# Swift X-ray Telescope Status & Observations of the Afterglow of GRB 041223

David Burrows - PSU

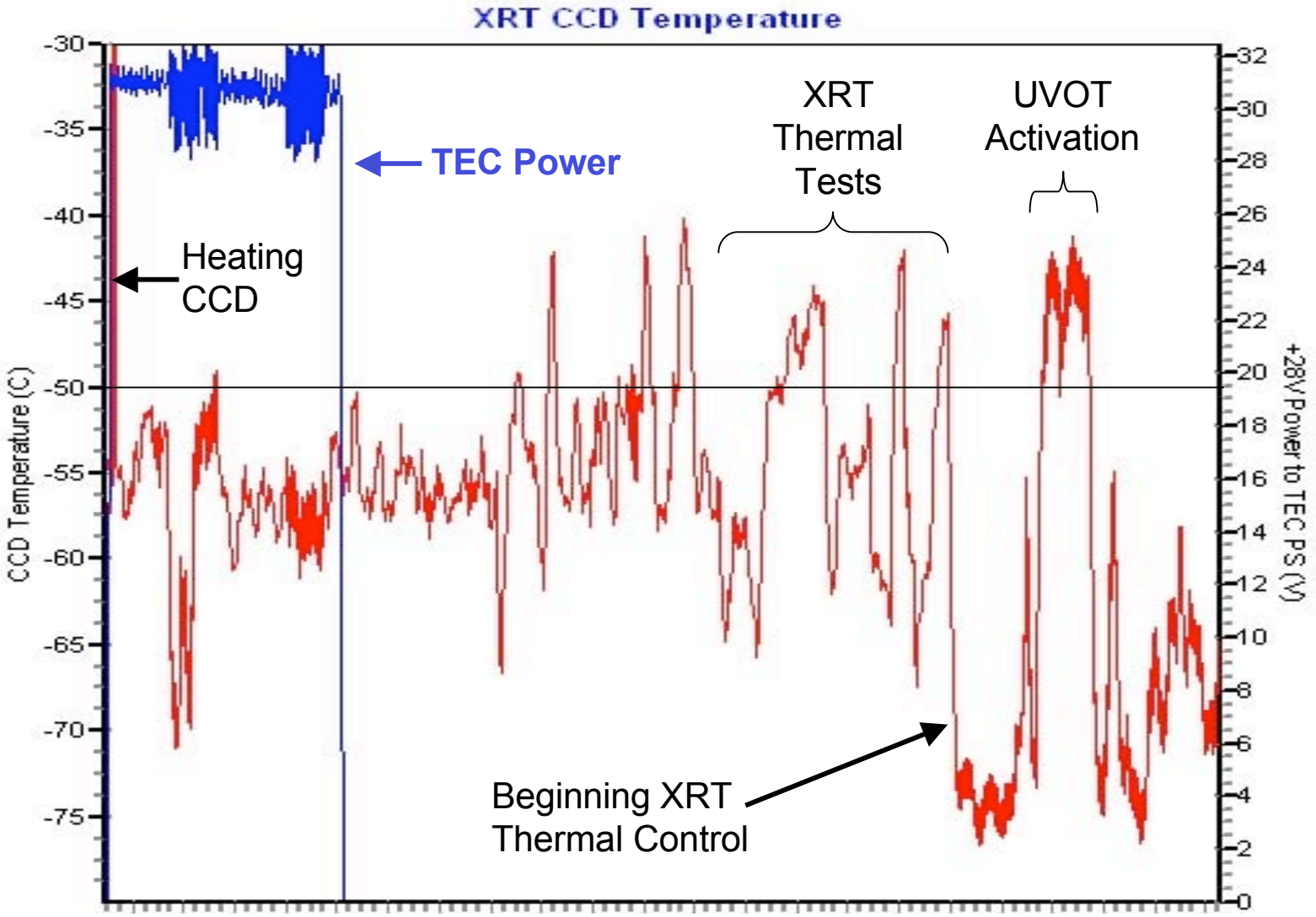
**University Partners:**

PSU UL OAB

# The Swift Observatory

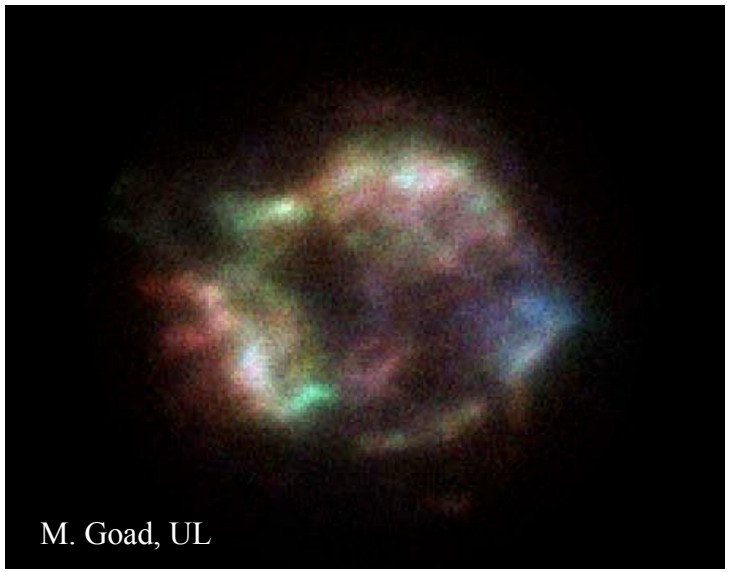
- Launched: 20 November 2004
- XRT turned on: 23 November 2004
- XRT First Light: 11 December 2004

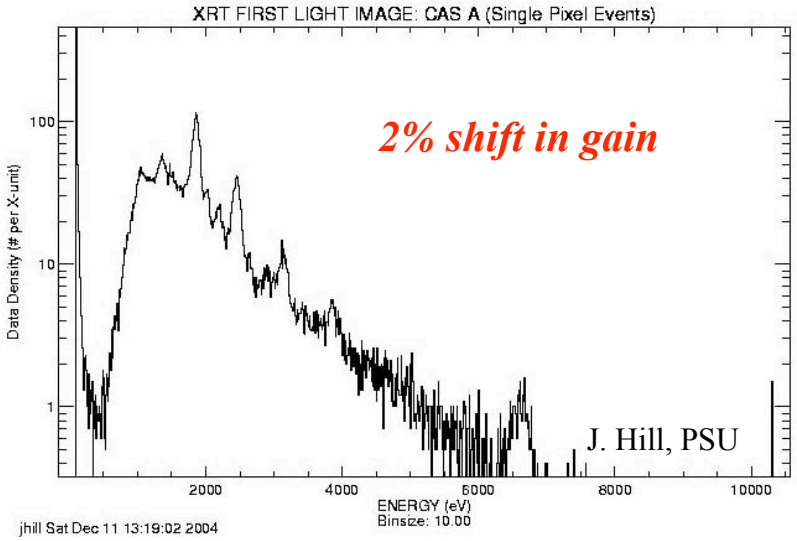

- First BAT Burst: 17 December 2004
- First XRT Afterglow: 23 December 2004


XRT CCD Temperature
TEC Power
Heating CCD
XRT Thermal Tests
UVOT Activation
Beginning XRT Thermal Control
CCD Temperature (C)
+28V Power to TEC PS (V)
-30
-35
-40
-45
-50
-55
-60
-65
-70
-75
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0

# XRT First Light Observations

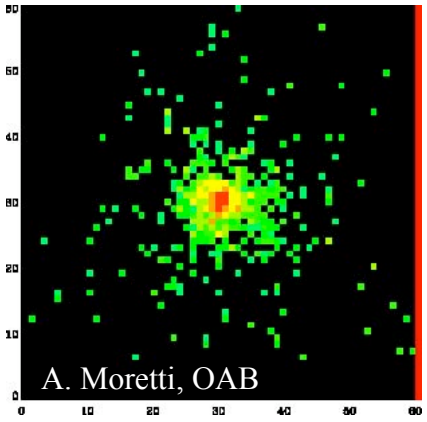
Cas A:
(13 ks)

