The Transient Galactic Sky

RXTE workshop: Nov. 5, 2009

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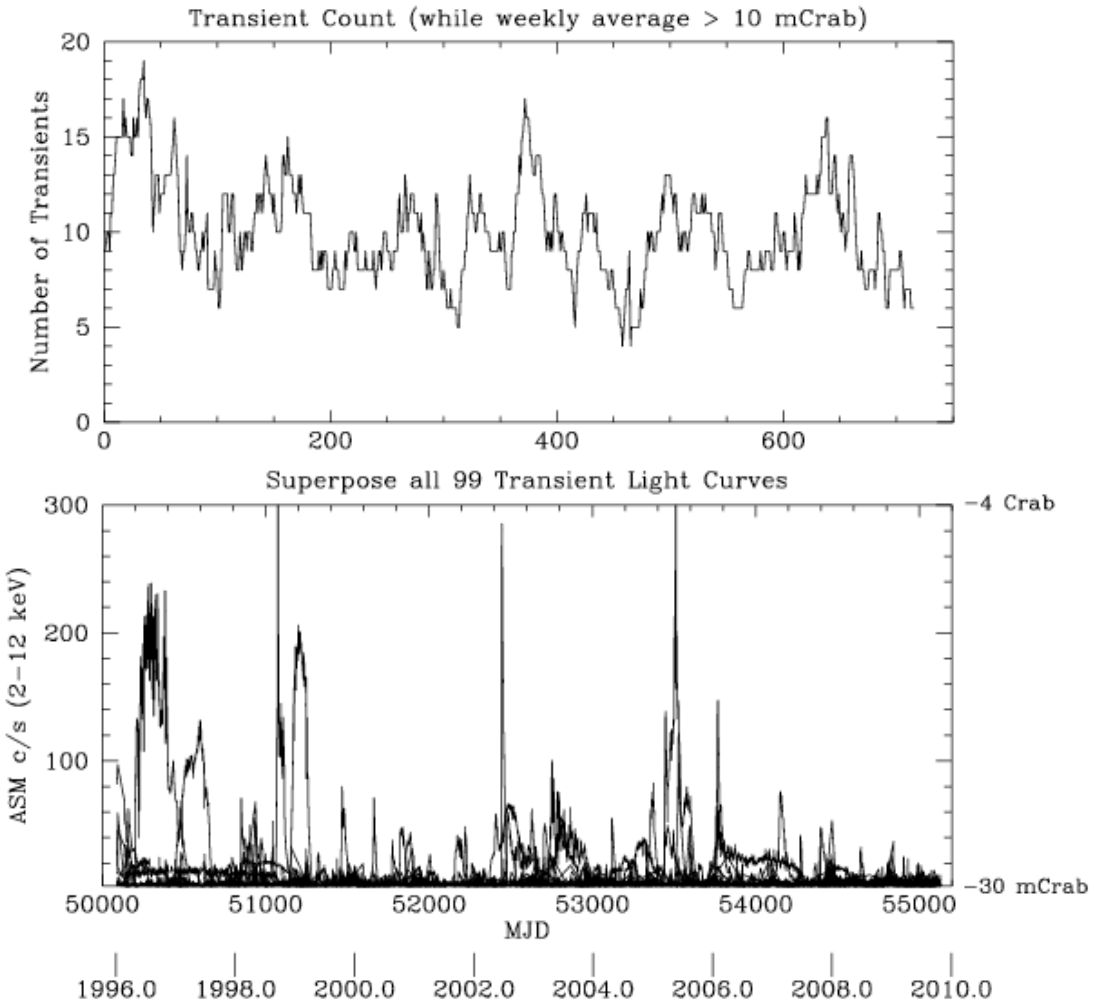
Outline

- Rates & Types of X-ray Transients
- Science Values of X-ray Transients
- Example: XTE J1701-462 (first Z-source transient)
- Communicating RXTE Capabilities

Rates and Brightness of X-ray Transients



bright transients will return soon !

