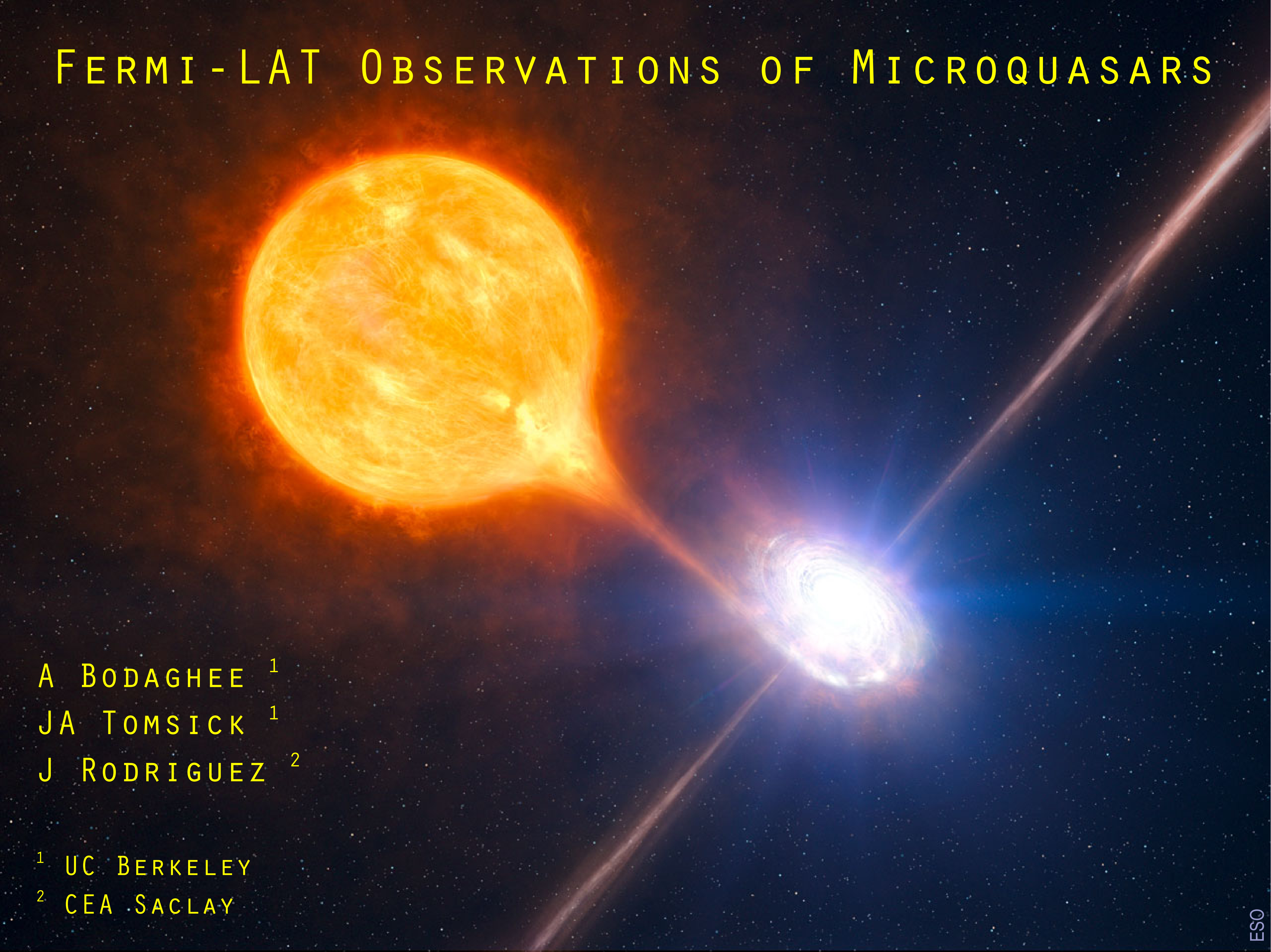
Fermi-LAT Observations of Microquasars



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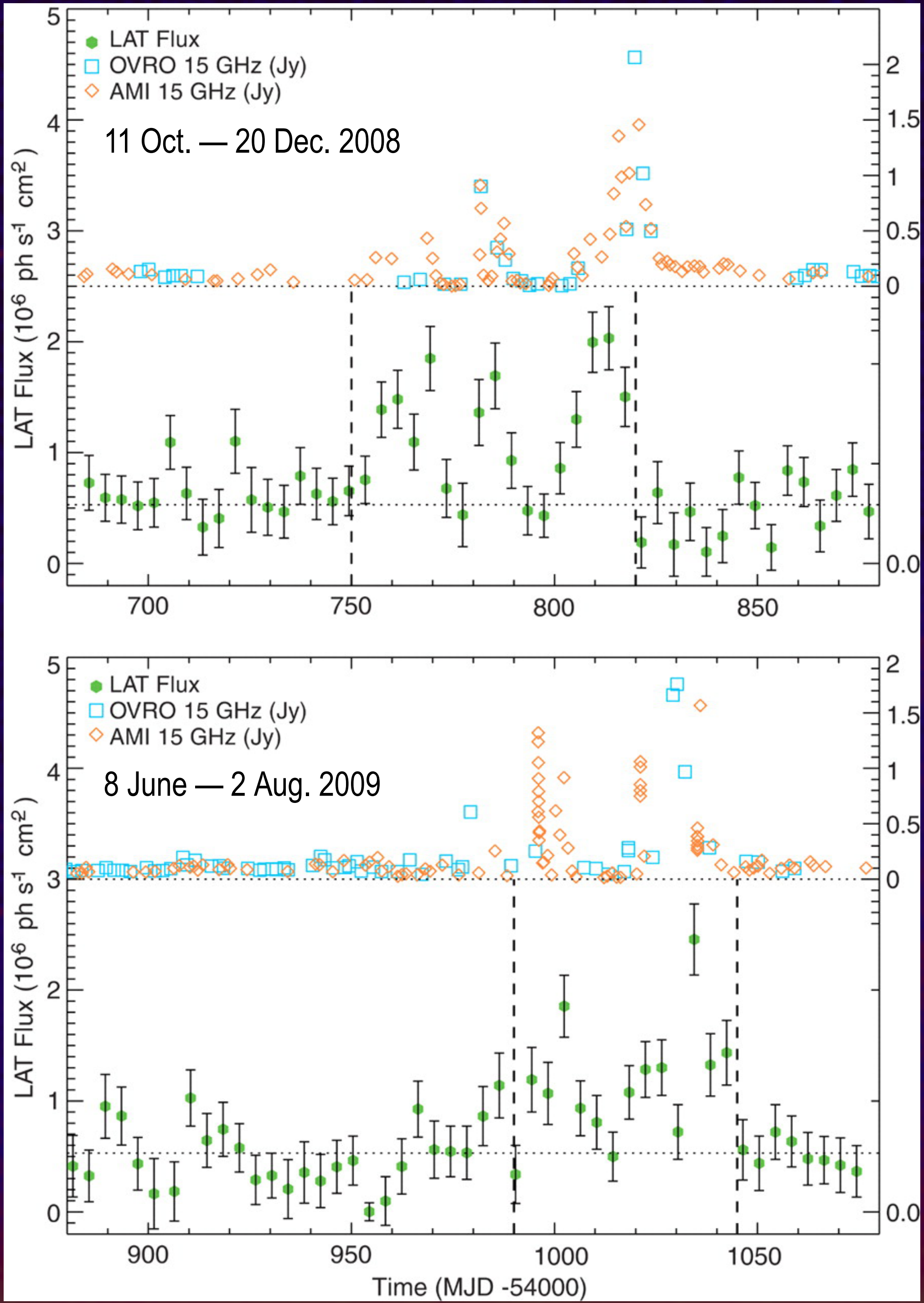
JA Tomsick [1]
J Rodriguez [2]

