X-rays capabilities for GLAST

- **Which X-ray capabilities will better serve GLAST AGN science?**

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X-ray facilities

Table 1: Currently operating X-ray Telescopes

Name	Det.	FOV	Orbit	Energy Band	PSF/Ang res	Positional Acc.
Chandra	ACIS	17'x17'	High	0.3-10	1"	0.2"
XMM	EPIC	30'	High	0.4-10	6"	1.0"
Suzaku	XIS	18'x18'	Low	0.3-12	$< 1.5'$	
	HXD	4.5x4.5deg		100-600		
		34'x34'		10-100		
Swift	XRT	23.6'x23.6'	Low	0.3-10	18"	3-5"
	BAT	2sr		15-150	17'	4'
RXTE	PCA	1 deg	Low	2-100	1 deg	
	ASM			2-10		

Sensitivities (eff. area)

- @ 1.5 keV:

  EPIC pn: 1304 cm^2

  ACIS FI: 525

  XIS : 1600

  XRT : 135

  RXTE : - 1300 cm^2 @ 6 keV

  XIS: 1000
- Background an issue for RXTE and EPIC

Flexibility of scheduling

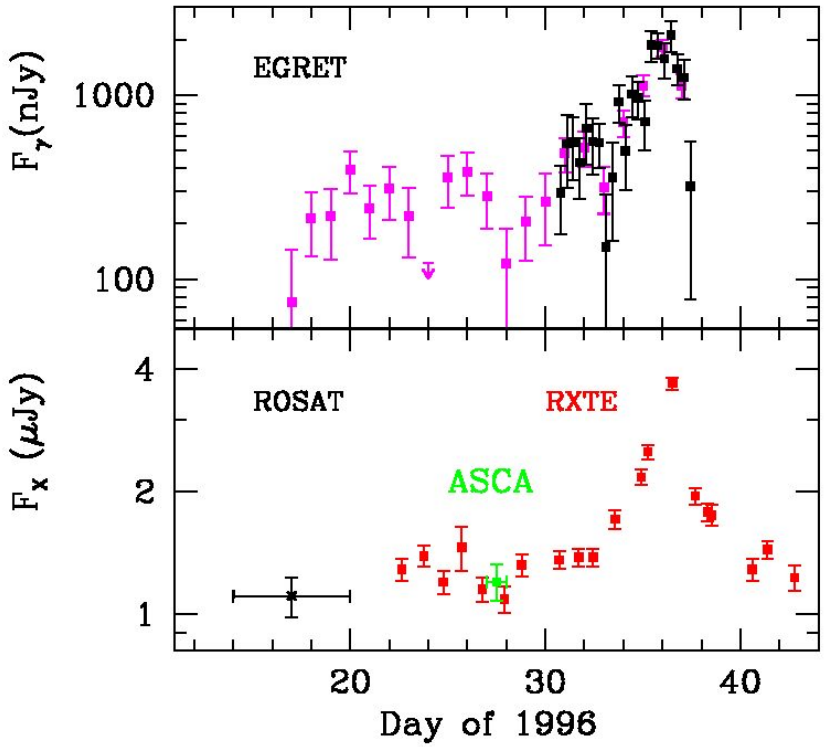
1. How *fast* can a ToO be triggered?
2. How *long* to slew to new position?
3. For how long can the X-ray obs be *continuous*?

RXTE (still alive in 2008?)

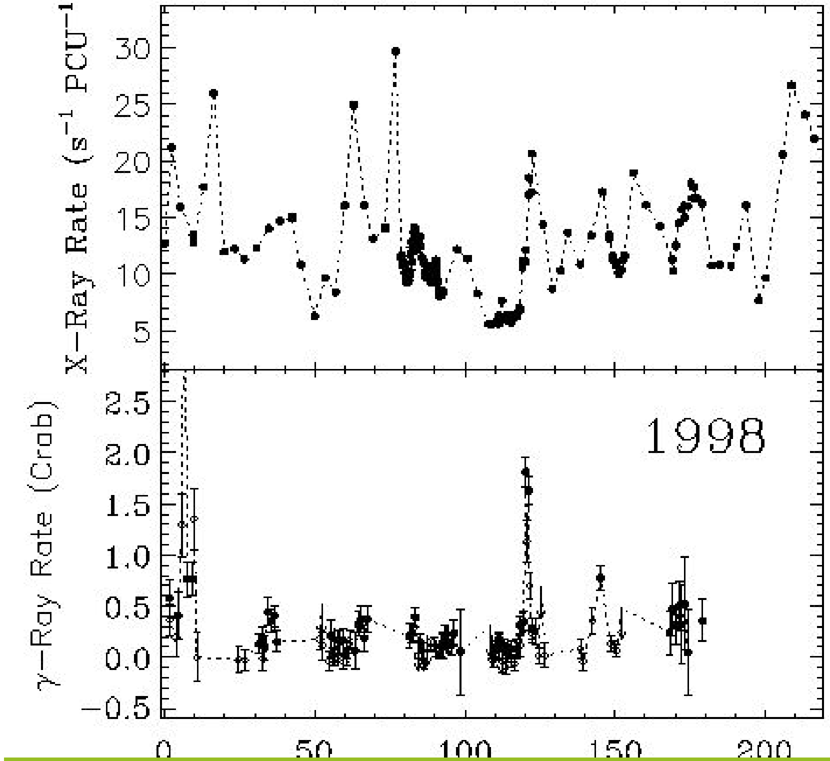
- Typically 0.5 days to go into queue, 1 day worst case
- Slew time is 6 deg/minute
- Orbit = 5480 sec