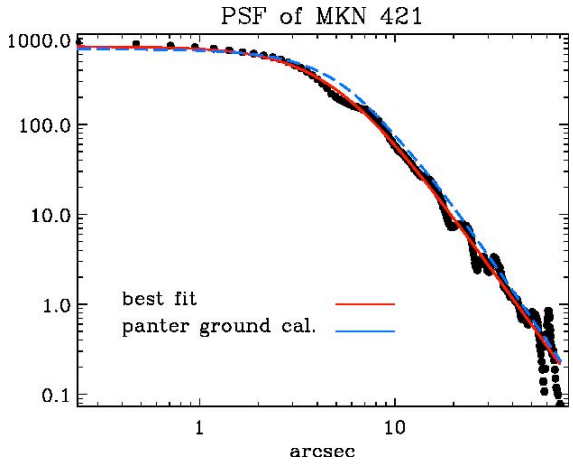



***2% shift in gain***

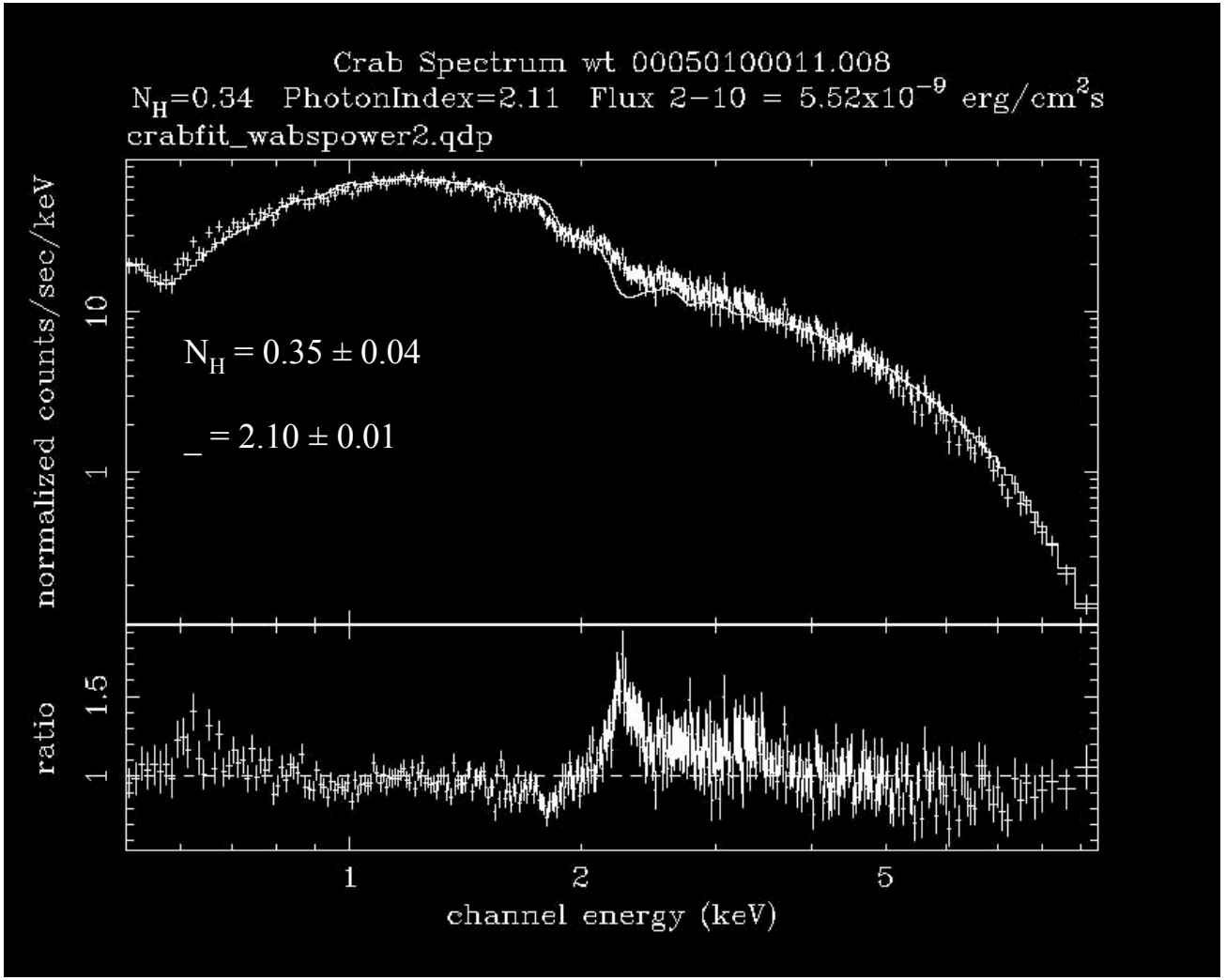
Mkn 421:



