



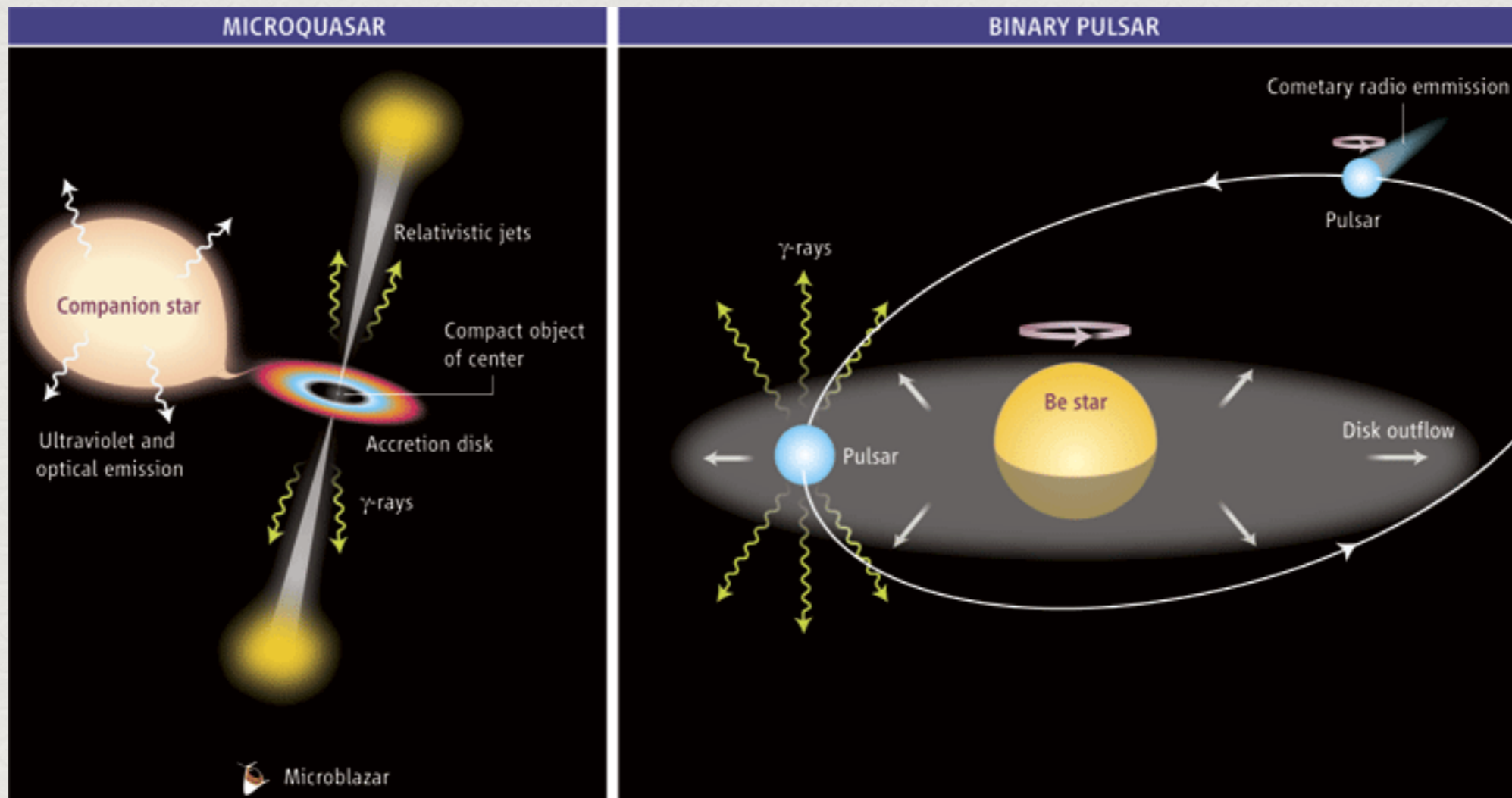
The hour timescale GeV
flares of PSR B1259-63 in 2017
(2018, ApJ, in press, arXiv:1804.09861)

P. H. Thomas Tam 譚栢軒

SYSU 中山大學

Yudong Cui, Partha Pal, Xinbo He (SYSU)

Gamma-ray binaries



Currently known high-mass gamma-ray binaries

Dubus (2015)

| name | binary components | P_{orb} (d) | HE | VHE | refs (★) | notes |
|--------------------------------|-------------------|----------------------|--------|-----|----------|---------------------|
| (high-mass) gamma-ray binaries | | | | | | |
| PSR B1259-63 | pulsar | Be | 1236.7 | ✓ | ✓ | [12, 13] 47.7 ms |
| HESS J0632+057 | ? | Be | 315 | | ✓ | [14, 15] |
| LS I +61°303 | ? | Be | 26.5 | ✓ | ✓ | [16, 17] magnetar ? |
| 1FGL J1018.6-5856 | ? | O | 16.6 | ✓ | ✓ | [18, 19] |
| LS 5039 | ? | O | 3.9 | ✓ | ✓ | [20, 21] |

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| LMC P3 | ? | O | ~10 | ✓ | ✓ | |
| PSR J2032+4127 | pulsar | Be | 50 years | | | GeV pulsation |