Science Values of X-ray Transients

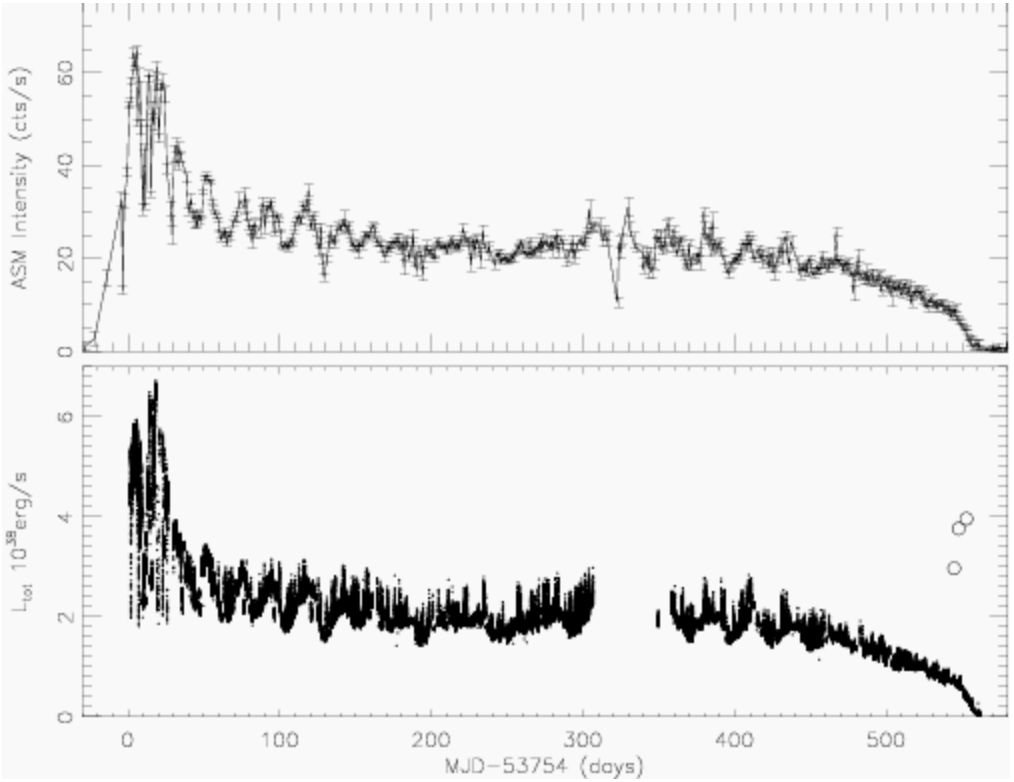
- New Sources for Astronomy
  - Different compact object mass, spin
  - Find sources with low distance, preferred inclinations
  - New phenomenology
- Large dynamic range in luminosity
  - More robust tests of accretion physics
  - More state transitions
  - Quiescent phase to study companion star
  - Quiescent phase to study neutron stars
- Realized by **Dedicated** Monitoring
  - ***Unique strength of RXTE***

Example: Transient Z-Source, XTE J1701-462

2006-2007
First and only
Z-source (NS) transient

RXTE: 866 obs.
3 Ms archive

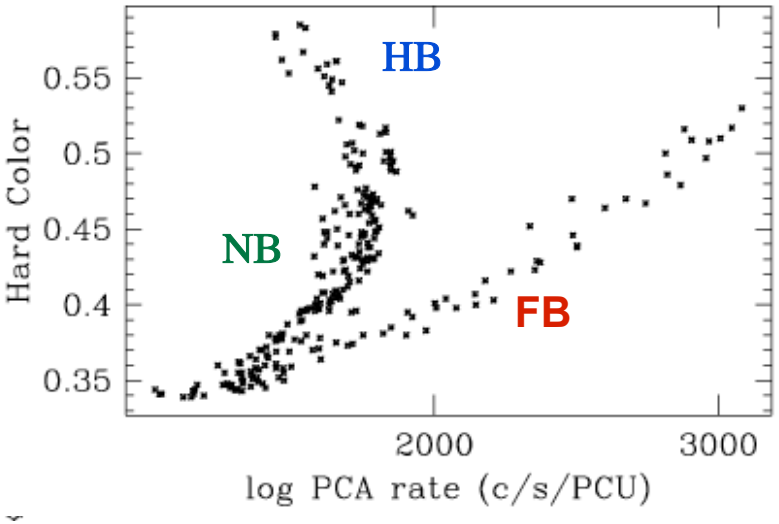
Dedication!