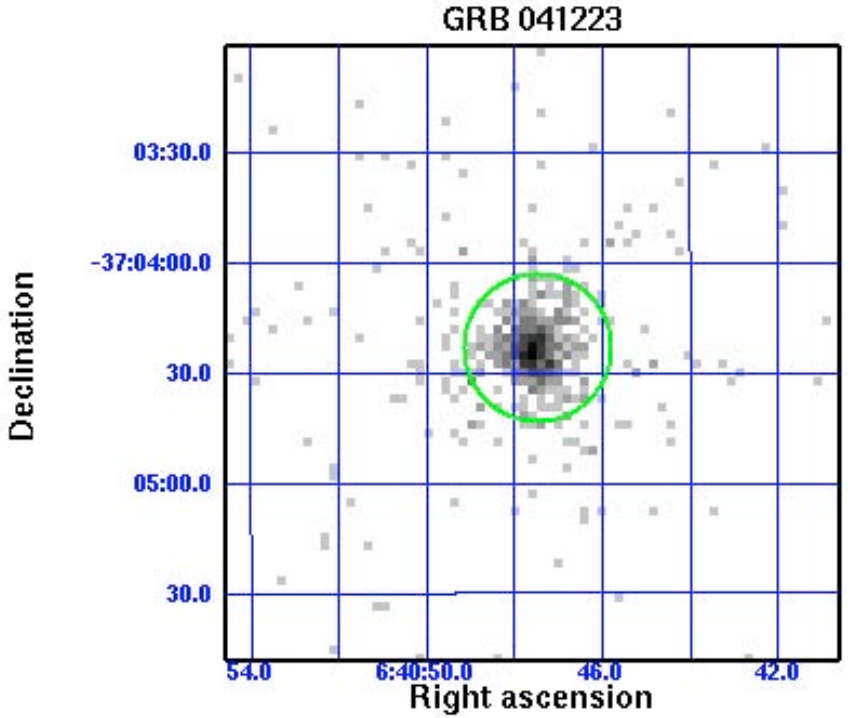

***Focus is perfect!!***

# Preliminary Crab spectral fit



# GRB 041223

- Discovered by BAT at 14:06:18 on 23 December 2004
- XRT was in midst of thermal tests, taking data in PC mode
- Slewed to GRB 4.6 hrs after burst as ToO
- Observed on 3 consecutive orbits for total of about one hour on-target