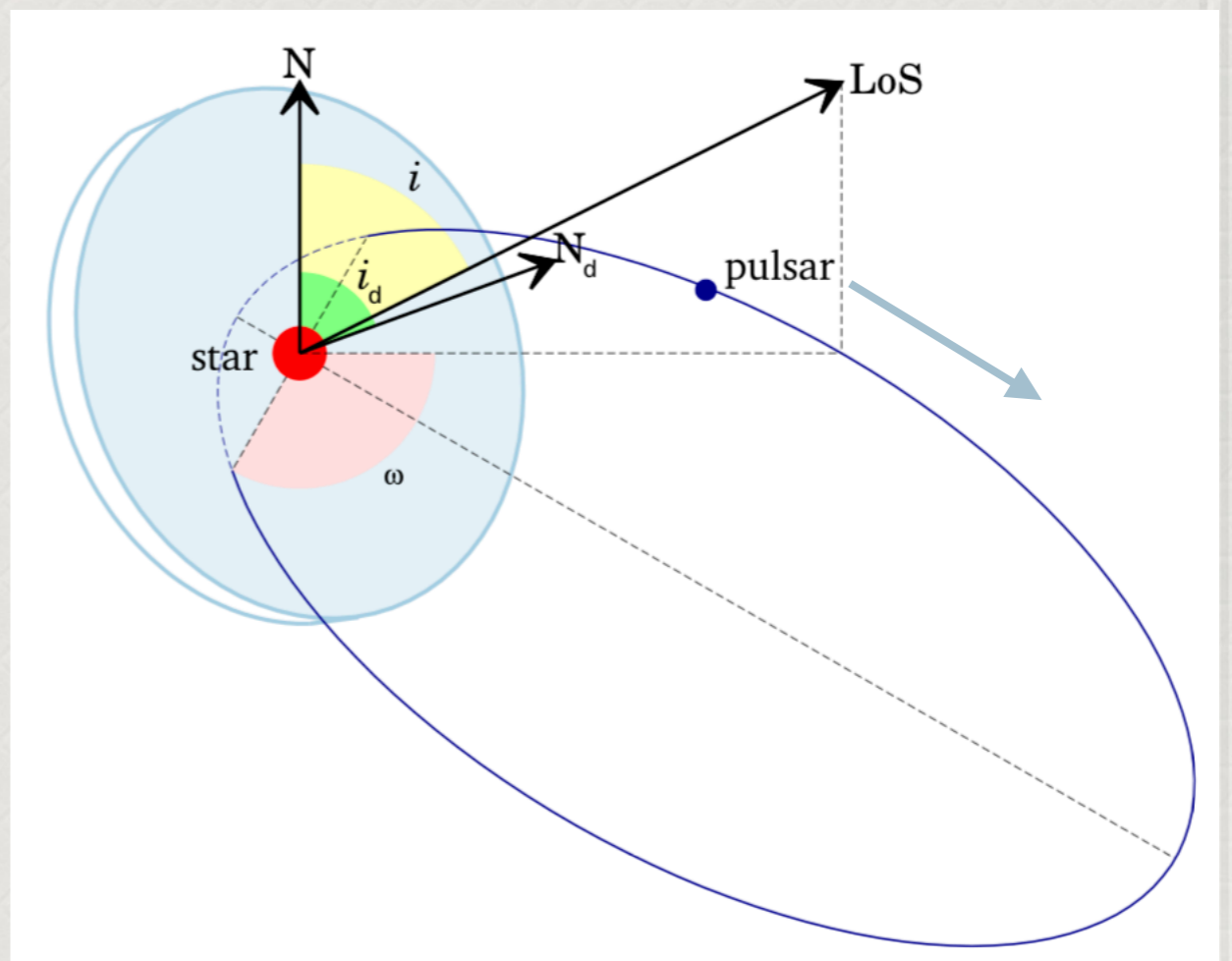
Currently known high-mass gamma-ray binaries

Dubus (2015)