Z sources behavior

Hasinger & van der Klis 1990 proposed increasing ***dM/dt*** along

Horizonal Branch → **Nornal Branch** → **Flaring Branch**



XTE J1701-462

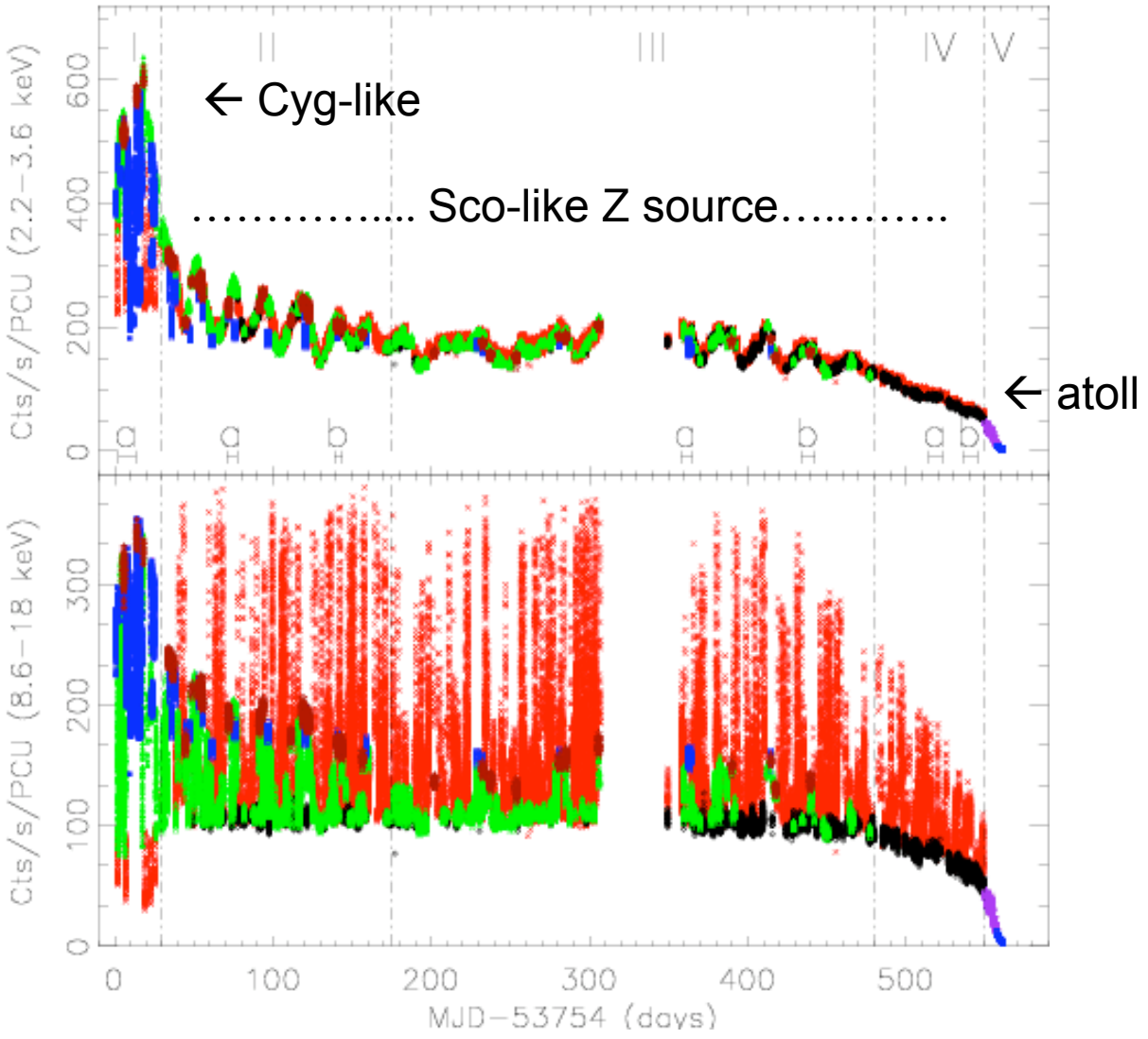
Horizontal (HB)