  15 orbits per day

  2/3 orbits go through SAA



Wehrle et al. 1998



Gliozzi et al. 2006

Suzaku

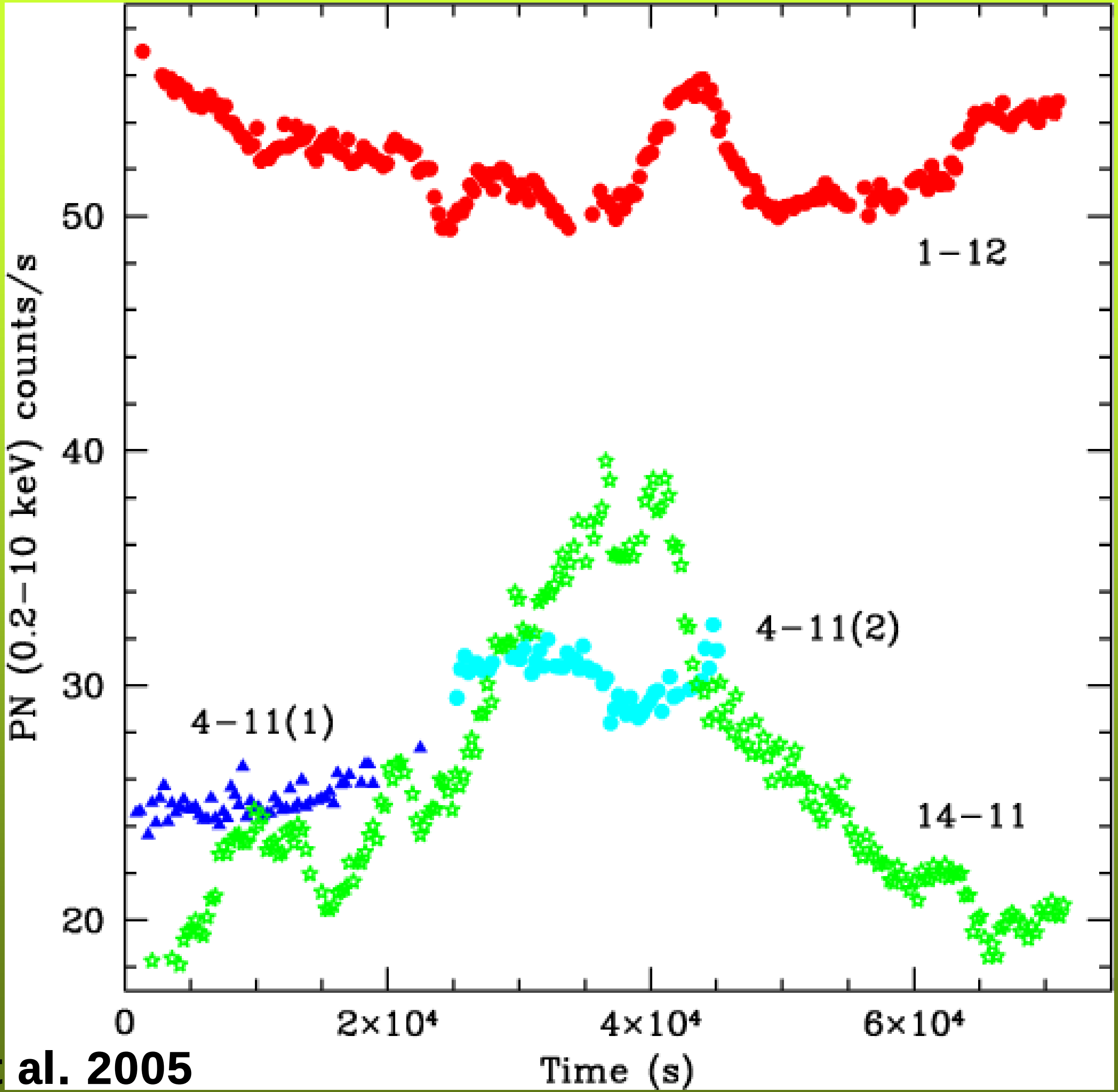
- MINIMUM time is few days (approval + manual queue)
- Slew time depends on next TDRAS contact
- 15 orbits per day, 10 through SAA
- Maximum continuous time 0.5 days, more typically 60 min off, 35 min off

