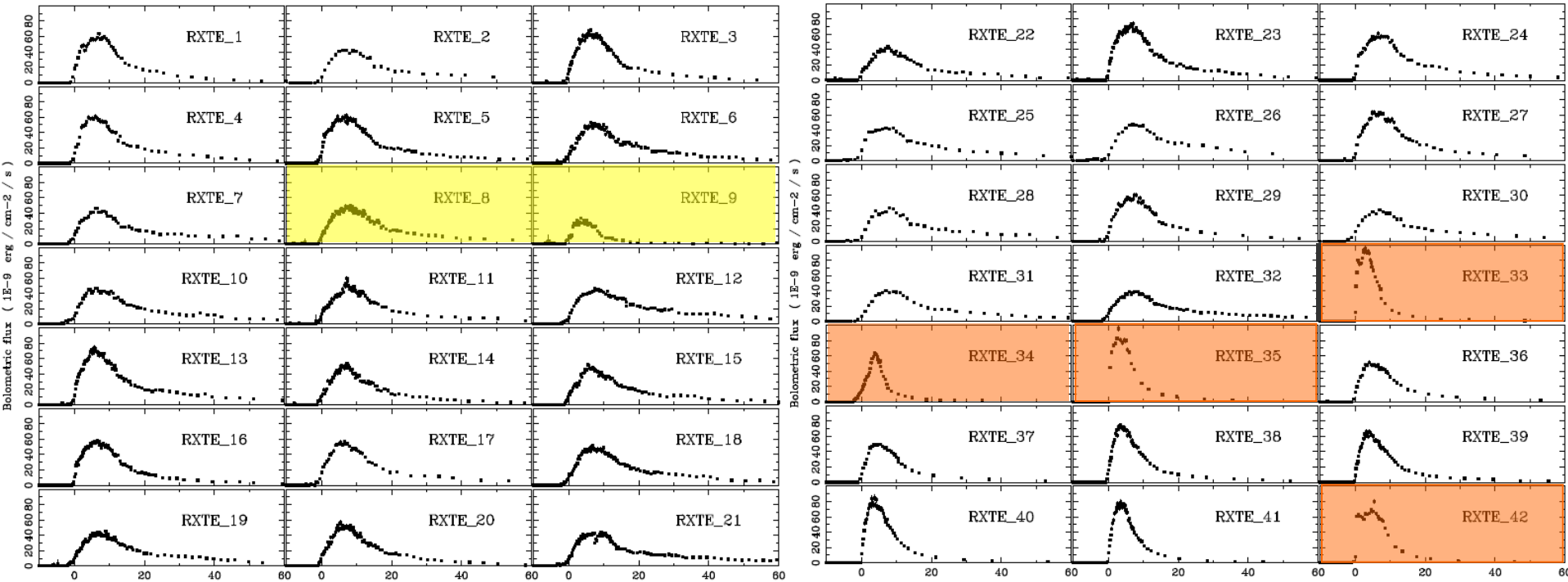


JEM-X bursts



42 RXTE/PCA bursts

He/H (stable H)