[1] UC Berkeley
[2] CEA Saclay

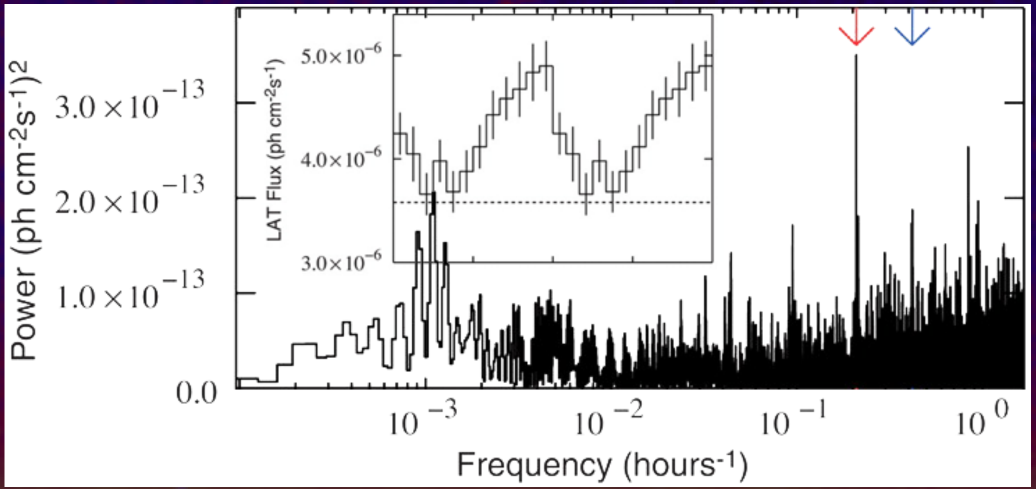
Cygnus X-3: the first gamma-ray microquasar



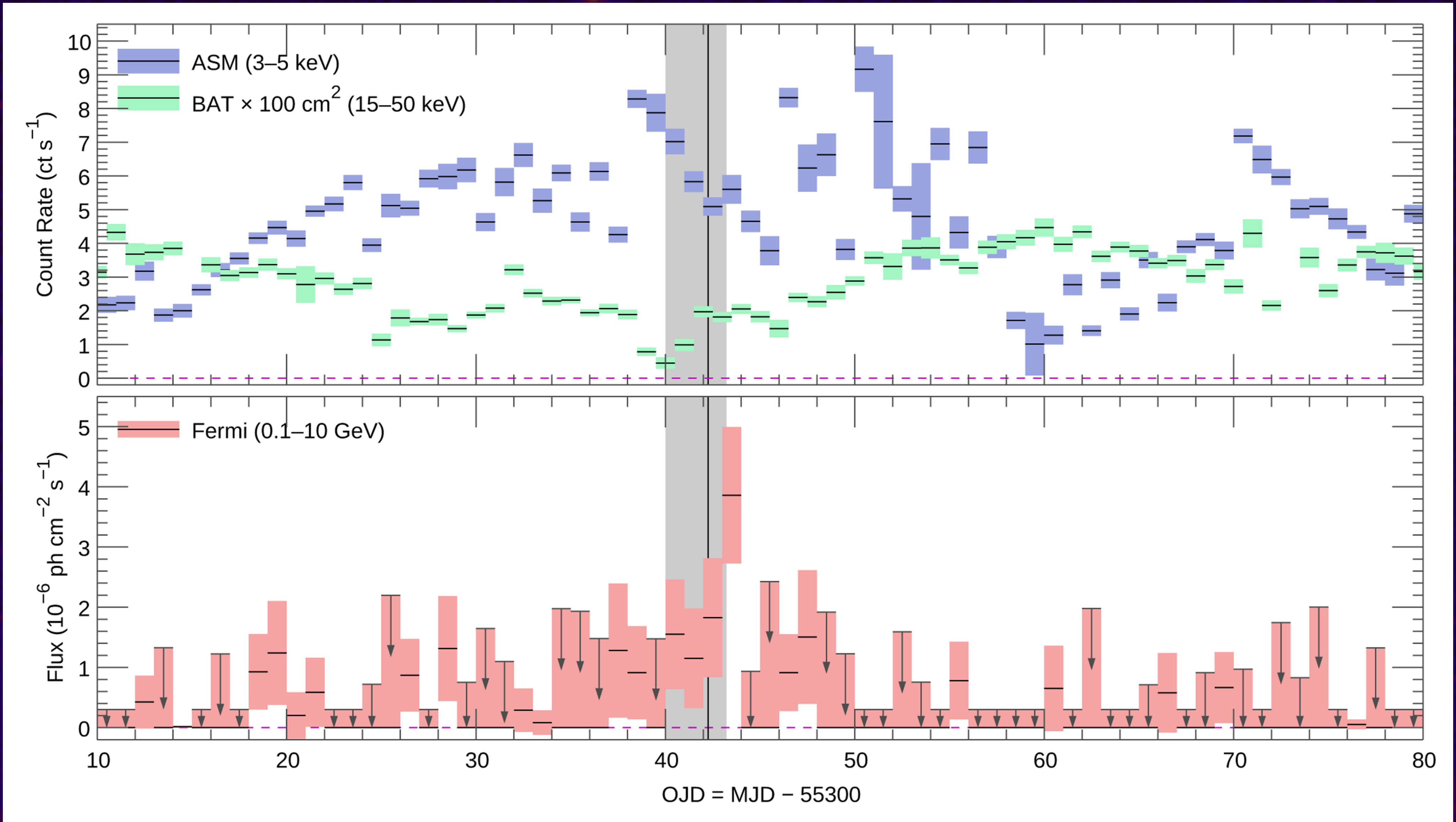
Fermi-LAT collab. (S. Corbel) 2009 Science 326 1512

sequence: gamma-rays then radio (lag: 5±7 days)

⇒ likely mechanism, IC:
UV photons from WR star upscatter
off of relativistic electrons in the jet



Cygnus X-3: gamma-ray flare of May 2010



AGILE: Bulgarelli et al. 2010 ATel 2609, 2645
Fermi: Corbel et al. 2010 ATel 2611, 2646