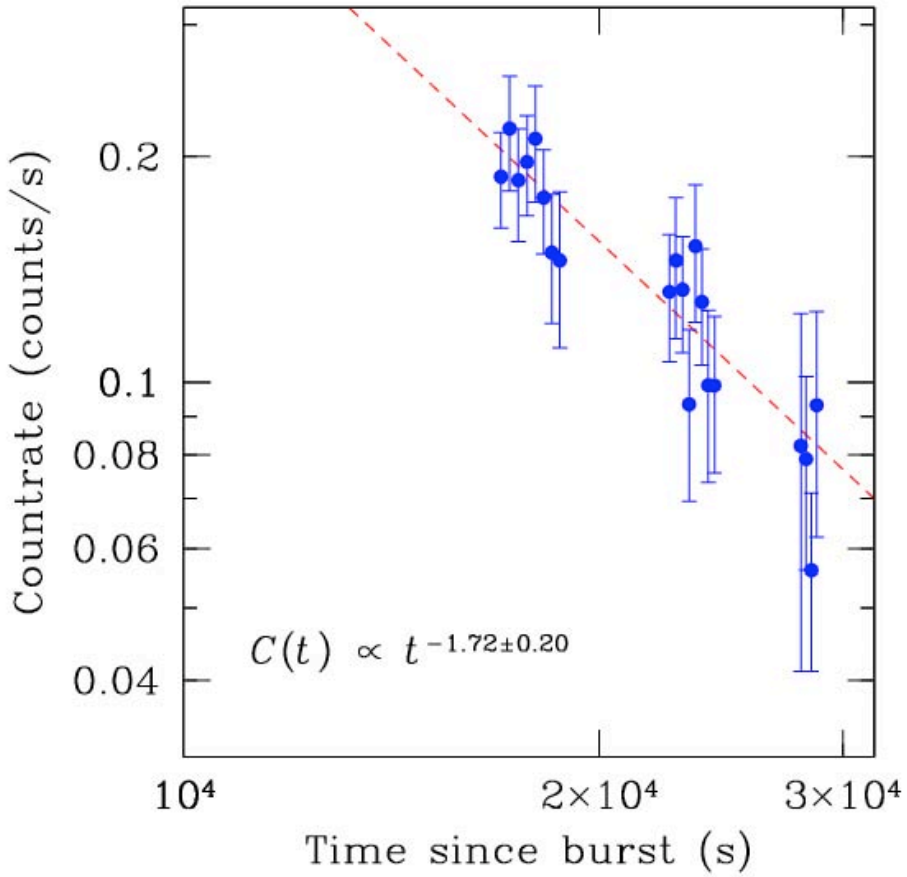



XRT position:
RA(J2000) = 06:40:47.5
Dec (J2000) = -37:04:22.5
SWIFT J064047.5-370423

Offset from BAT position:
50 arcseconds

Offset from optical transient:
2.1 arcseconds

# Lightcurve




X-ray source was uncatalogued.

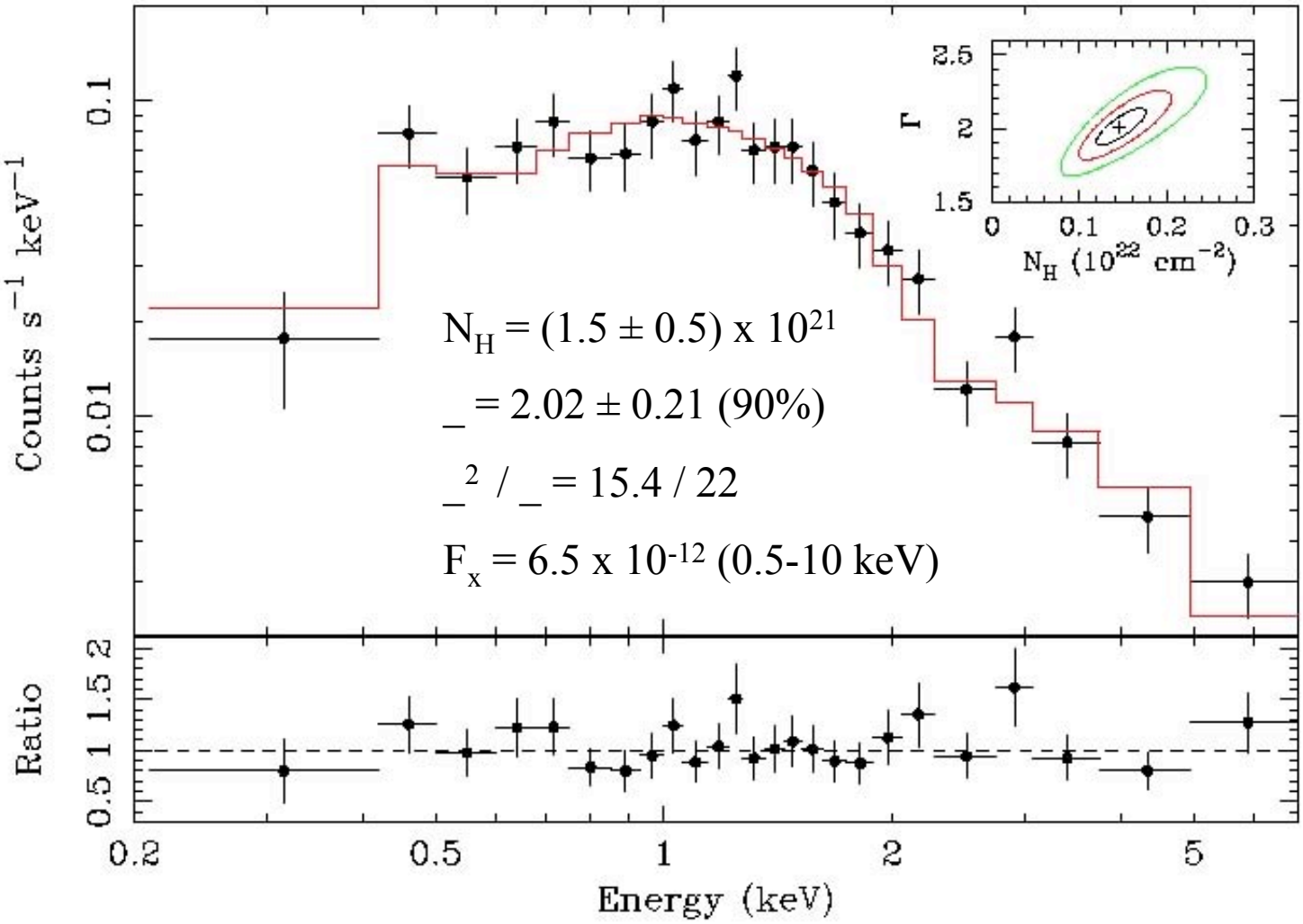
X-ray source faded rapidly.