Normal (NB)

Flaring (FB)

NB-FB Vertex

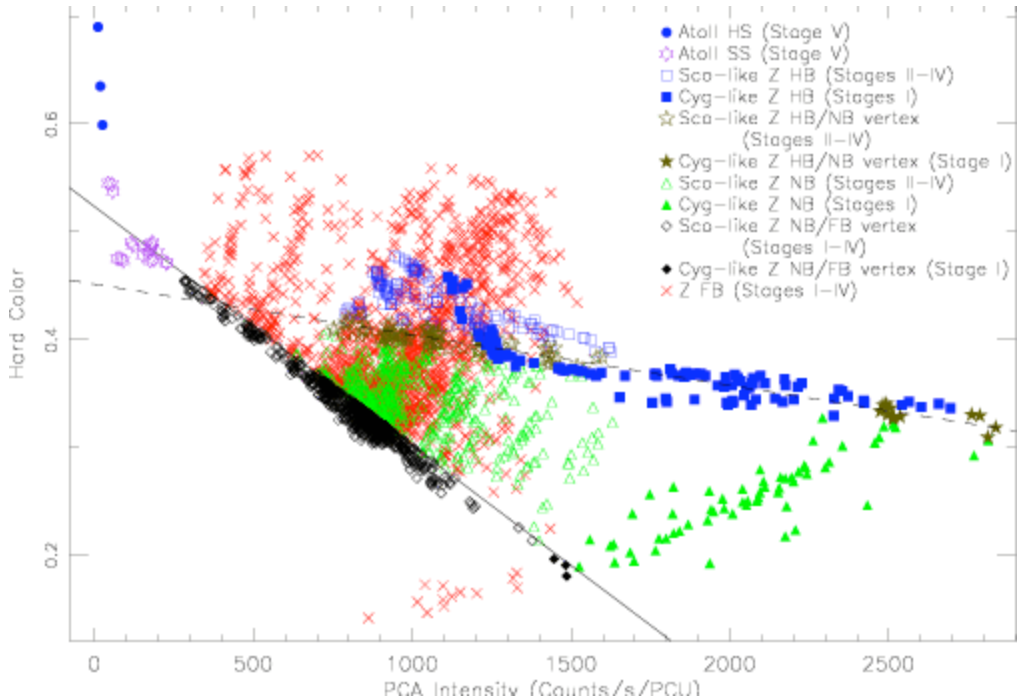
Lin, Remillard & Homan 2009



XTE J1701-462: Total Hardness-Intensity Diagram

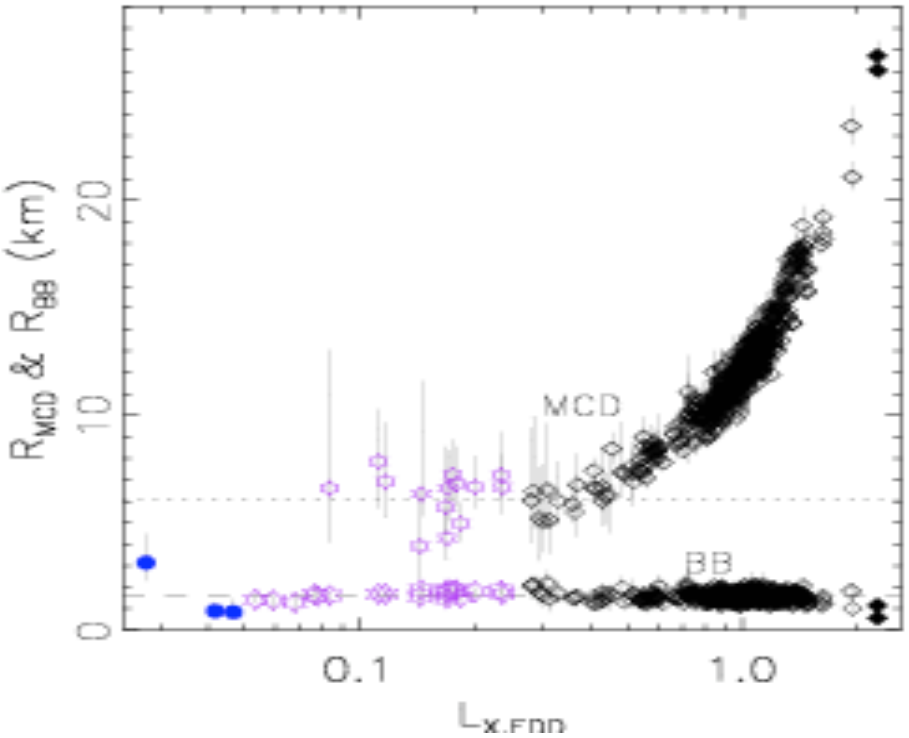
Upper and lower vertices: single lines on the HID.