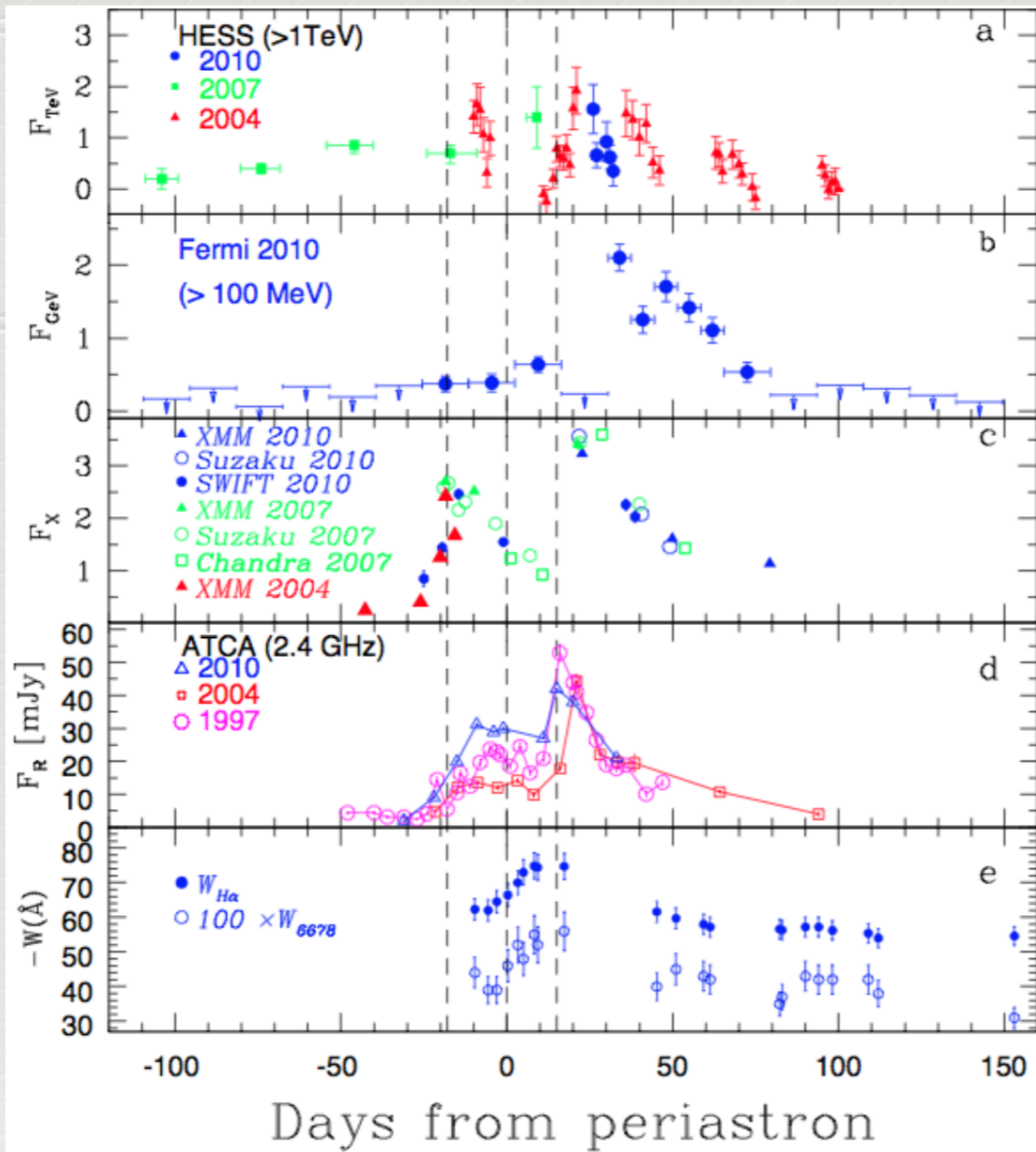
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PSR B1259-63/LS 2883

- ✦ *comprising of a pulsar and an Oe star, at $d \sim 2.3$ kpc*
- ✦ *orbital period: 3.4 years*
- ✦ *Interaction between the stellar wind/disk and the pulsar wind \Rightarrow non-thermal radiation close to periastron*



Sushch & van Soelen (2017)