Data extracted with *ximage* from 20” radius circle. Background extracted from 47” radius circle.

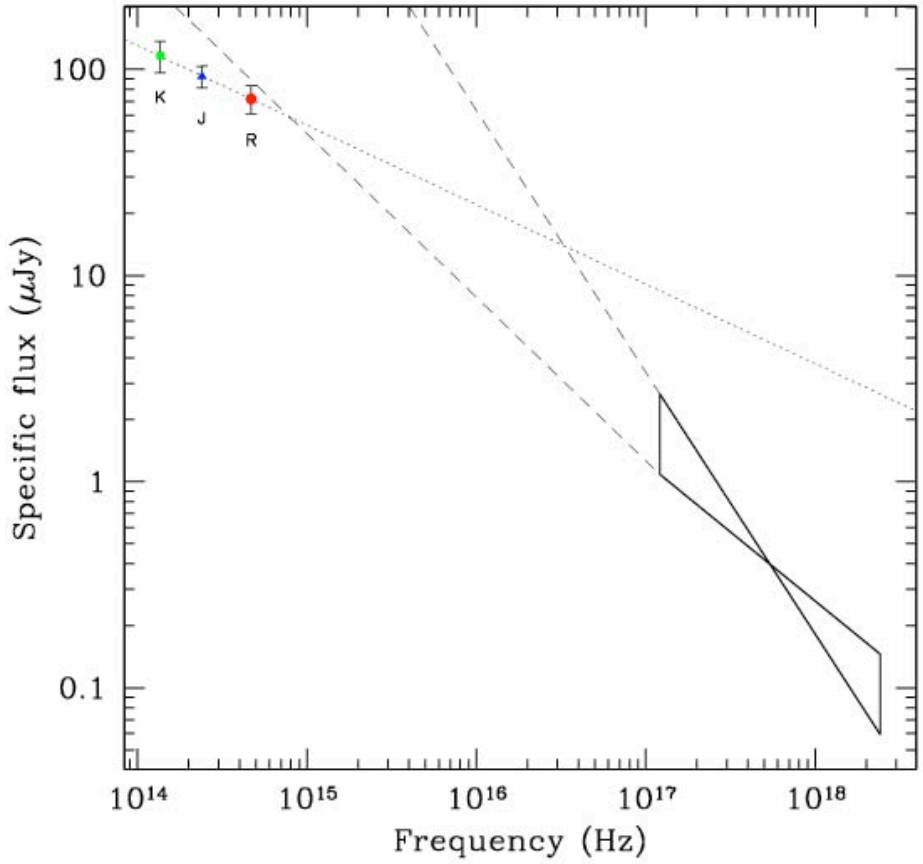
Only used times when pointing was stable and background was low.

520 counts in 3504 seconds.

# Spectrum


Counts s$^{-1}$ keV$^{-1}$
0.1
0.01
Ratio
0.5 1 1.5 2
0.2
0.5
1
2
5
Energy (keV)
$N_H = (1.5 \pm 0.5) \times 10^{21}$
_ = 2.02 ± 0.21 (90%)
_$^2$ / _ = 15.4 / 22
$F_x = 6.5 \times 10^{-12}$ (0.5-10 keV)
Γ
2.5
2
1.5
0
0.1
0.2
0.3
$N_H$ ($10^{22}$ cm$^{-2}$)

# Broad-band SED




(VLT observations from MISTICI collaboration)