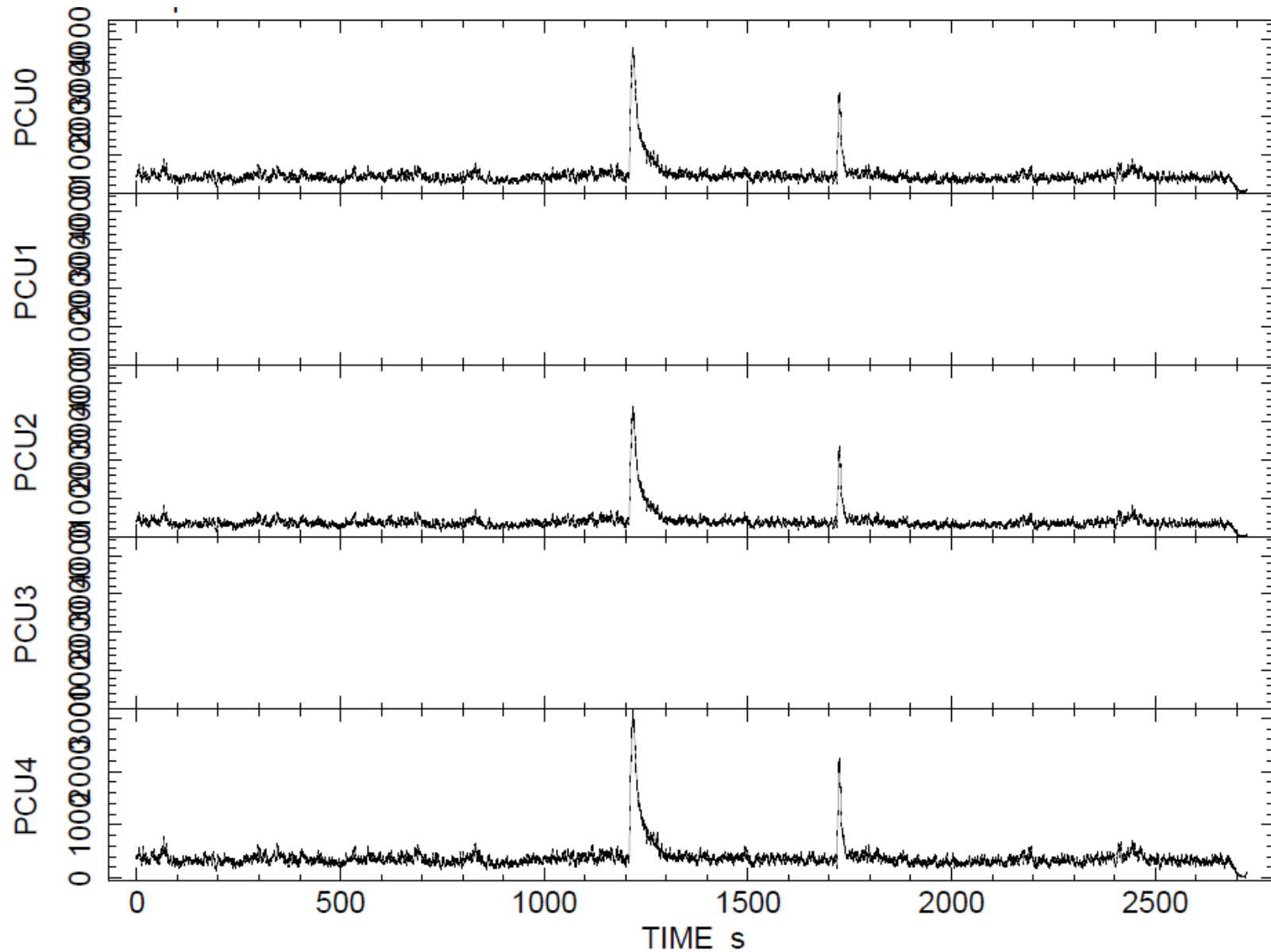
H/He

Rise: 6-9s
 τ : 10-18s

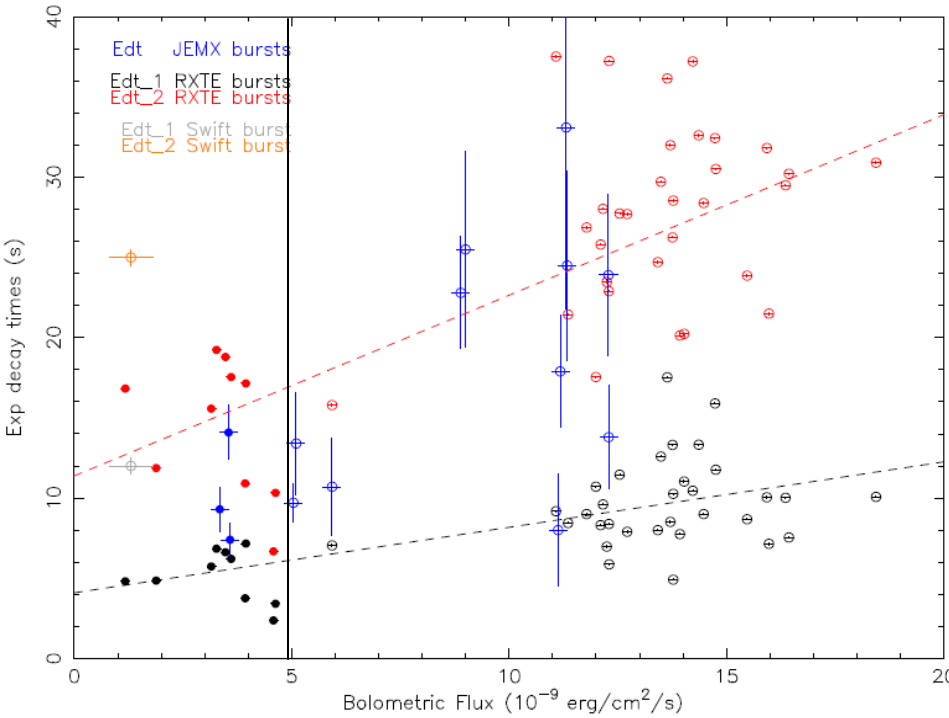
(stable He) He

Rise: 2-5s
 τ : 8-16s

A double burst observed by *RXTE*/PCA

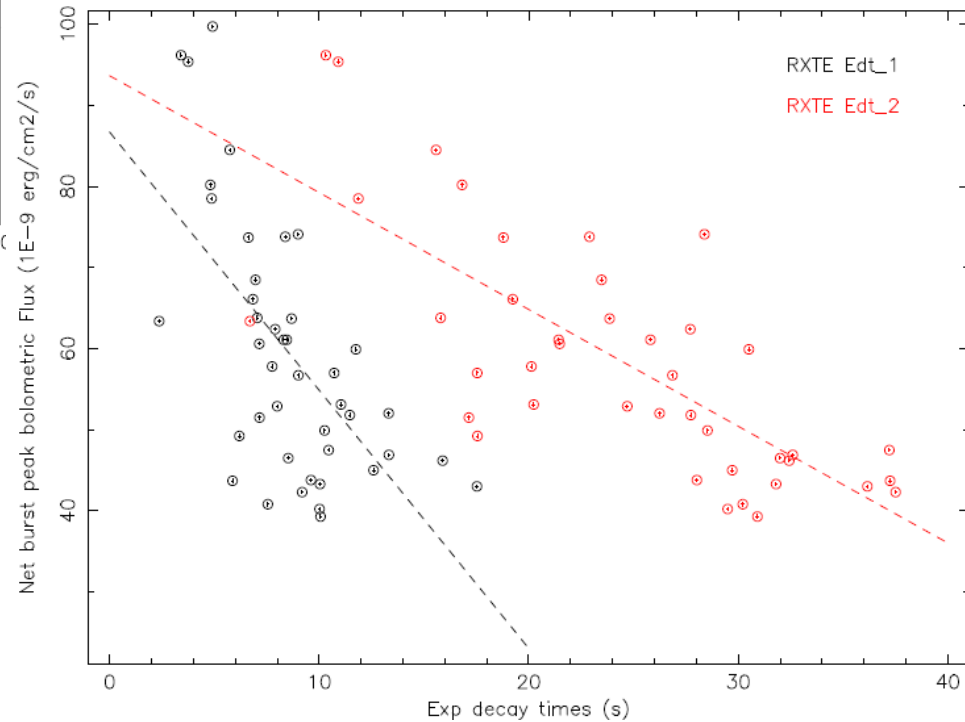


Burst properties



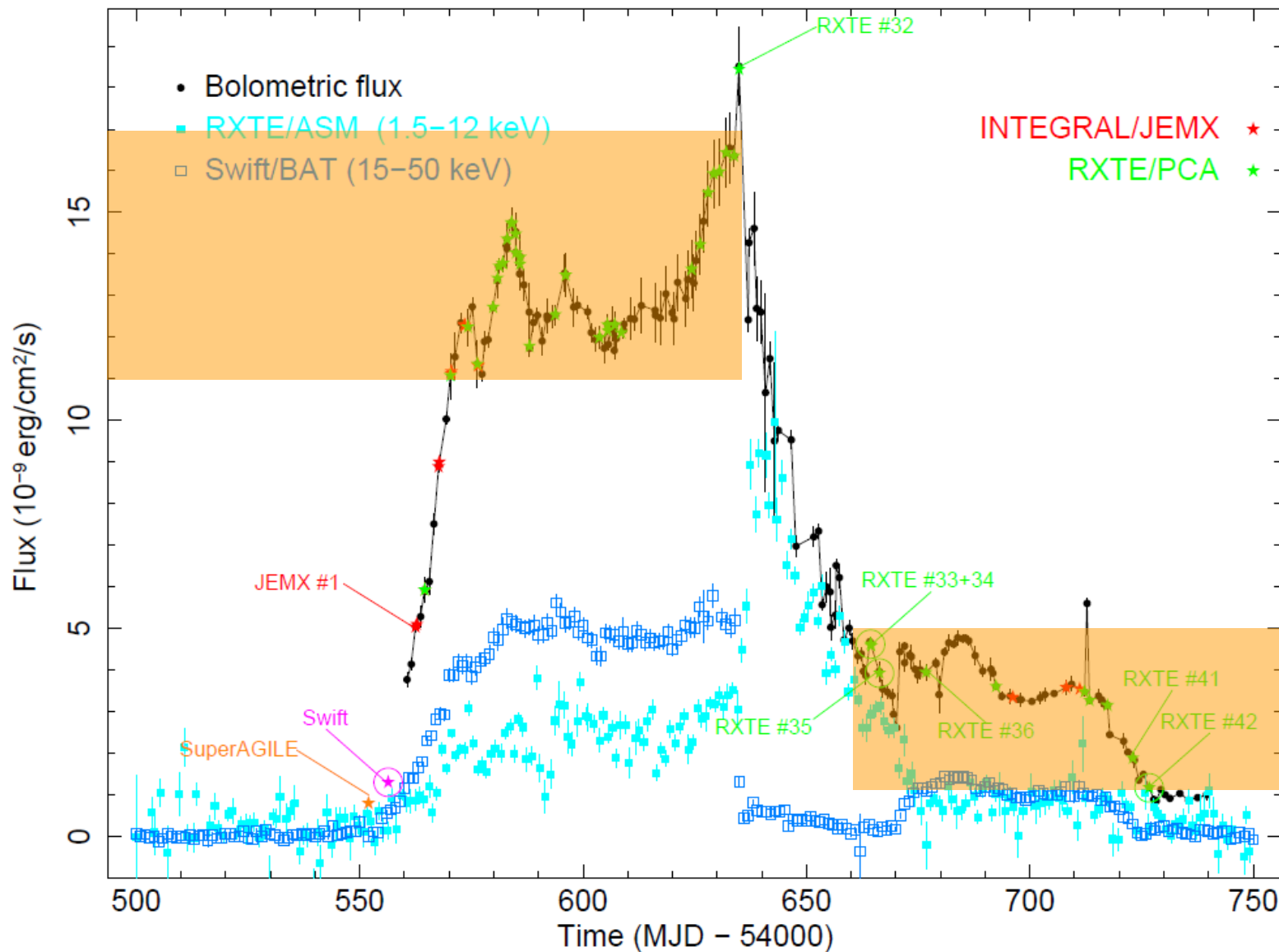
Burst decays vs. emission intensity