TeV

GeV

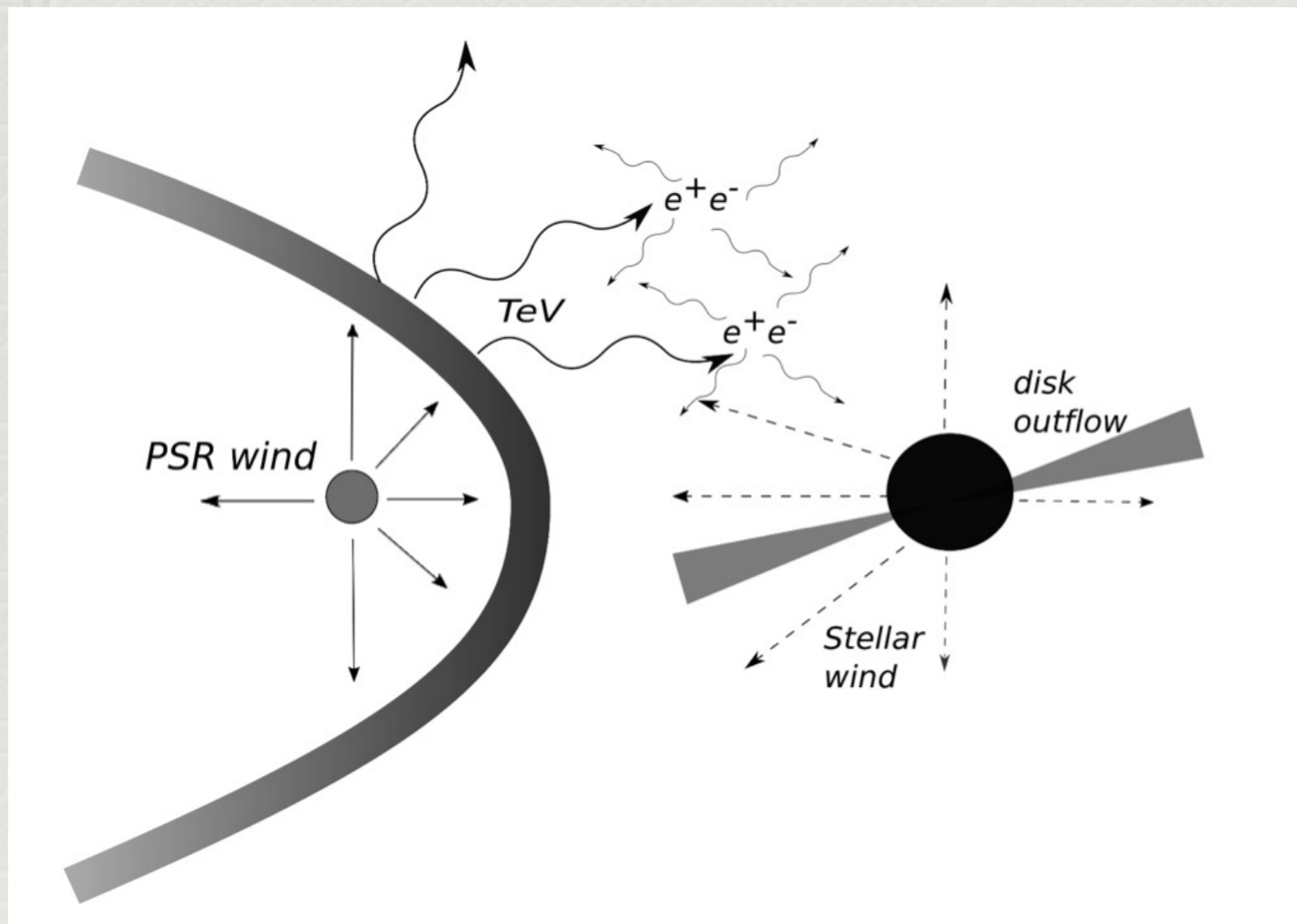
X-ray

Radio

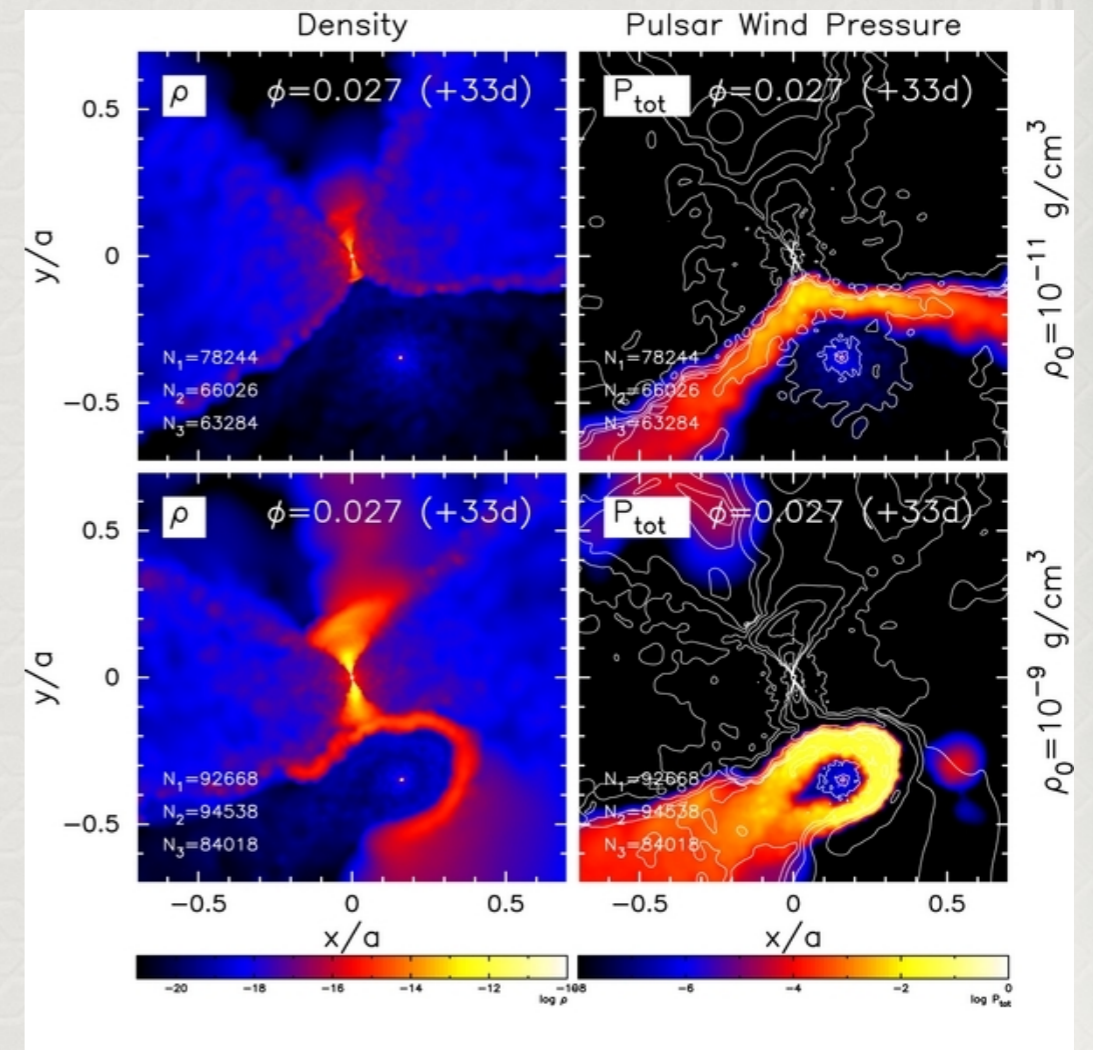
H α

Chernyakova et al. (2014)