Lower vertex is key to understand adjoining **FB**, **NB**



Spectral model: double-thermal + weak Comptonization

NB:FB Vertex: local Eddington limit in the accretion disk?



FB: disk tries to shrink toward ISCO from a point on this curve

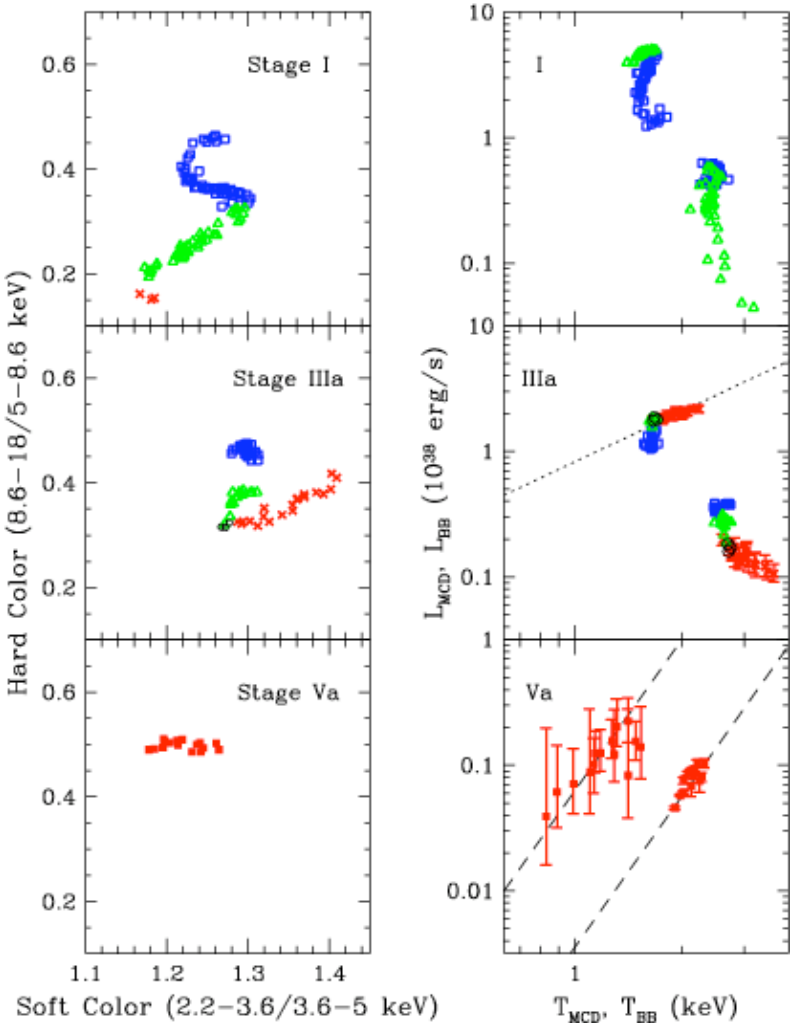
Spectral model: double-thermal + weak Comptonization