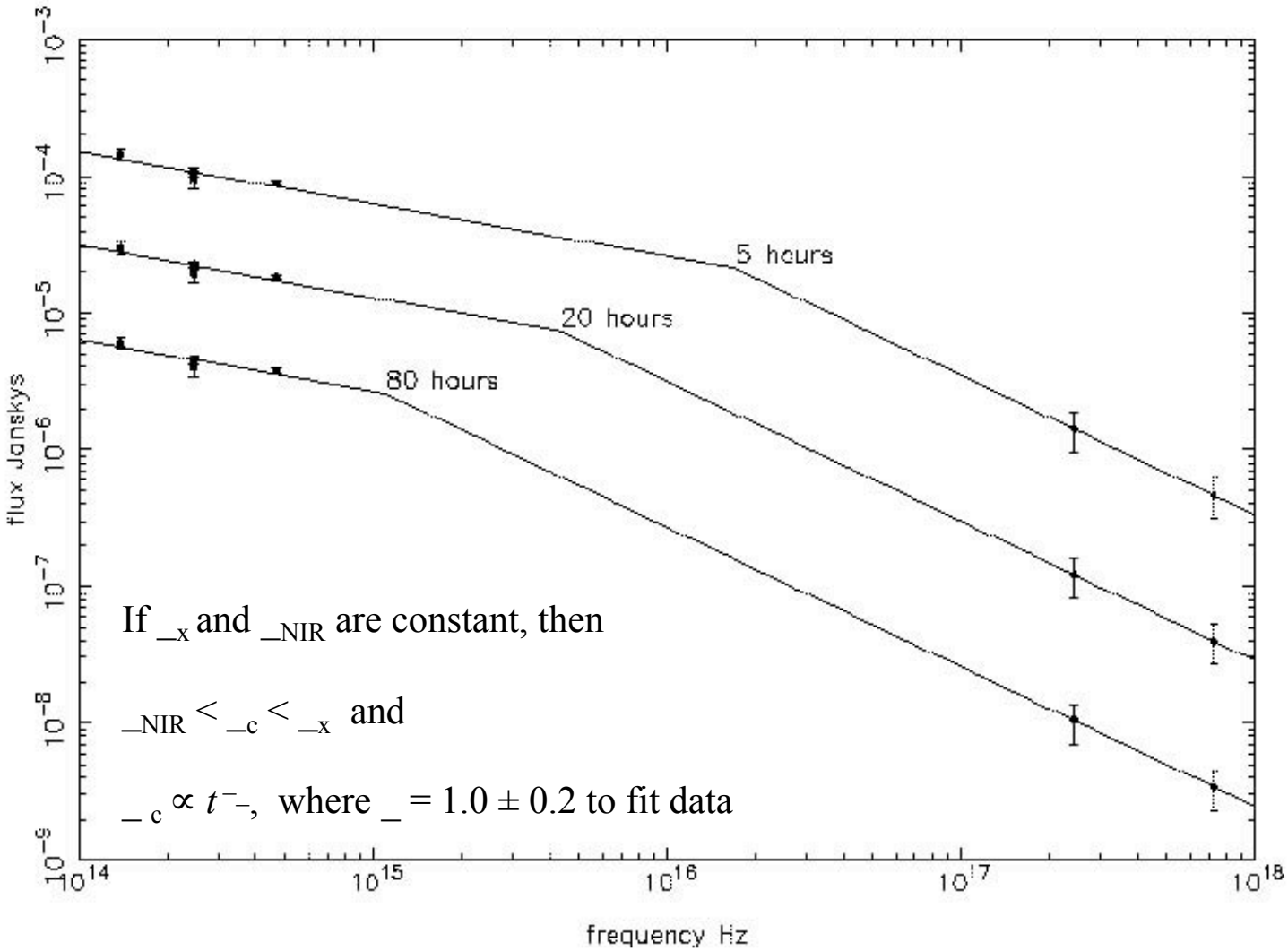
For $F_{\nu}(t) = t^{-\alpha}$ and $F(\nu) = \nu^{-\beta}$

| Band | $\alpha$ | $\beta$ | $t - t_0$ |
|---|---|---|---|
| *J* | 1.14 ± 0.08 | 0.40 ± 0.03 | 16 – 87 |
| 0.5-10 keV | 1.72 ± 0.20 | 1.02 ± 0.07 | 4.6 – 7.9 |

(68% confidence errors)

Spectral break suggests that cooling frequency lies between the X-ray and optical bands.