Burst intensity vs. decays

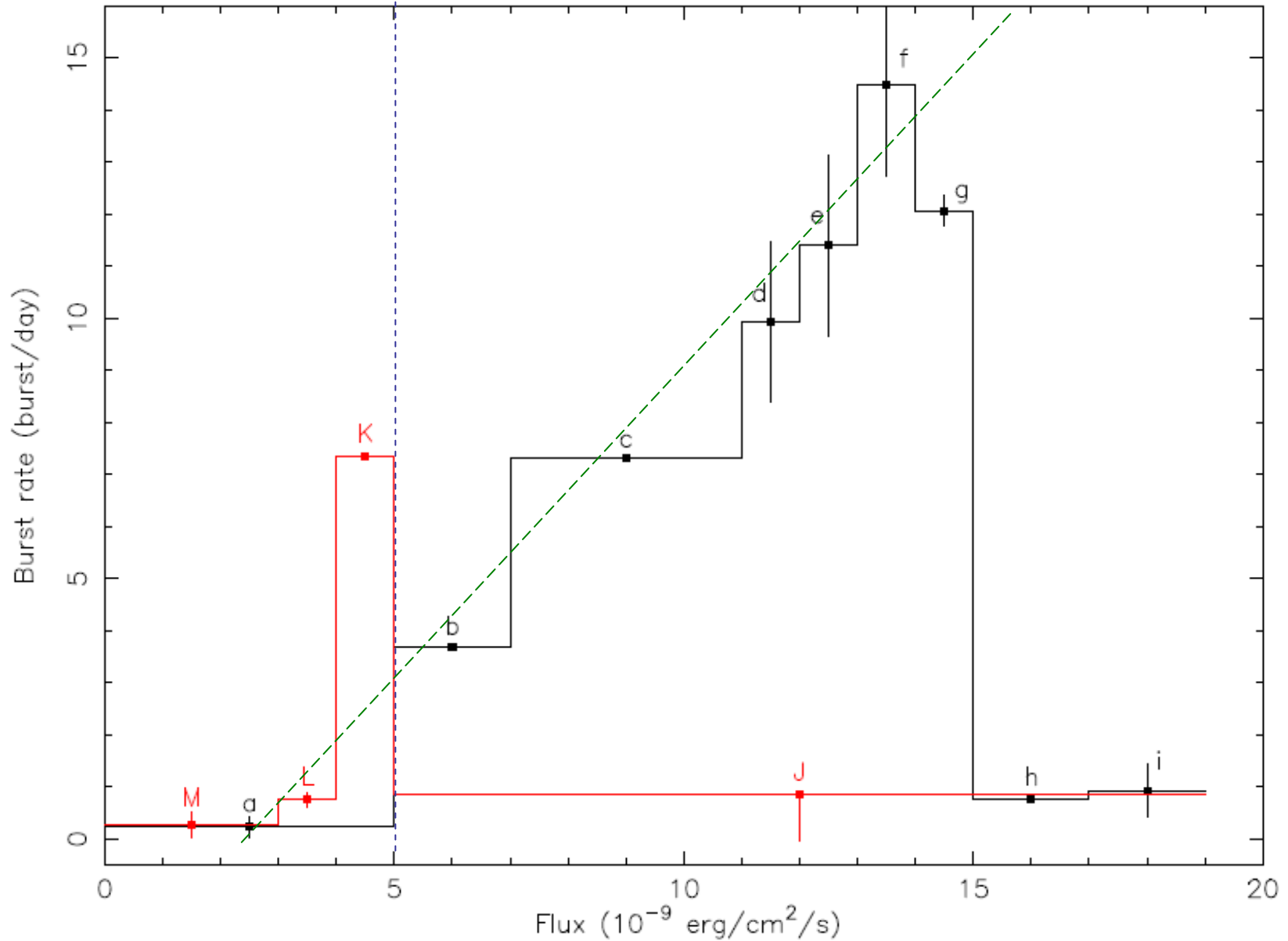


Outburst with sudden spectral transition

IGR J17473-2721 outburst 2008 and burst times



Burst rate vs. accretion rate



SUMMARY



- Identification of IGR J17473-2721 as a transient NS –LMXB source
- Dramatic spectral transition simultaneous with burst intermission at outburst peak.
- Distance ≈ 5.5 kpc derived from Eddington-limited PRE bursts
- 57 X-ray bursts \Rightarrow 7 different regimes identified:
 1. Hard He bursts at outburst onset (very low accretion rate)
 2. He-trig. H/He bursts in hard state (short recurrence times)
 3. He/H bursts with H & He stable burning at high accretion rate
 4. No burst activity at soft-high state (due to a **SUPERBURST?**)
 5. Pure He bursts (with PRE) at soft-low state
 6. Mixed He/H burning at hard-low state
 7. Last He burst at low accretion rate in soft state
- Rising bursting rate $< 15\%$ Eddington accretion rate and **hysteresis**