Williams et al. 2011 ApJL 733 20

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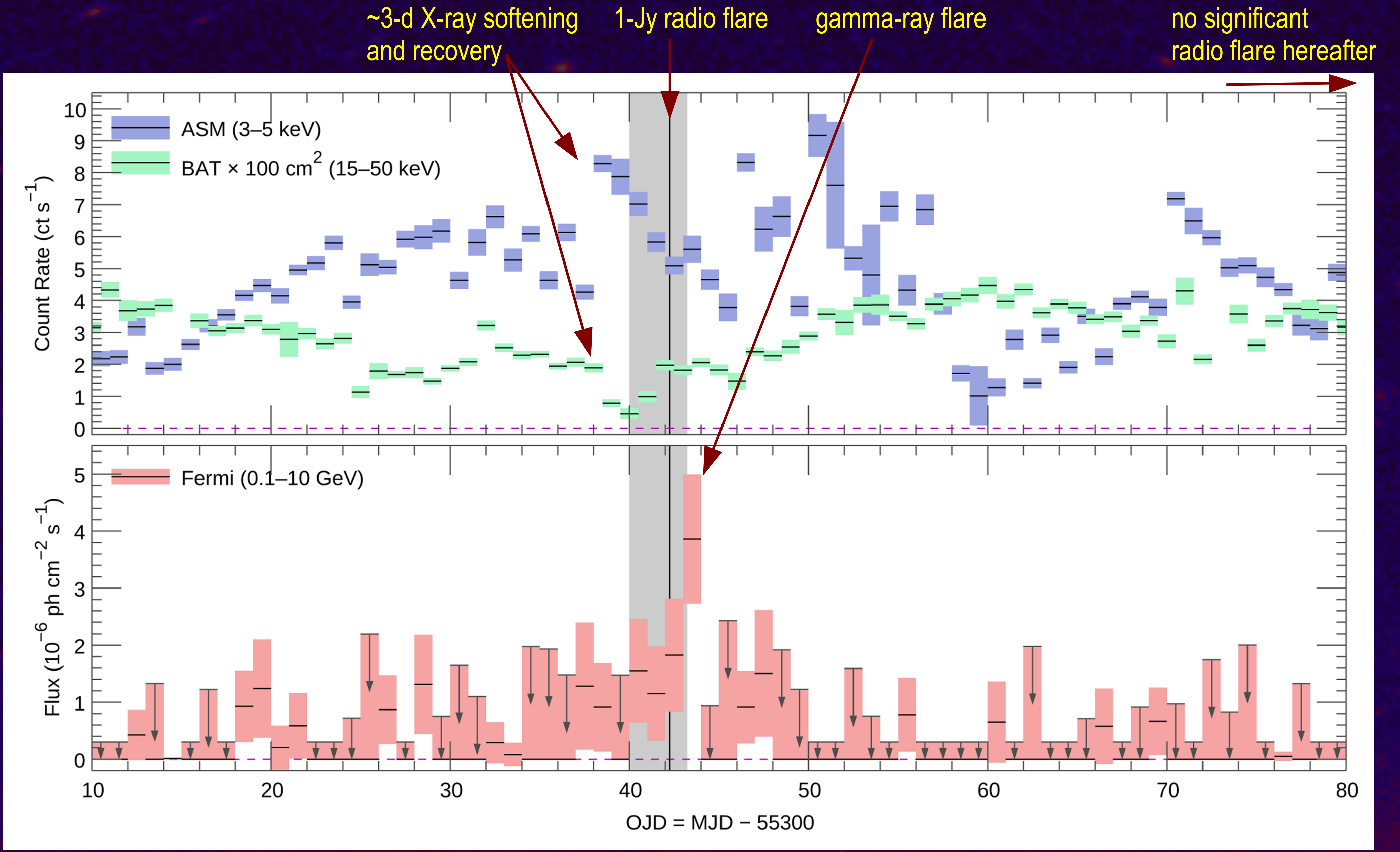
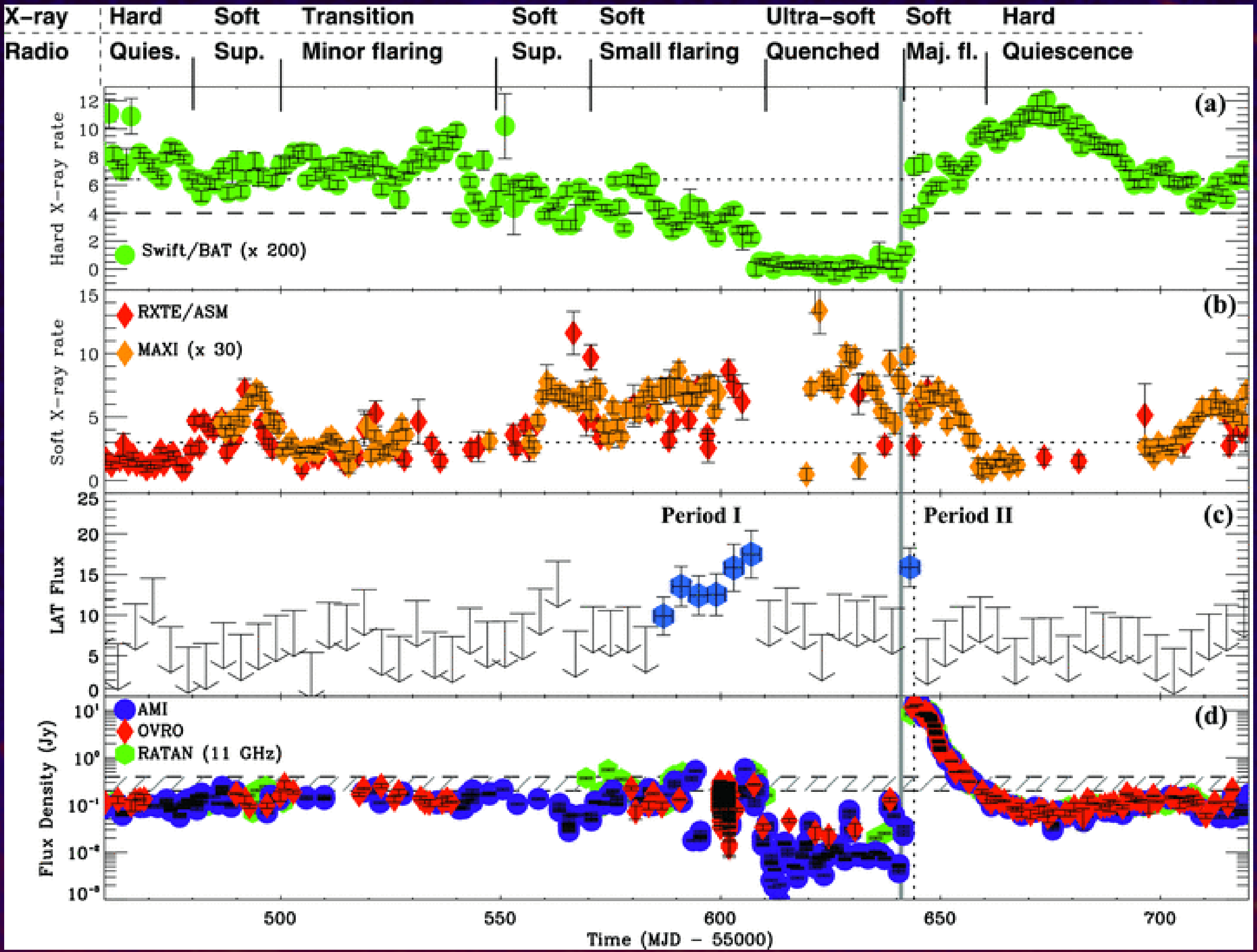


radio flare precedes gamma-ray emission: IC probably not the only mechanism

... could be ejection event w/ shock and/or hadronic processes: $p + \gamma \rightarrow \pi^0 + \ldots \rightarrow 2\gamma$

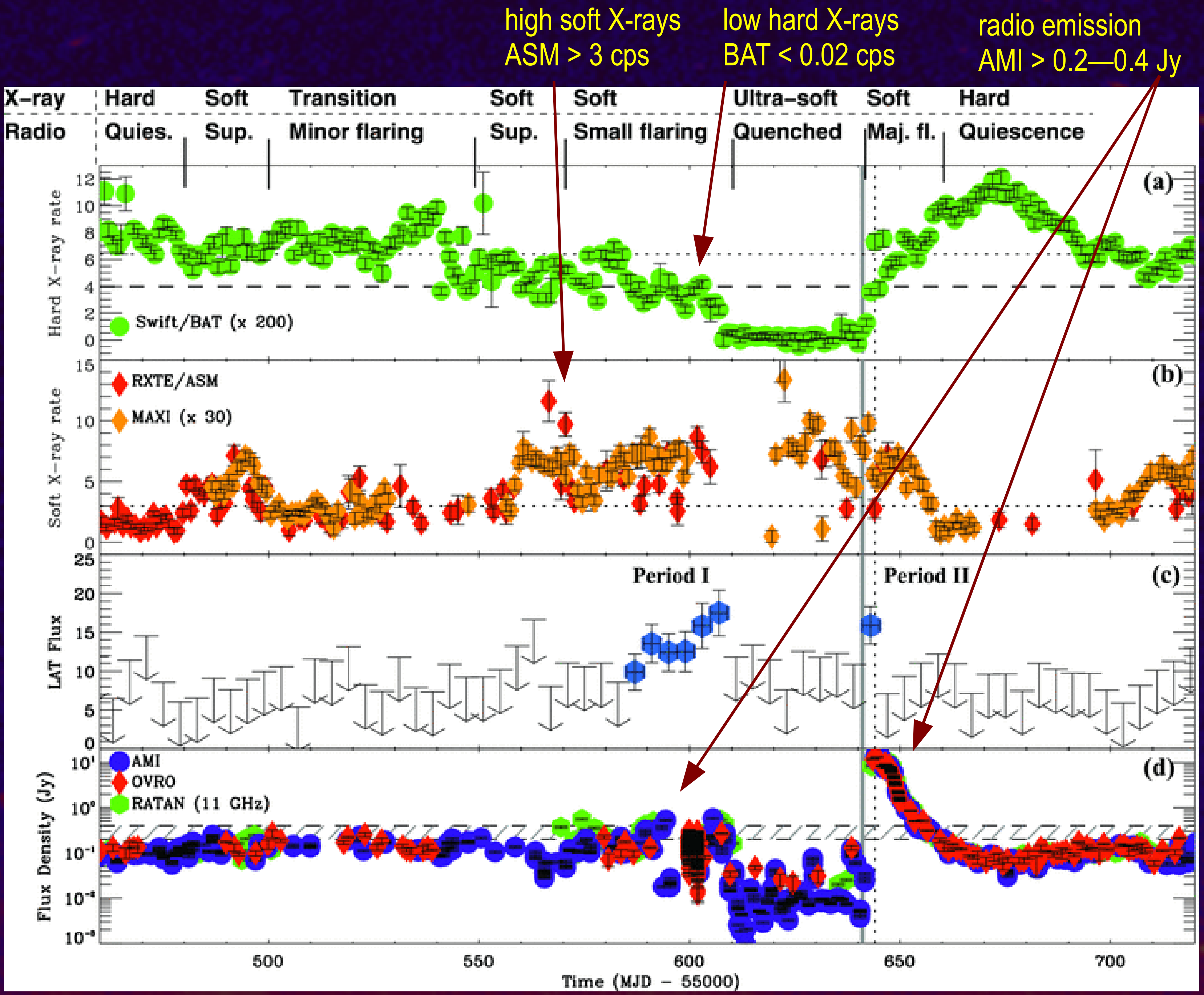
Williams et al. 2011 ApJL 733 20

Cygnus X-3: gamma-ray flare of March 2011



Corbel et al. 2012 MNRAS 421 2947

Cygnus X-3: gamma-ray flare of March 2011



Corbel et al. 2012 MNRAS 421 2947

Fermi-LAT observations of microquasars

100 MeV – 10 GeV
all data within 20° of each target (p7v9r27)
from aug 2008 until may 2012

timescale: 0.1, 1, and 10 days
spectral model: 2FGL (+diffuse emission) refined with binned likelihood analysis of full data set