Swift

- Trigger time is fast, < 1 hour
- Slew time ~ minutes
- Low-orbit; same as XIS

Chandra and XMM

- High orbits → more continuous exposure
- ACIS: spectral degradation for bright sources (as GLAST blazars)
- EPIC: episodes of flaring background
- Both oversubscribed but not impossible



Ravasio et al. 2005

Summary Flexibility

- RXTE: great flexibility of scheduling, rapid response, limited sensitivity at lower energies
- Suzaku: great sensitivity, slower response
- Swift XRT: great flexibility, good sensitivity, also UVOT

Situations

1. **Flaring AGN during survey mode**
2. **X-ray counterparts of survey sources**
3. **Multiwavelength campaigns**

GLAST constraints

From Multiv. Report:

- Source detection: limited by number of photons
- Localization: 1’ bright, 10’ weak
- Flaring info takes 0.5 days to reach ground

1. X-ray follow-up of flaring AGN

- Flexibility of scheduling and rapid response: RXTE, Swift

- Question: *Swift response is currently limited by GRB occurrence. Can Swift be dedicated to GLAST follow-ups after 2008?*

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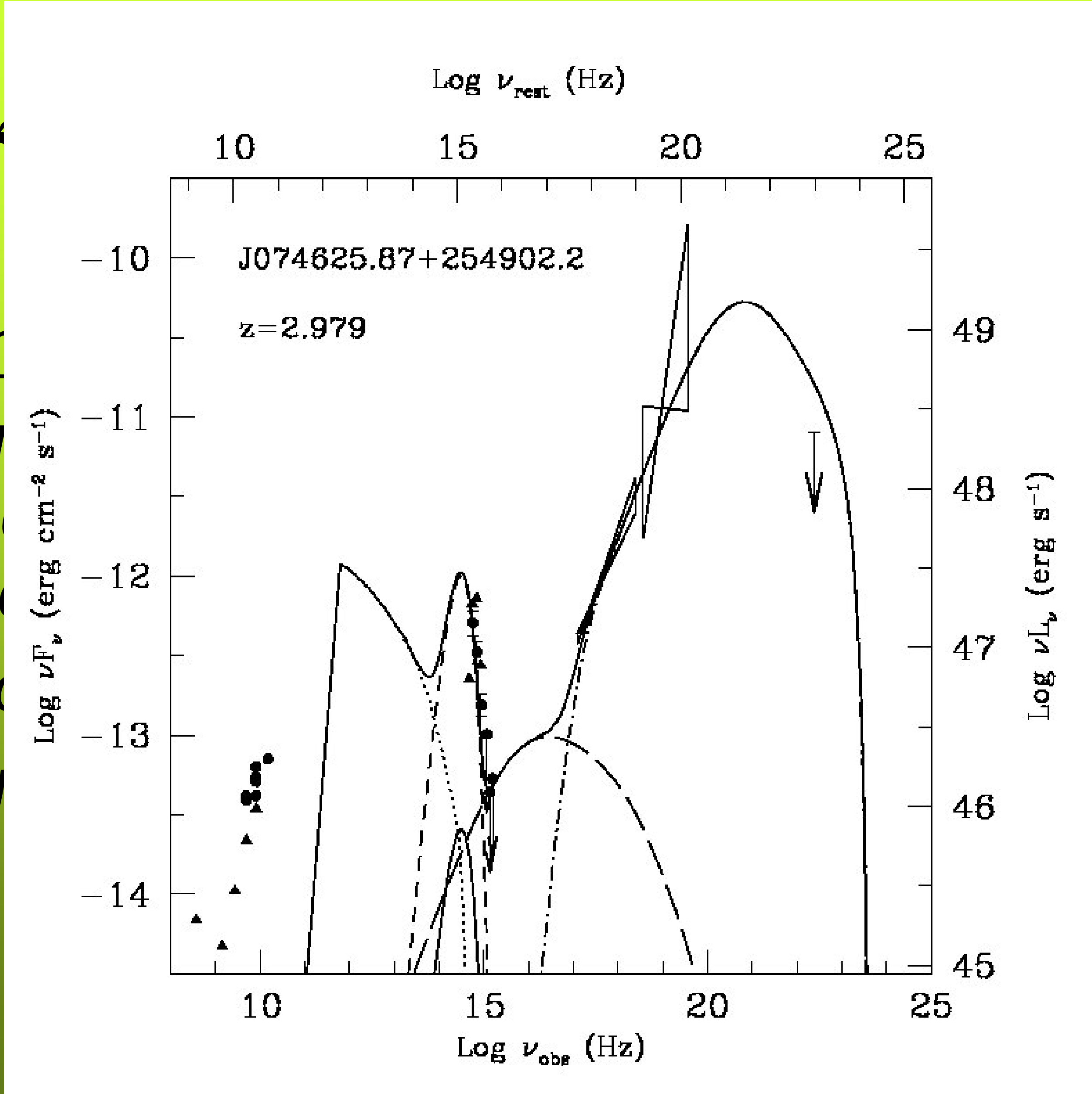