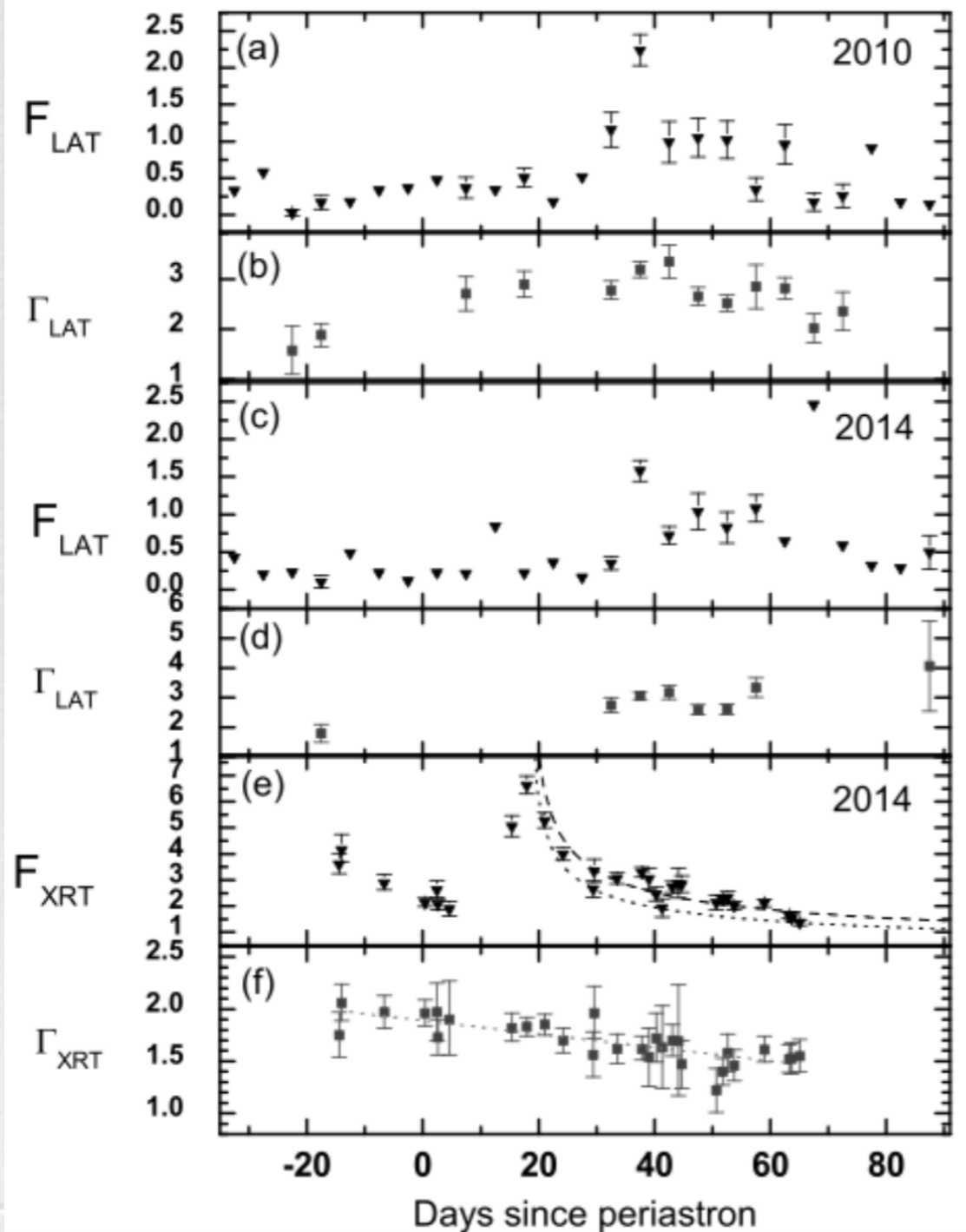
Shock acceleration can explain the X/TeV well, e.g., Takata+(2012)



Takata +(2017)