1) wide-aperture unbinned likelihood analysis ⟶ Test Statistic (TS)
2) aperture-restricted event weighting ⟶ Probability (P)

name	type	l	b	Po (days)
4U 1630–47	LMXB	336.9	+0.3	---
4U 1957+11	LMXB	51.3	–9.3	0.38823(2)
Cygnus X-1	HMXB	71.3	+3.1	5.6008(7)
Cygnus X-3	HMXB	79.8	+0.7	0.1996907(7)
GRO J1655–40	LMXB	355.0	+2.5	2.621(7)
GRS 1758–258	LMXB	4.5	–1.4	18.973(7)
GRS 1915+105	LMXB	45.4	–0.2	33.5(1.5)
GX 339–4	LMXB	338.9	–4.3	1.7563(3)
LS I+61 303	HMXB	135.6	+1.1	26.496(3)
SAX J1819.3–2525	HMXB	6.8	–4.8	2.8019(2)
SS 433	HMXB	39.7	–2.2	13.080(3)
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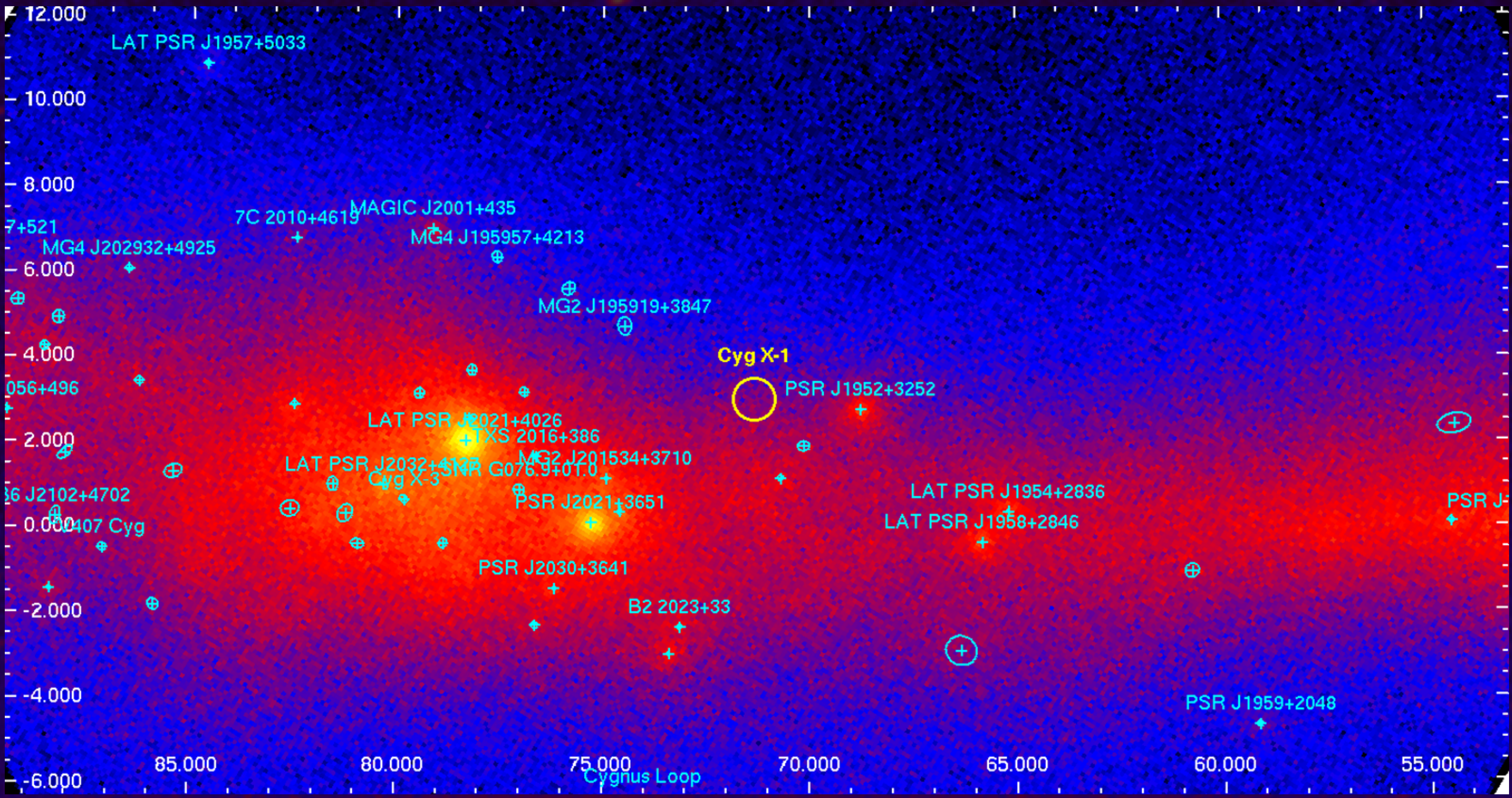
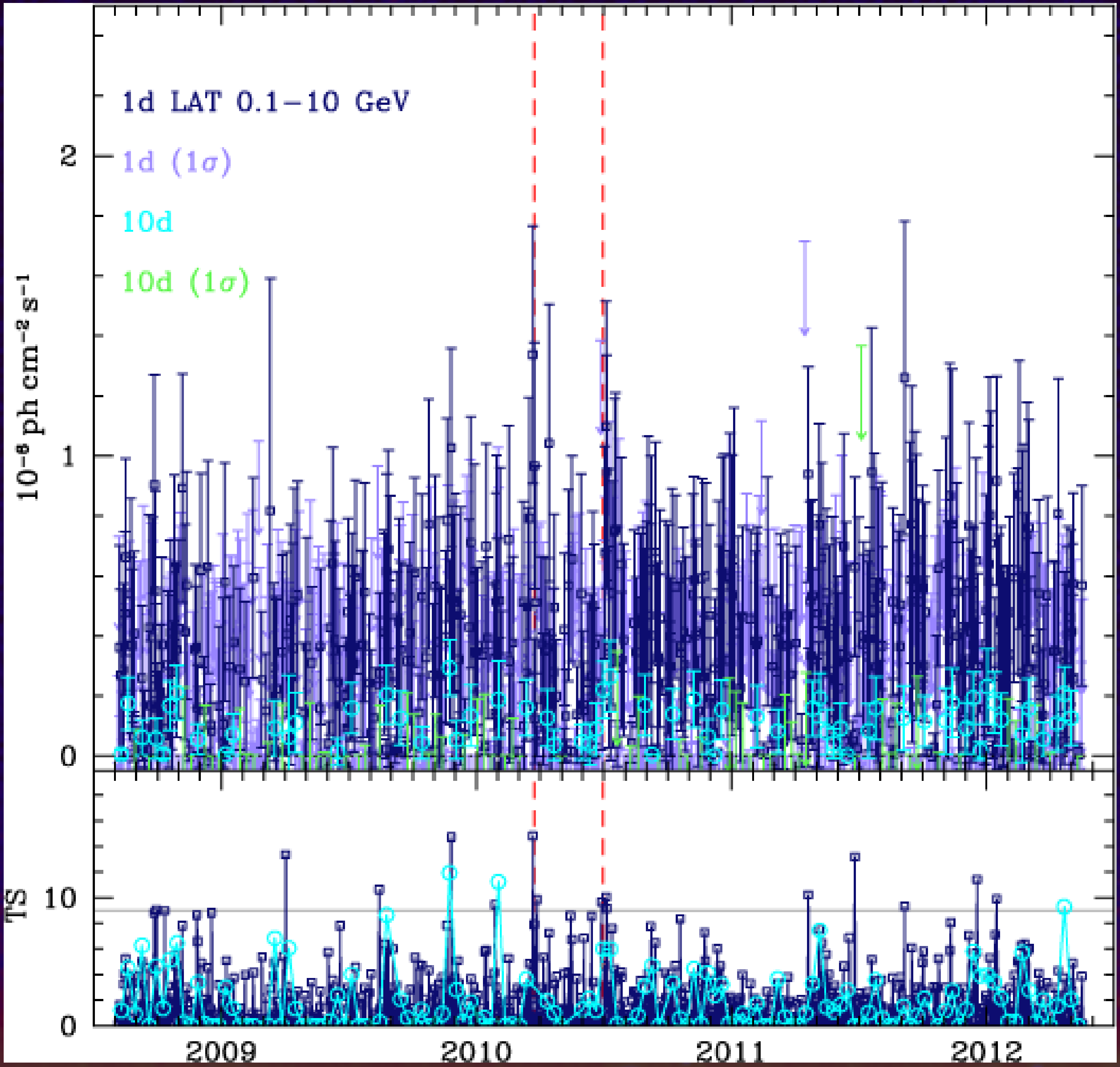
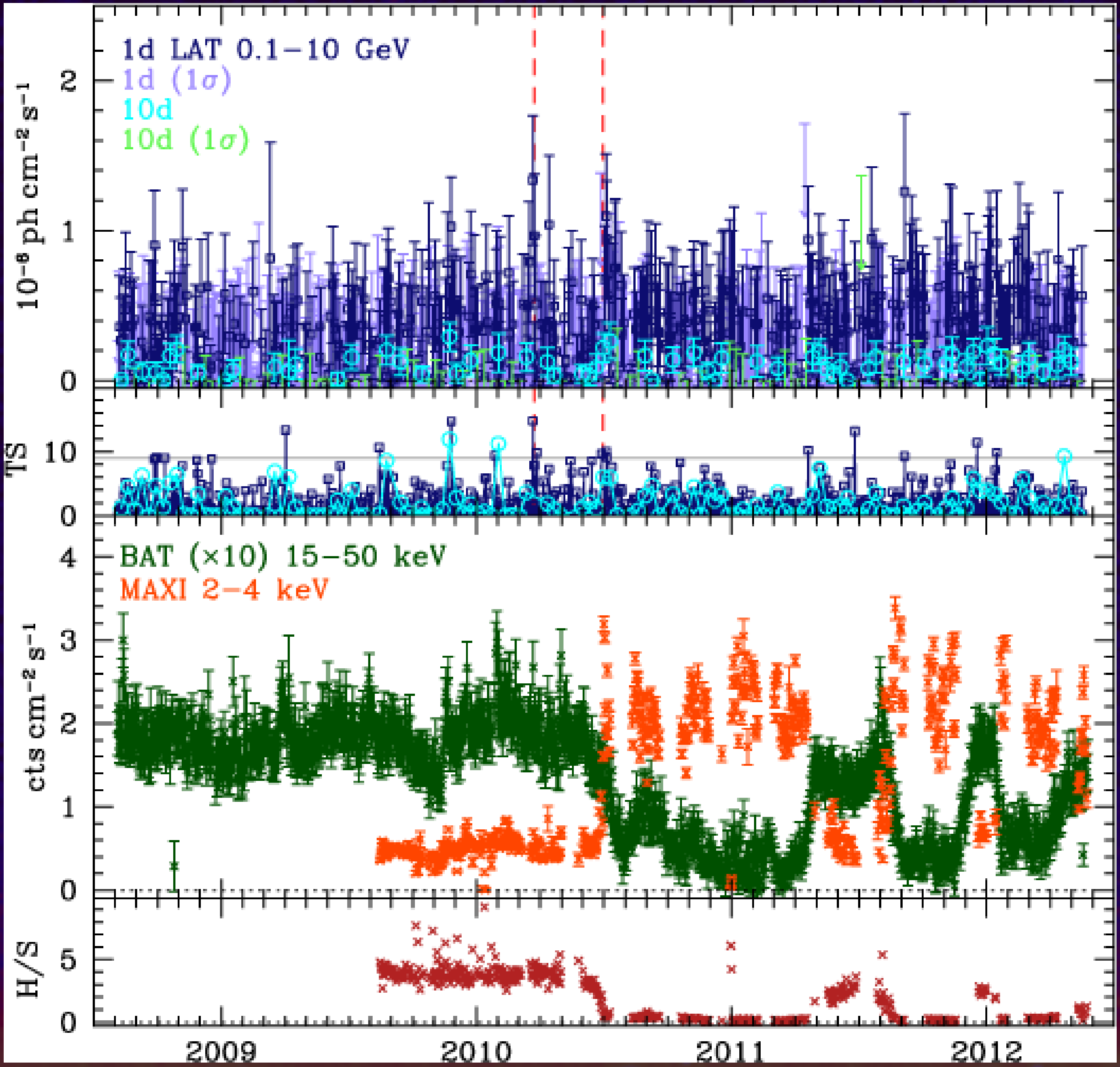
Cygnus X-1: photon counts map (0.1–10 GeV)