X-ray survey

- <u>Chandra ACIS</u>

  + best angular resolution

  + best astrometry

  - limited FOV

  - pileup threshold is low (~10^{-12} cgs)

How X-ray bright will be (most of) the GLAST AGN?

1.5 Ms ACIS exposure of Hubble Deep Field North

Bauer et al. 2004:

For flux limit 2×10^{-16} cgs in 2-8 keV:

- 5 sources in 1’, 471 in 10’
- 4 to 408 AGN

For fainter sources must have radio and optical as well!

X-ray survey

- XMM EPIC

+ large FOV
+ high pileup threshold
+ more sensitivity in same exposure

- lower angular resolution
- flaring background

Choice Chandra/XMM is tradeoff resolution/FoV

100 ks XMM observation of Lockman hole

Hasinger et al. 2001:

For flux limit 1.4×10^{-15} cgs in 2-10 keV:

- Expect 1-122 sources in LAT error circle

Summary

- Choice of Chandra or XMM depends on angular resolution, FOV needed

- Questions:

- When start applying for time?
- How many GLAST fields? All-sky?
- Simultaneity? Desirable but difficult

3. Multiwavelength campaigns

Strictly contingent upon science goals:

- Follow a flare: max coverage needed

  Chandra, XMM best

  Swift ?

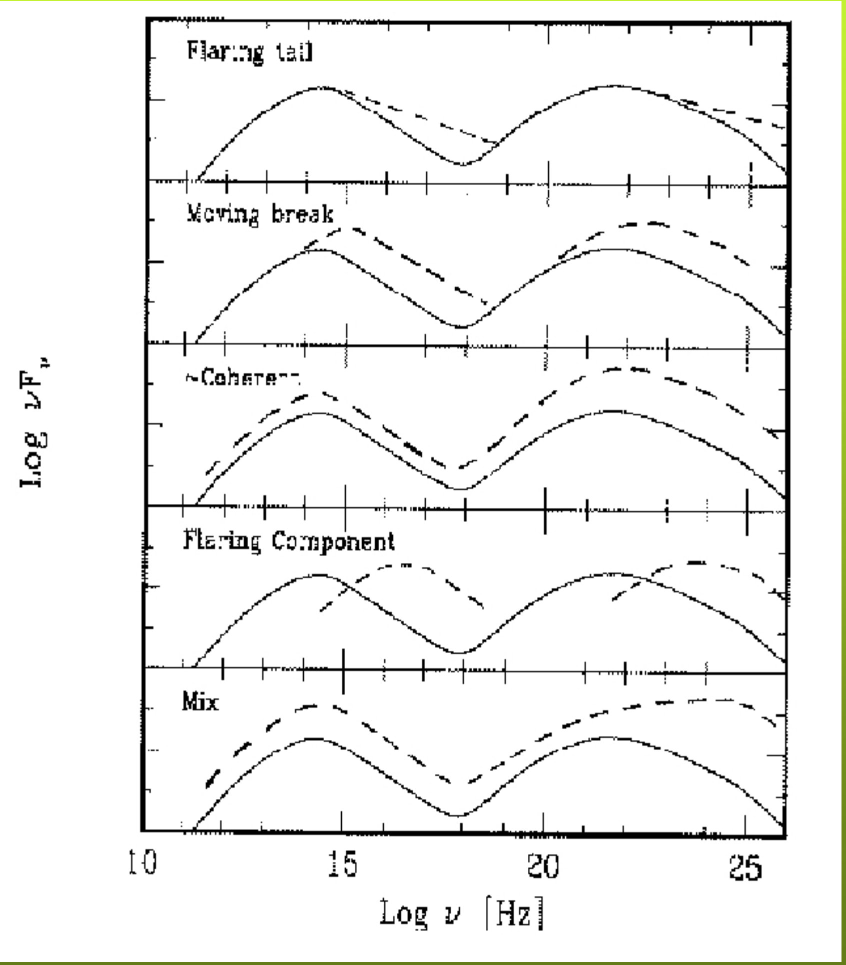
  RXTE (?)