Cyg-Like Z

Sco-like Z

Atoll Stage
Disk & BB:
$L \alpha T^4$
(constant R)

Color-color



spectral fit: L_x vs. T

←**FB**: disk shrinks at constant dM/dt

$T_R \alpha (M\ dM/dt\ R^{-3})^{1/4}$
$L \alpha R^2\ T_R^4$
$L \alpha (M\ dM/dt)^{2/3}\ T^{4/3}$

← Two reference lines:
Radius from bursts;
Fit to constant R_{BB}

XTE J1701-462 Spectral Fits

double-thermal model

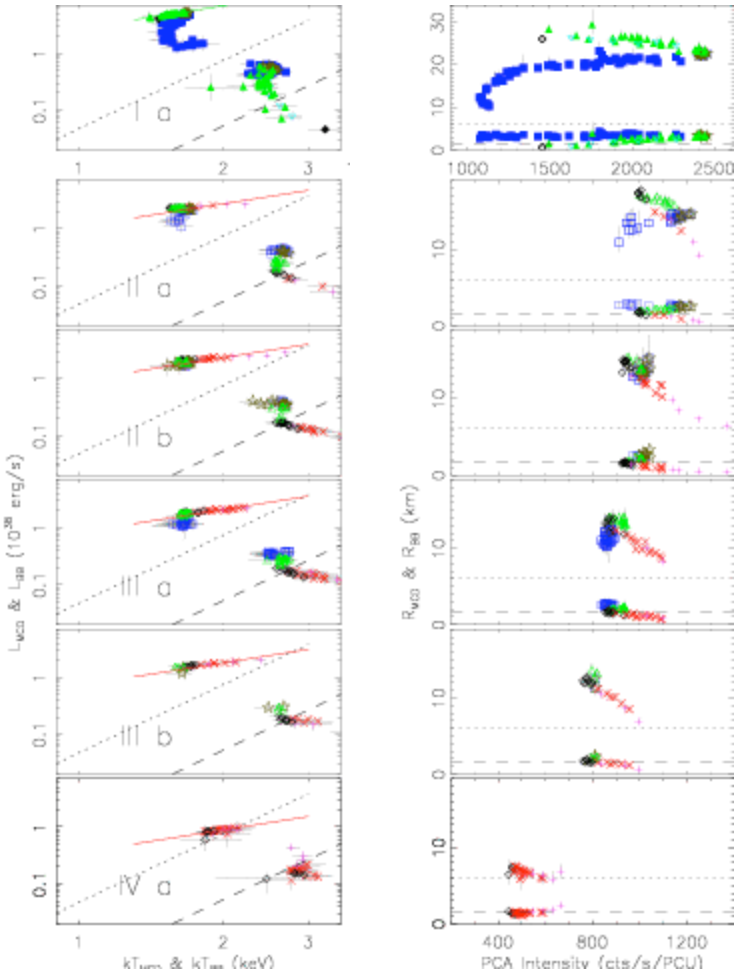
(disk + BB + CBPL)

Lin, Remillard, & Homan 2009

Spectral Fit Results

L_x vs. T

R vs. count rate



XTE J1701-462: summary

Secular increases in **dM/dt** shifts the **Z** in the HID and
shifts emphasis from **FB** / lower vertex → **NB** → upper vertex / **HB**

Local Eddington limit is first seen in disk, and the **NB:FB** vertex maps the disk response of R_{MCD} to L_x (i.e., **dM/dt**), while R_{BB} ~ constant.

Sco-like Z source phase:

From condition in lower vertex (R_{MCD} vs. L_x), disk shrinks to ISCO along **FB**

Along the **NB**, the boundary layer brightens independently from the disk, perhaps with onset of a radial accretion flow (small fraction of total)

HB is onset of Comptonization; upper vertex: thick disk solution?