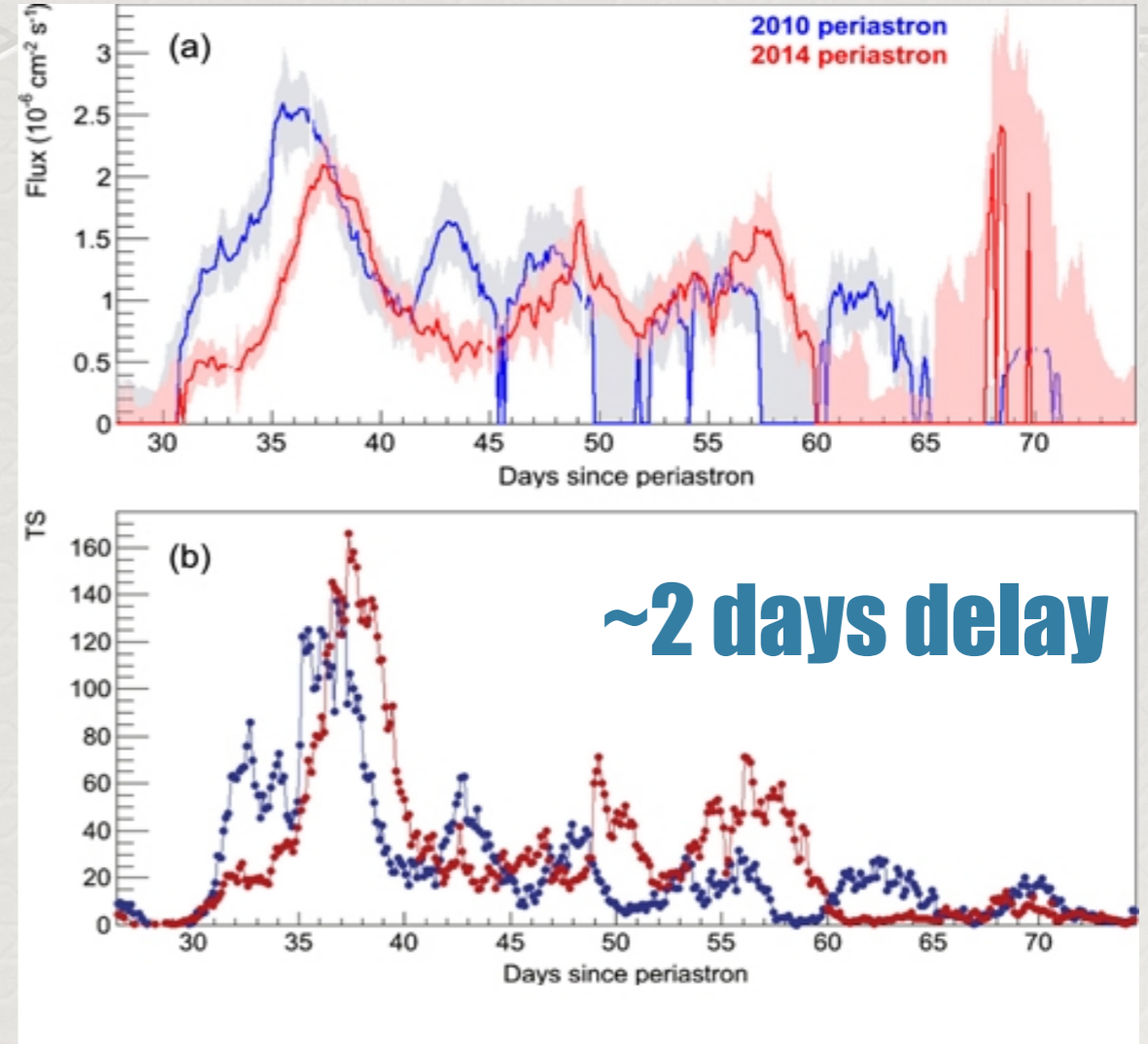
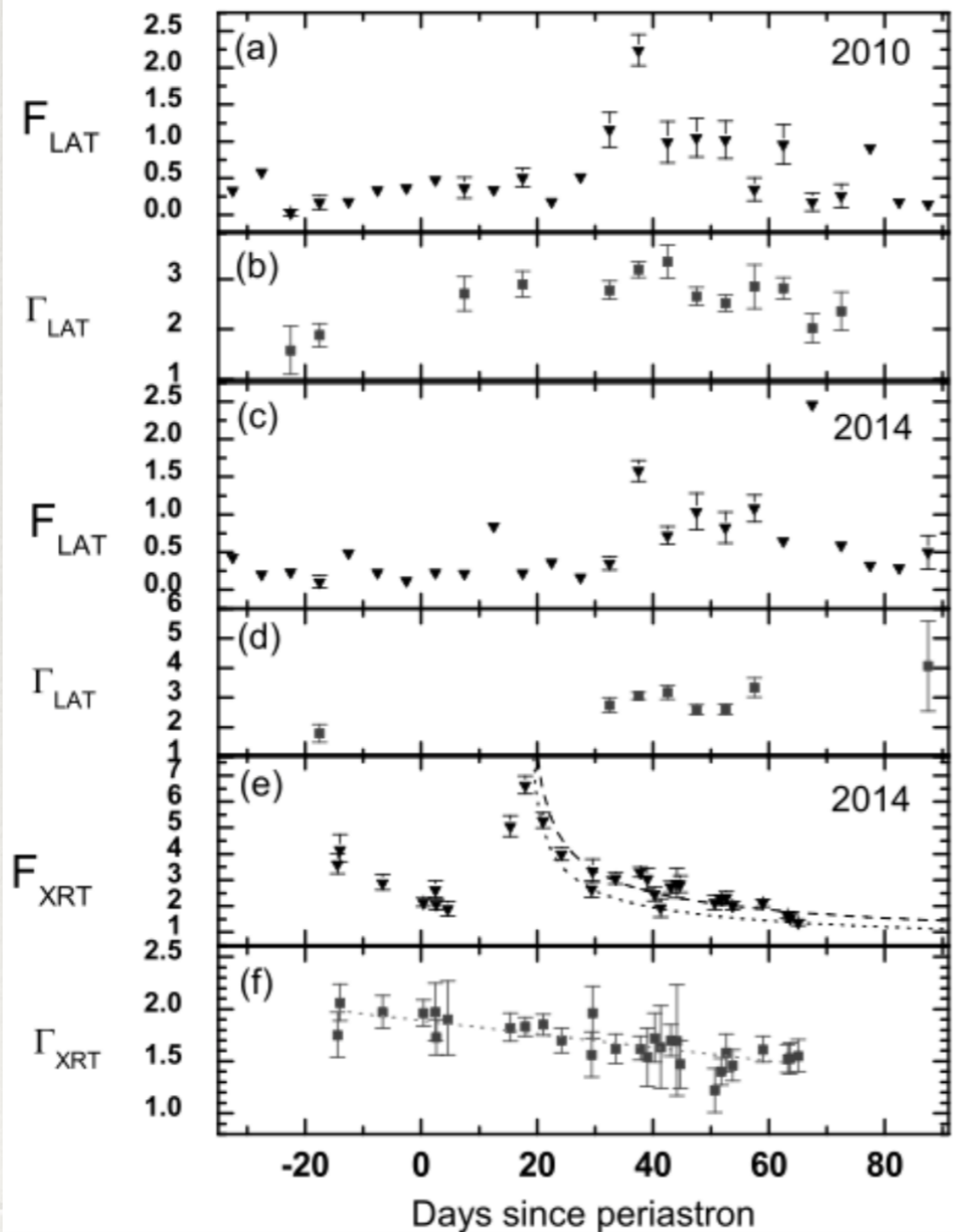