# Broad-band SED




If $\__x$ and $\__{NIR}$ are constant, then

$\__{NIR} < \__c < \__x$ and

$\__c \propto t^{-\_}$, where $\_ = 1.0 \pm 0.2$ to fit data

# Conclusions

- NIR and X-ray data are consistent with the following scenario:
  - Jet has two components: narrow component that produces X-rays and broader component that produces optical
  - Jet break of narrow component occurs before X-ray observations
  - Produces self-consistent model with electron power-law index of about 1.9 – 2.0

- XRT is working well and producing excellent data in spite of higher operating temperature
  - Images are spectacular
  - Spectroscopy is better than Chandra at beginning of GTO phase
  - Spectroscopy expected to remain better than ASCA over life
  - High resolution timing available (up to 140 microseconds)

# Co-Authors

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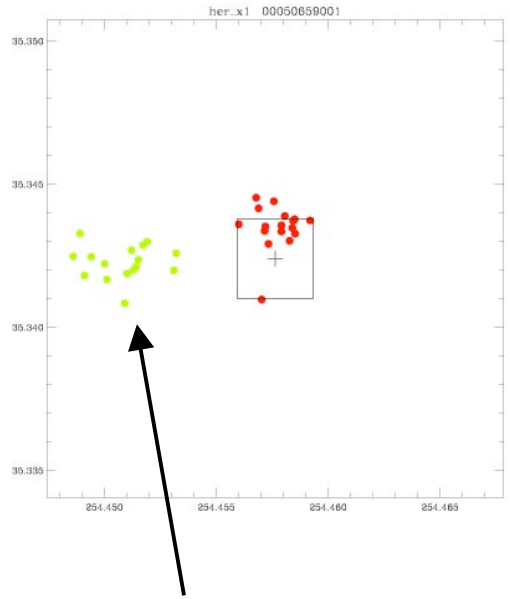
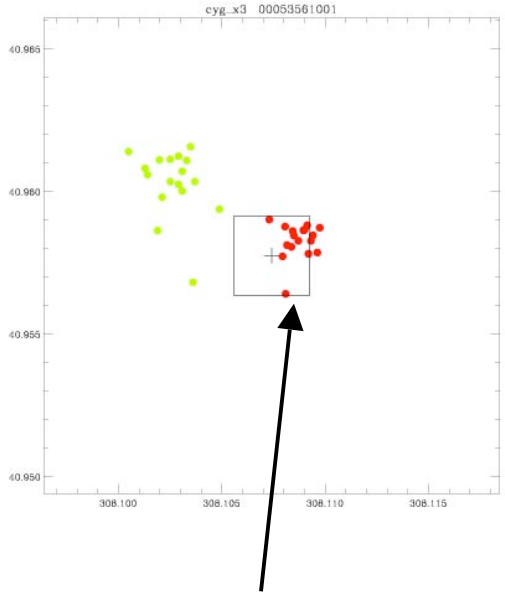
# Centroiding

Her X-1



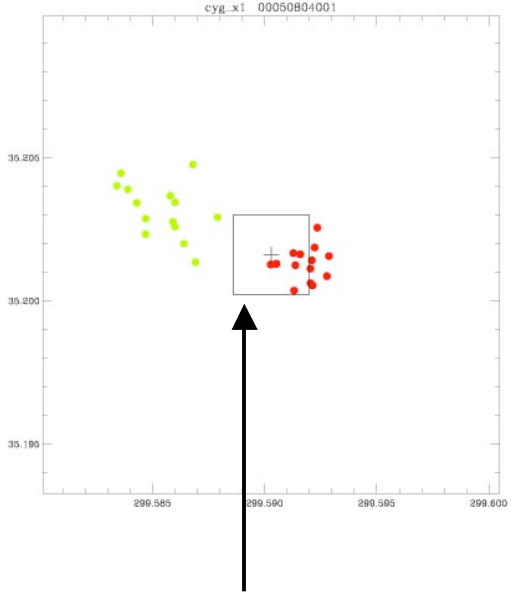

On-board calculation

Cyg X-3




Pipeline processing

Cyg X-1




10” x 10” box,
centered on source position