Not much ***dM/dt*** change in a *local* Z

XTE J1701-462: summary

Cyg-like Z source phase (higher dM/dt):

FB is the dipping type; spectral model does not fit! (variable N_H?)

in **NB**, the boundary layer brightens (like the Sco-like) + changes in the disk, complicating interpretations

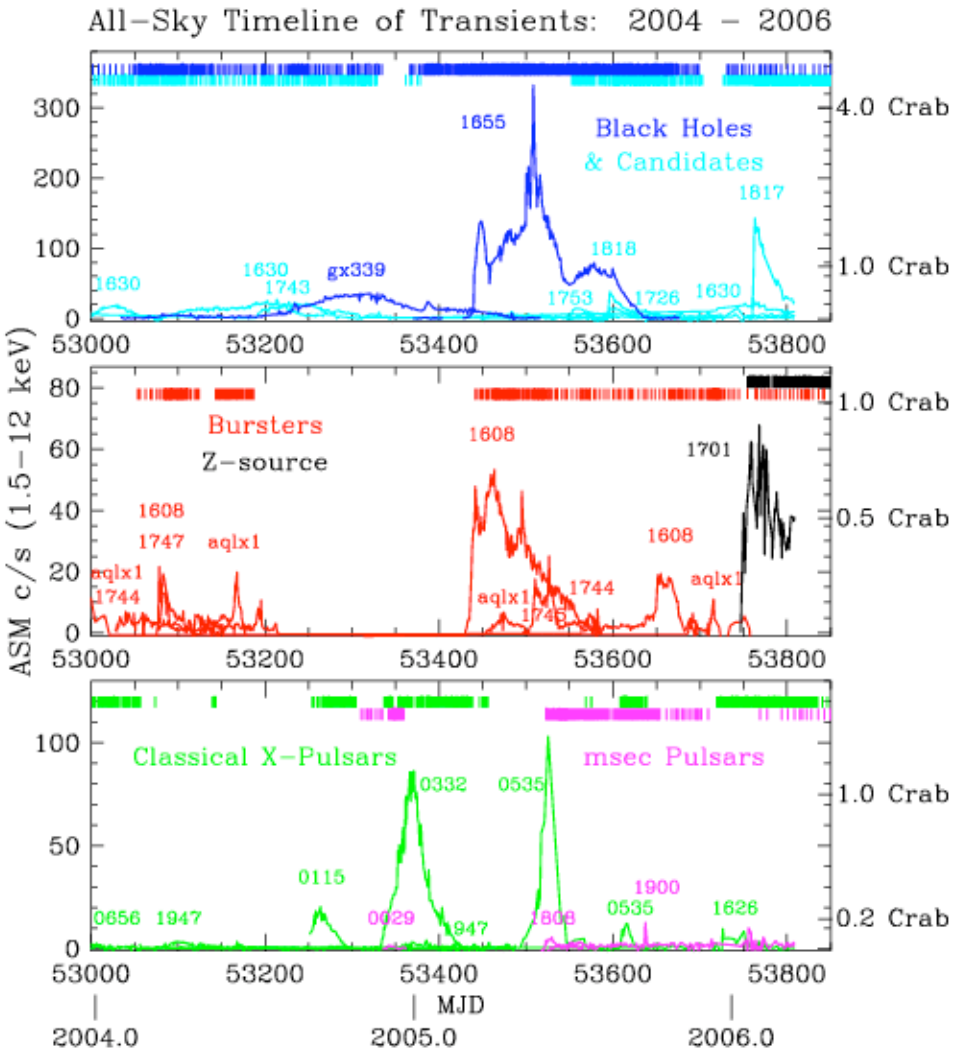
HB-upturn shows increased Comptonization, resembles Sco-like **HB**

non-upturn **HB**: large jump in ***rms*** without increase in Comptonization.

boundary layer responsible for the ***rms*** power (mystery)

X-ray Transients in the Milky Way

most powerful contribution: the ticks!



Communicating RXTE Capabilities

Dedicated Monitoring with RXTE

- One of the primary strengths of RXTE,
- Capitalizes on the advantages of transients,
- Defines unexpected transients in several types (AXPs, radio pulsars,
- Includes productive campaigns on persistent sources in core program,
- Growing multi-frequency partners (Fermi, wide-angle radio, optical)

Upper Z-vertex (HB:NB)

HB:NB Vertex: expansion of both disk and boundary layer with L_x
what causes this turning point?