2011 GeV flares repeat in 2014 in similar orbital phase



Tam et al.
(2011, 2015)

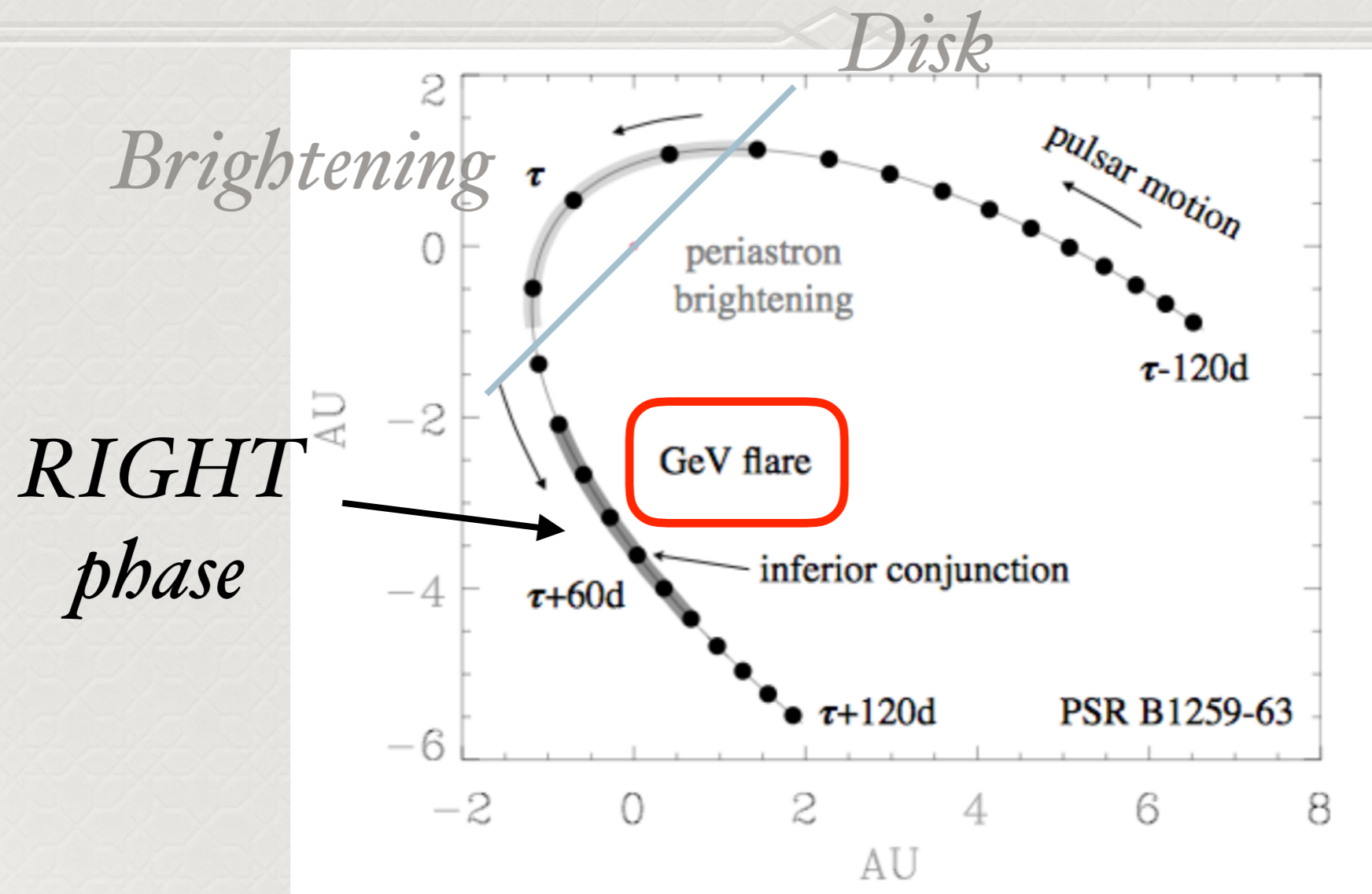
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Caliandro+ (2015)