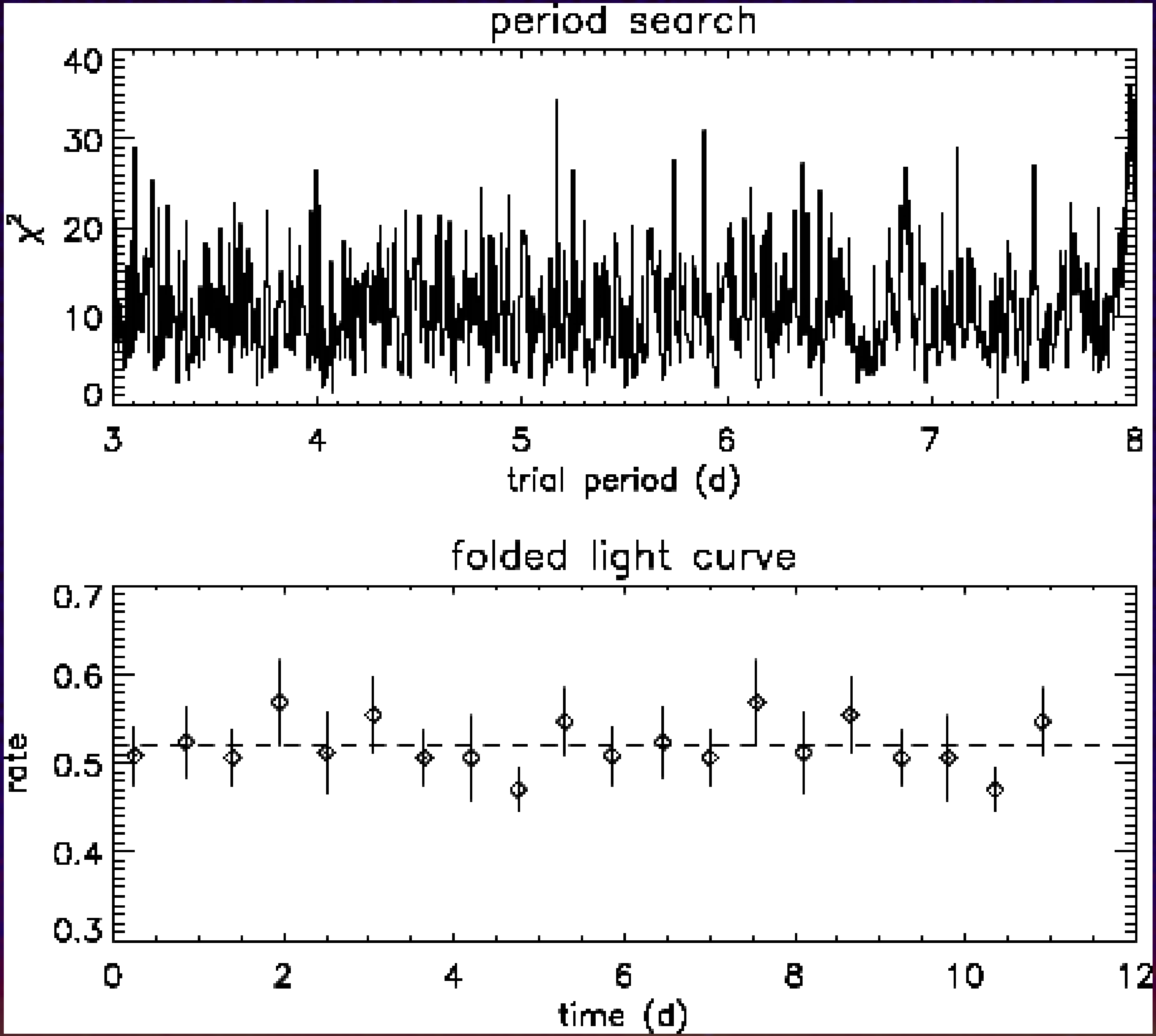
Cygnus X-1: gamma-ray light curve



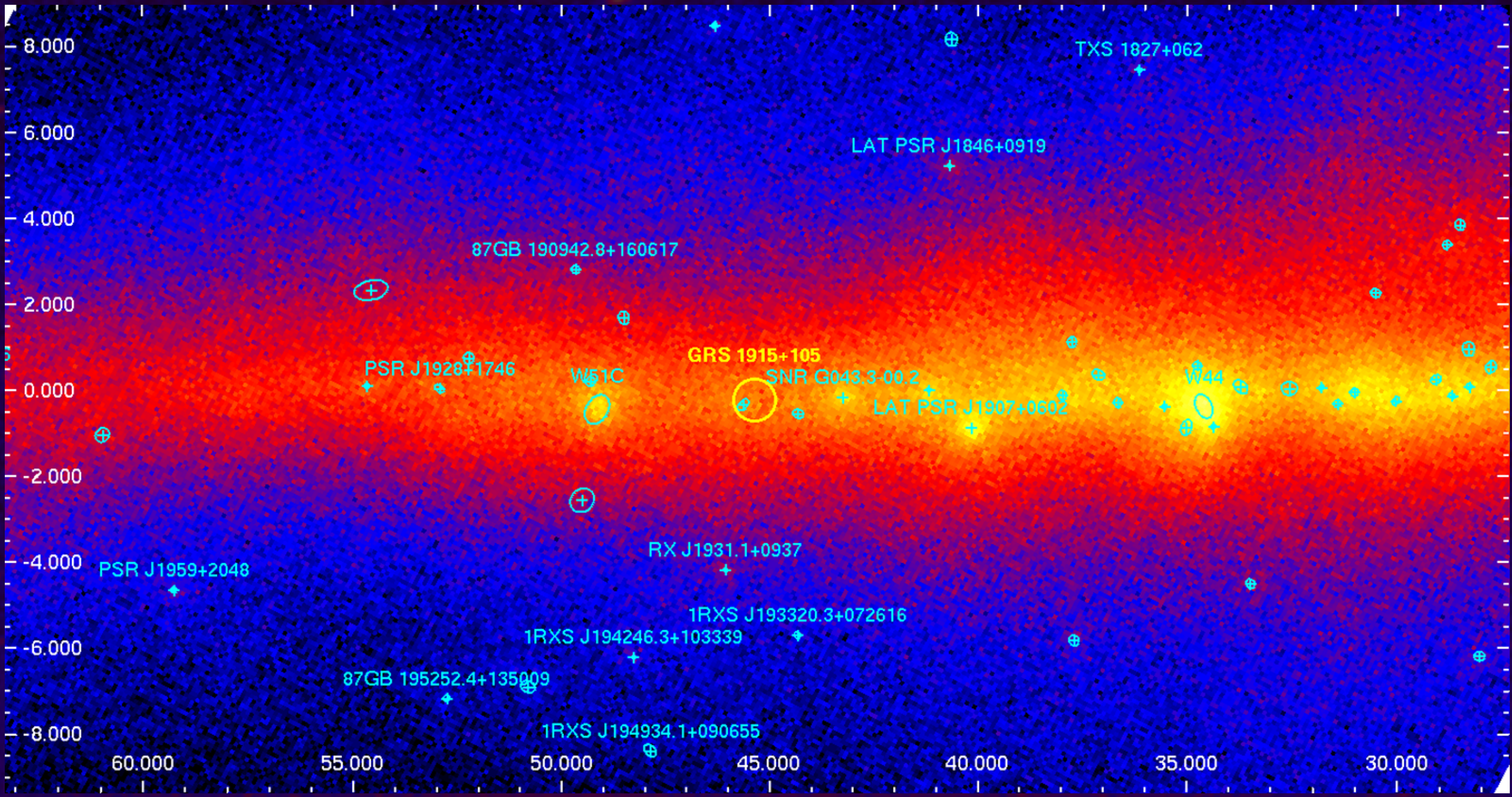
Cygnus X-1: X-ray/gamma-ray light curve



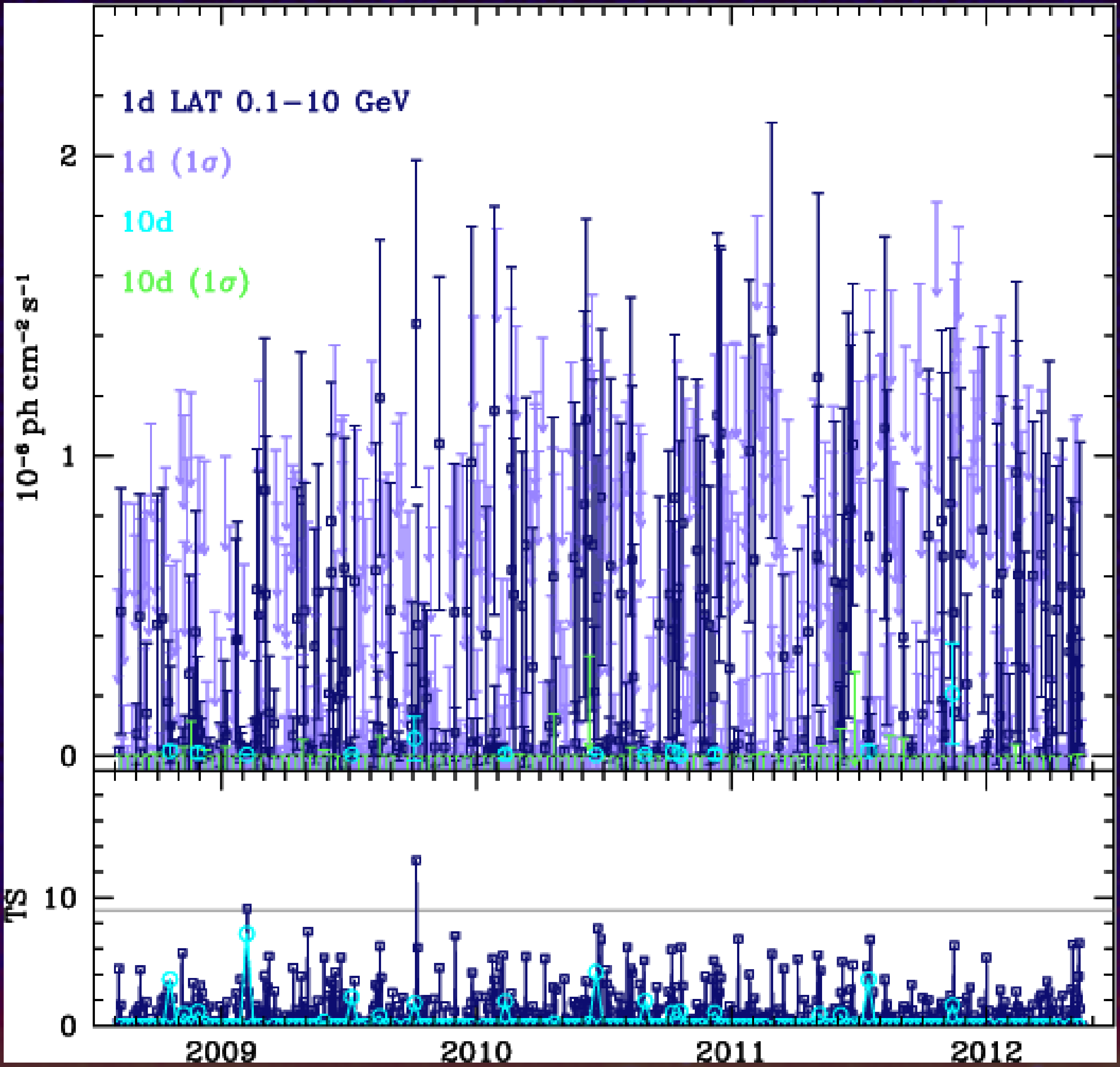
Cygnus X-1: gamma-ray periodicity search (P_0 = 5.6 d)