- Snapshot SEDs:

  Suzaku (XIS + HXD), Swift

Which λ to trigger ToO?

- For blazars, trigger could come from any wavelength
- Usually, IR-optical and X-ray-TeV
- Given the survey mode, it is more likely that the trigger will come from GLAST!

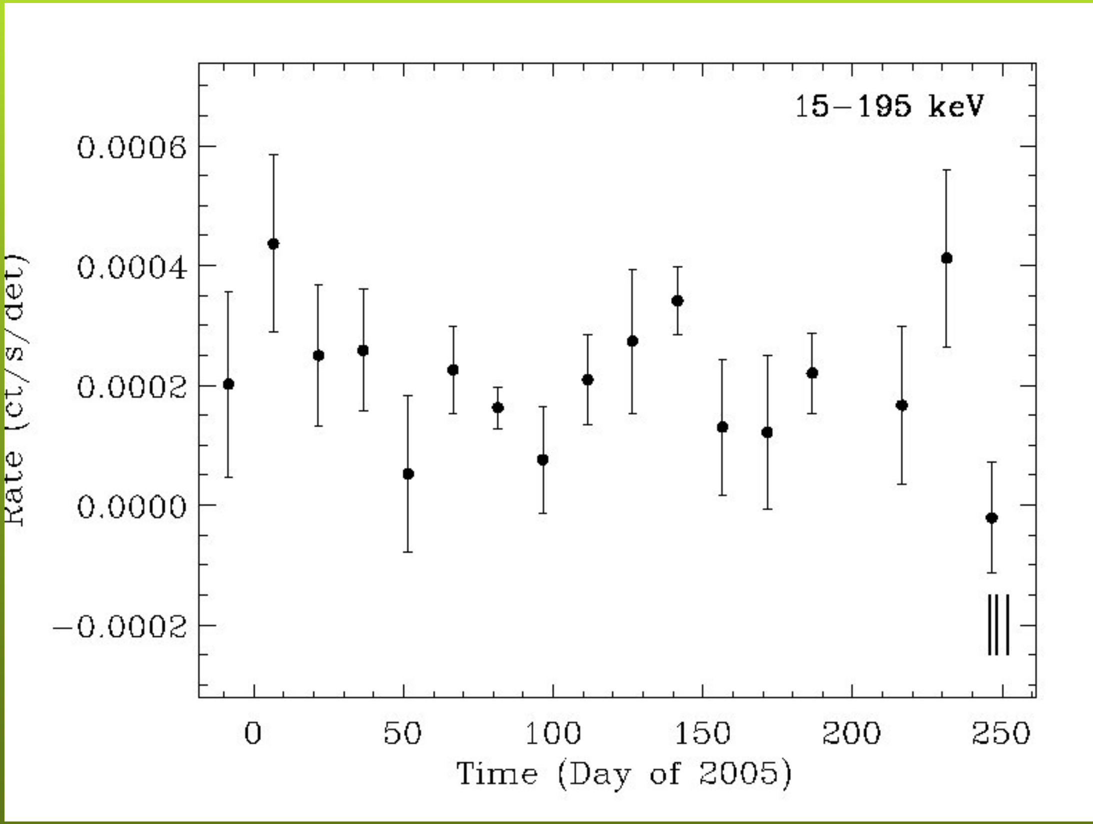


Ghisellini 1999

X-ray All-sky monitoring

- Both ASM and BAT have limited sensitivities (>10^{-11} cgs)

BAT light curve of J0746 (F~10^{-10} cgs)



Conclusions

- Likely, the best GLAST science will be served by as many X-ray observatories as possible with complementary capabilities and observing constraints (duh!)
- All-sky X-ray monitoring for trigger: bleak