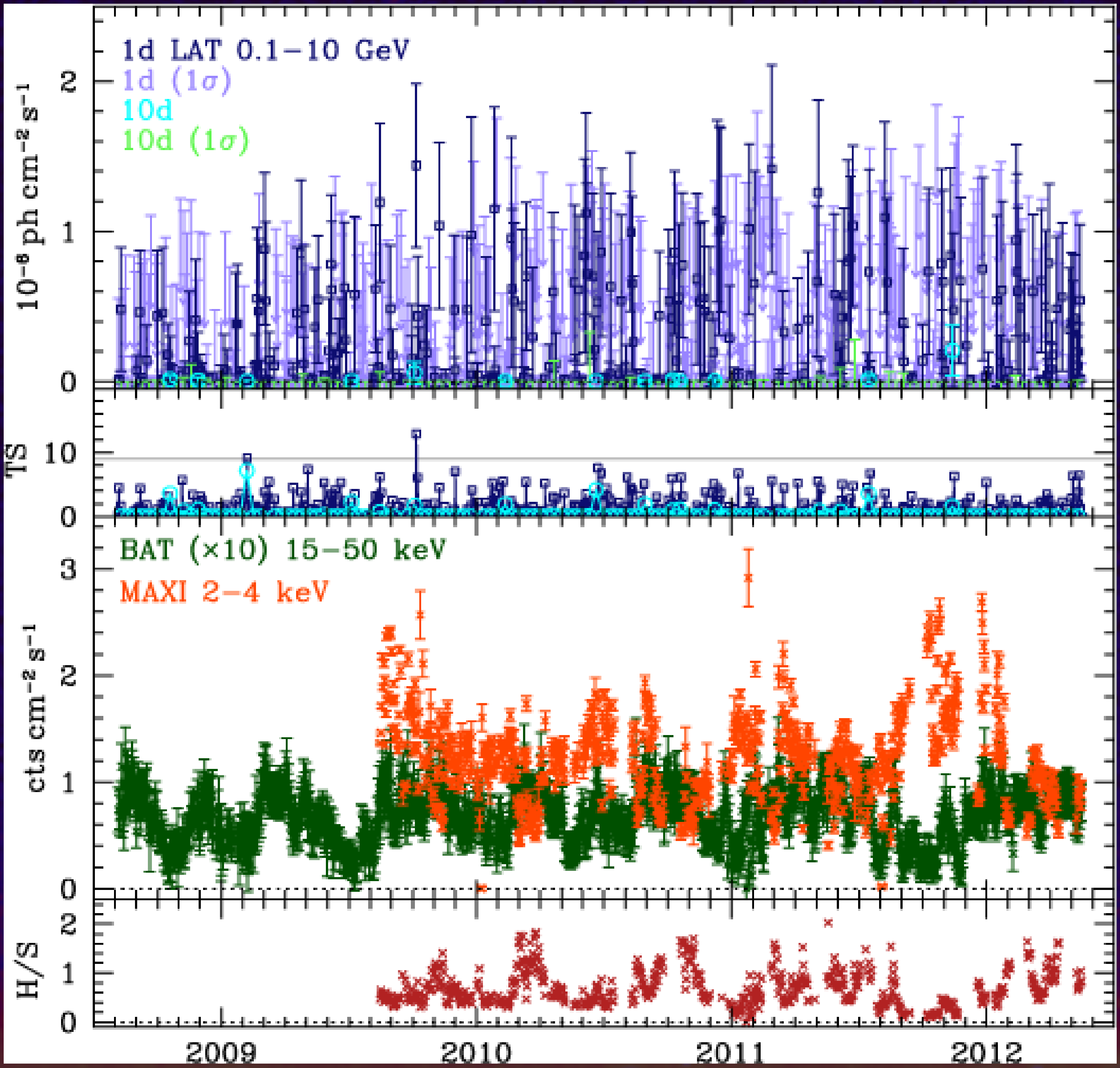
GRS 1915+105: Photon counts map (0.1–10 GeV)



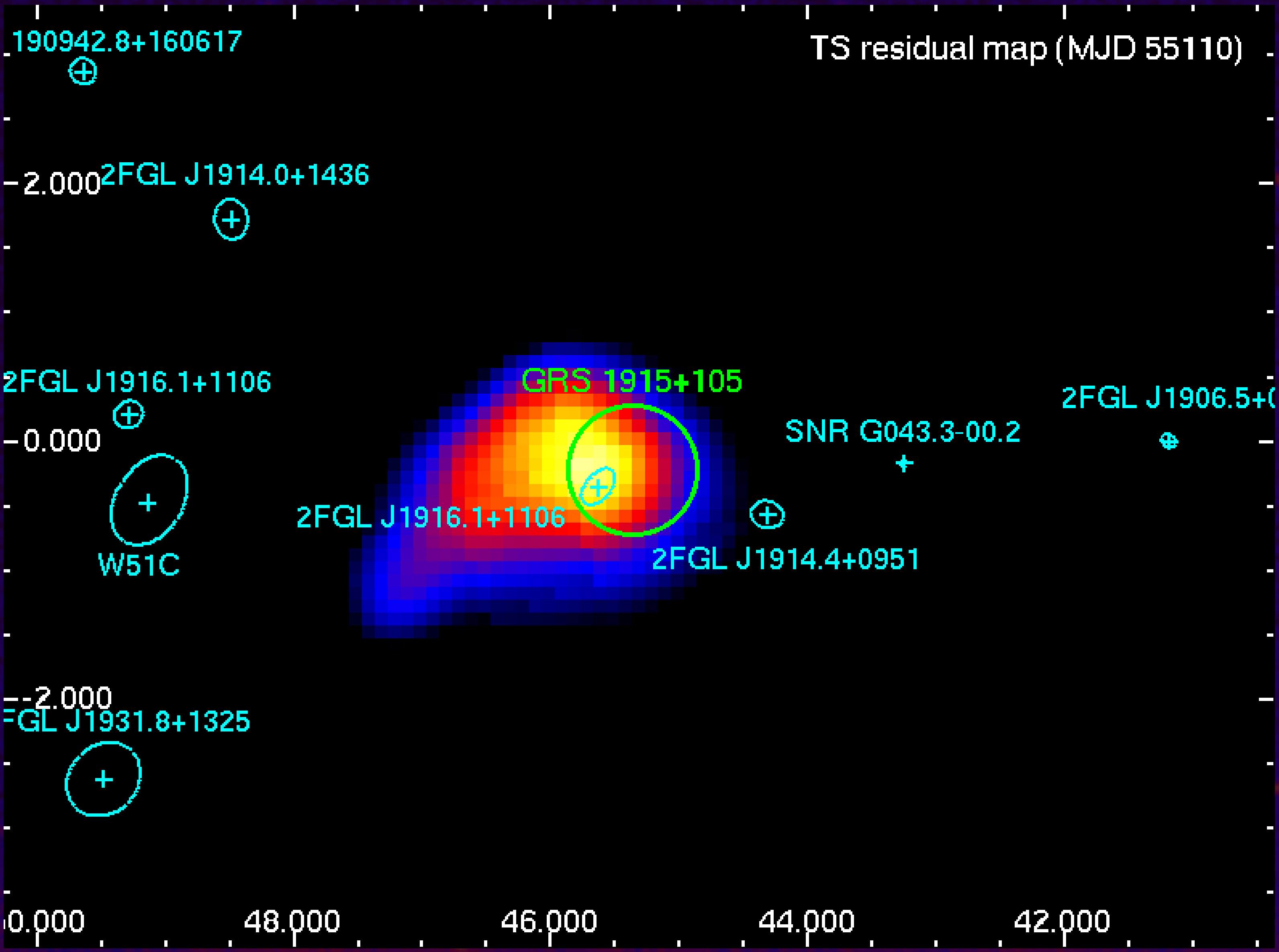
GRS 1915+105: GAMMA-RAY LIGHT CURVE



GRS 1915+105: X-RAY/GAMMA-RAY LIGHT CURVE

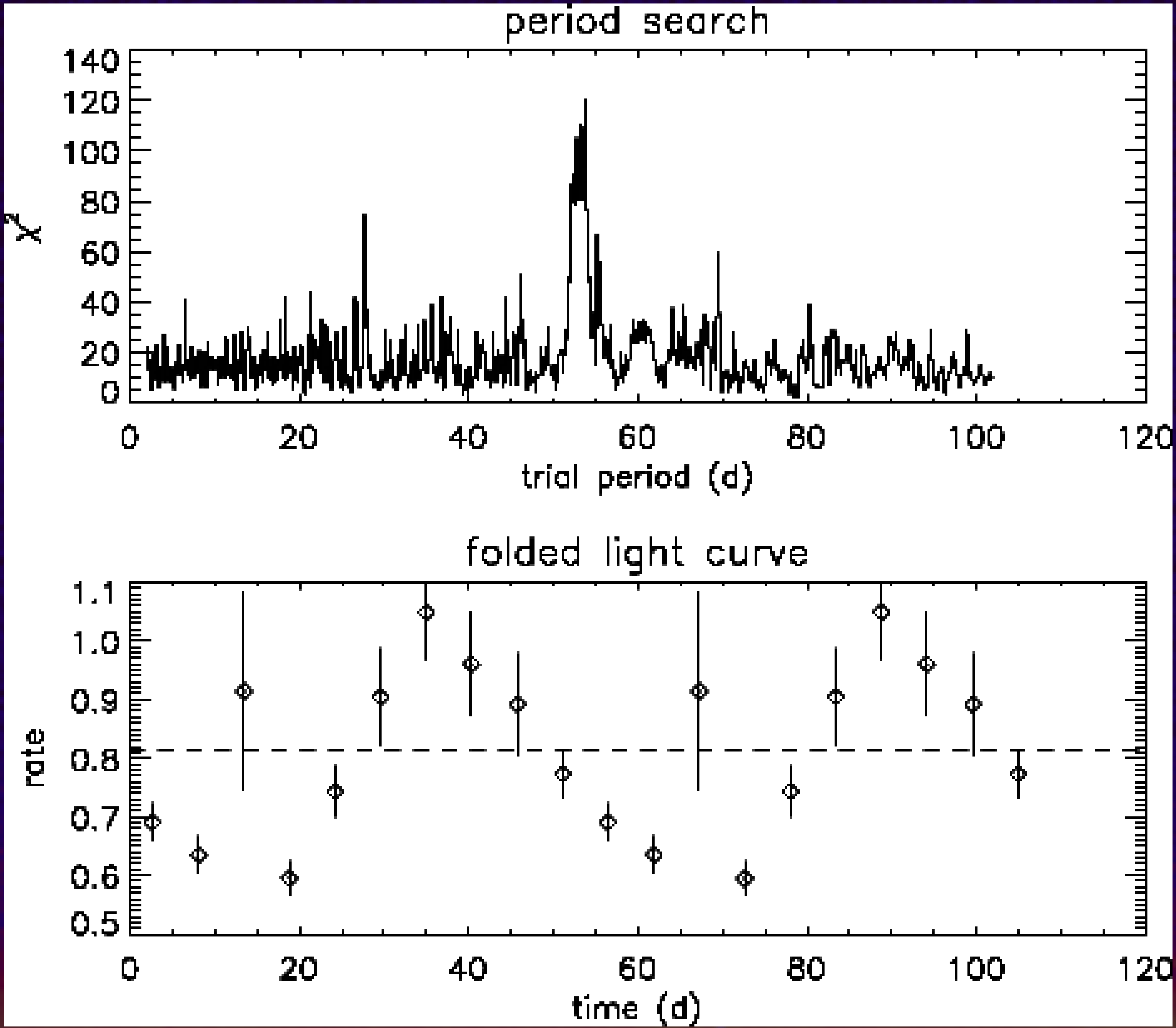


GRS 1915+105: RESIDUAL MAP FOR MJD 55110 (TS ~ 14)



GRS 1915+105: PERIODICITY SEARCH (P_0 = 33.5 D)

detection of a 53-d period: possible signature of a new gamma-ray binary?



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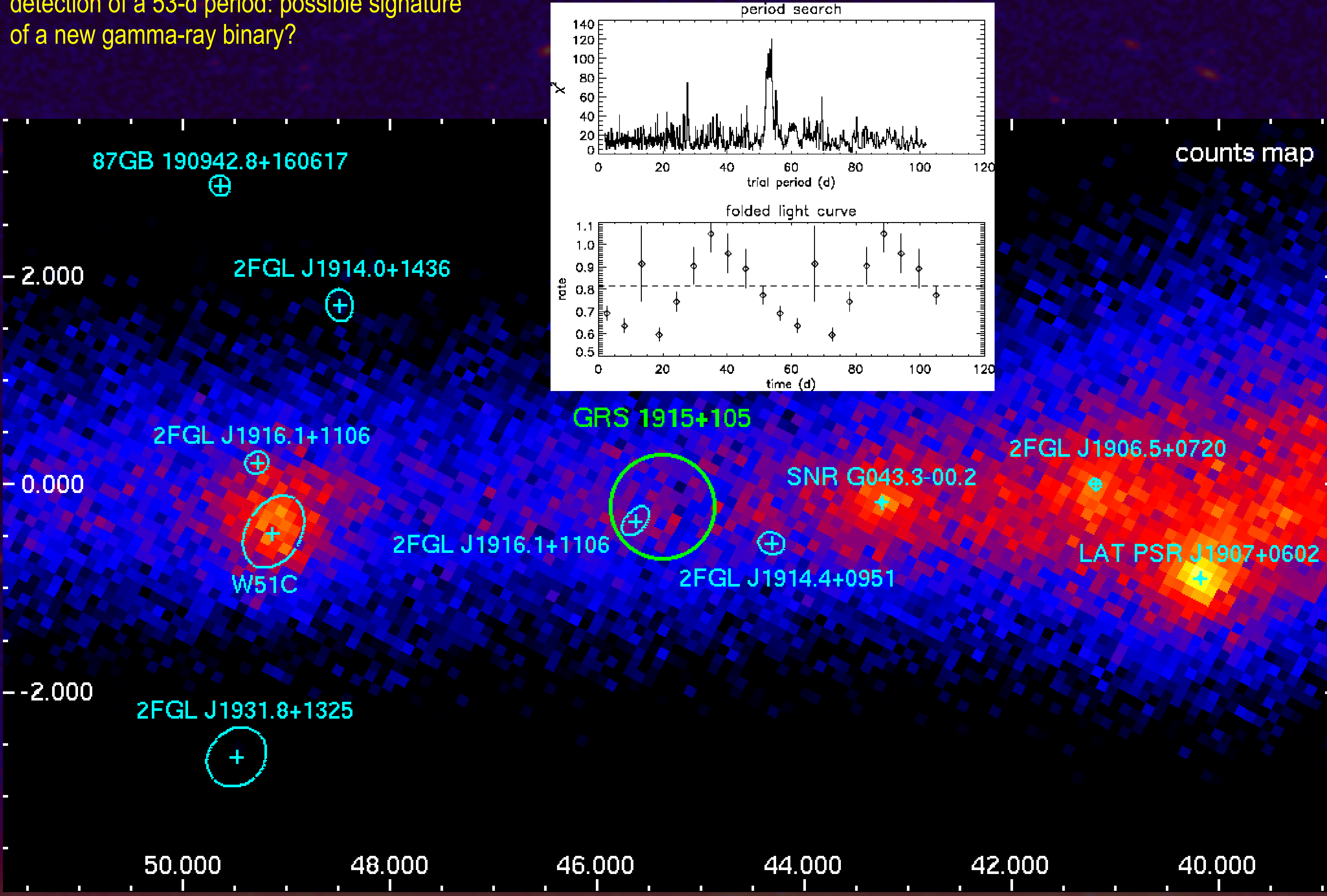

ONGOING WORK & OUTLOOK

EXTEND THIS ANALYSIS TO OTHER MICROQUASARS TO SEARCH FOR GAMMA-RAY EMISSION (TRANSIENT AND/OR PERIODIC)

IMPLEMENT EVENT WEIGHTING FOR SHORT TIME BINS

FERMI OBSERVATIONS OF MICROQUASARS
CAN SHED LIGHT ON THE ROLE OF RELATIVISTIC JETS
IN PRODUCING GAMMA-RAY EMISSION FROM ACCRETING COMPACT OBJECTS

BODAGHEE ET AL. 2012D IN PREP.

DANKE