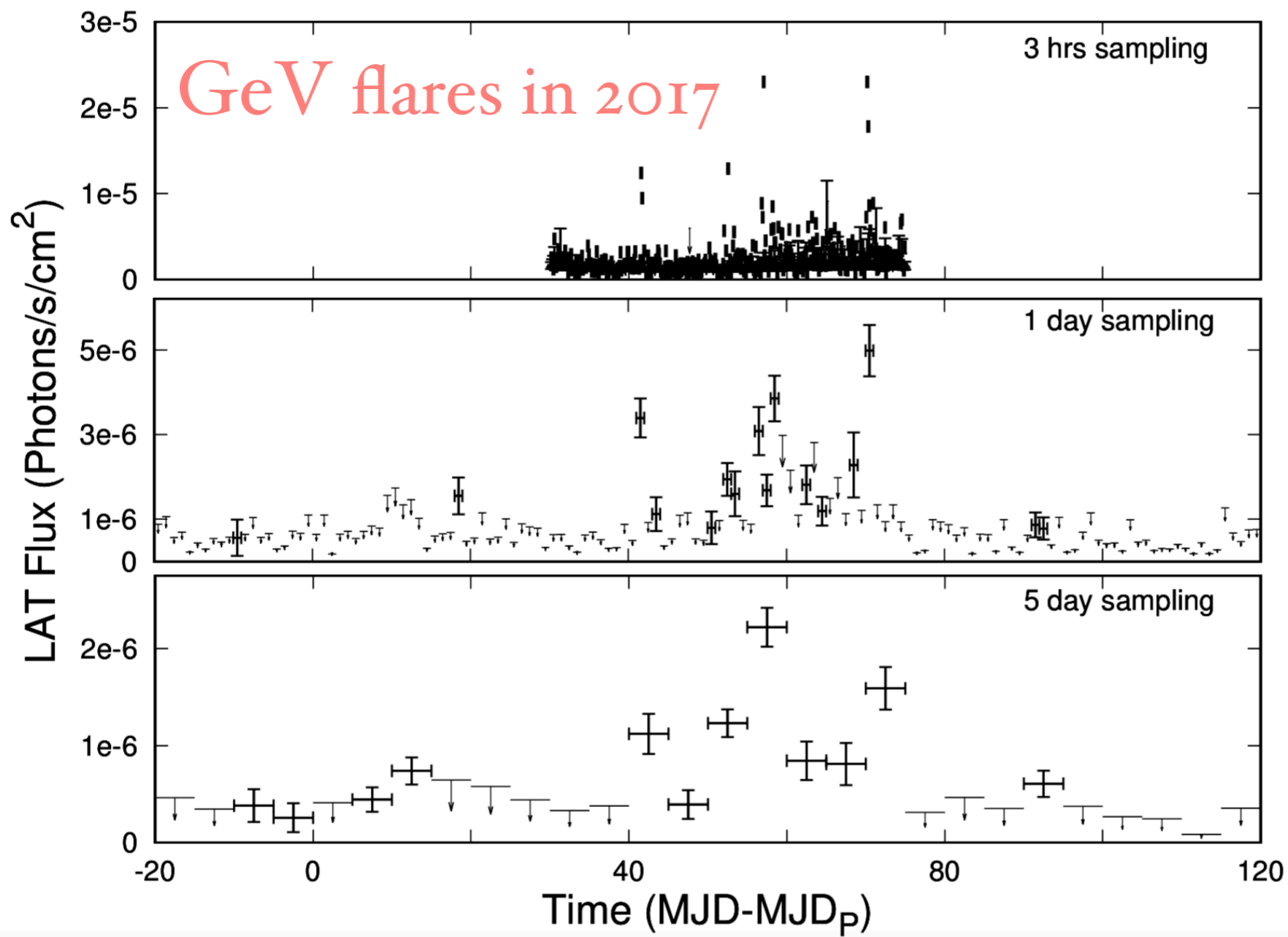
The orbital phase where GeV emission occurs



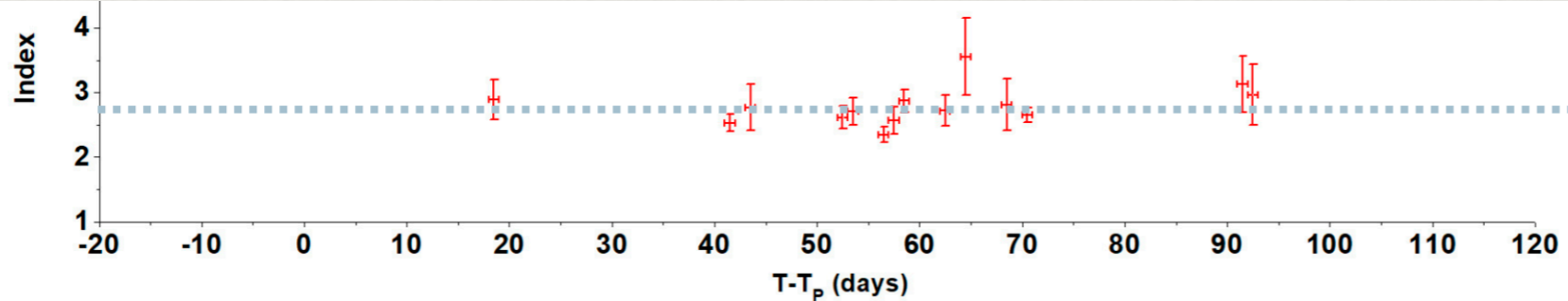
Dubus (2013)

News from 2017 periastron



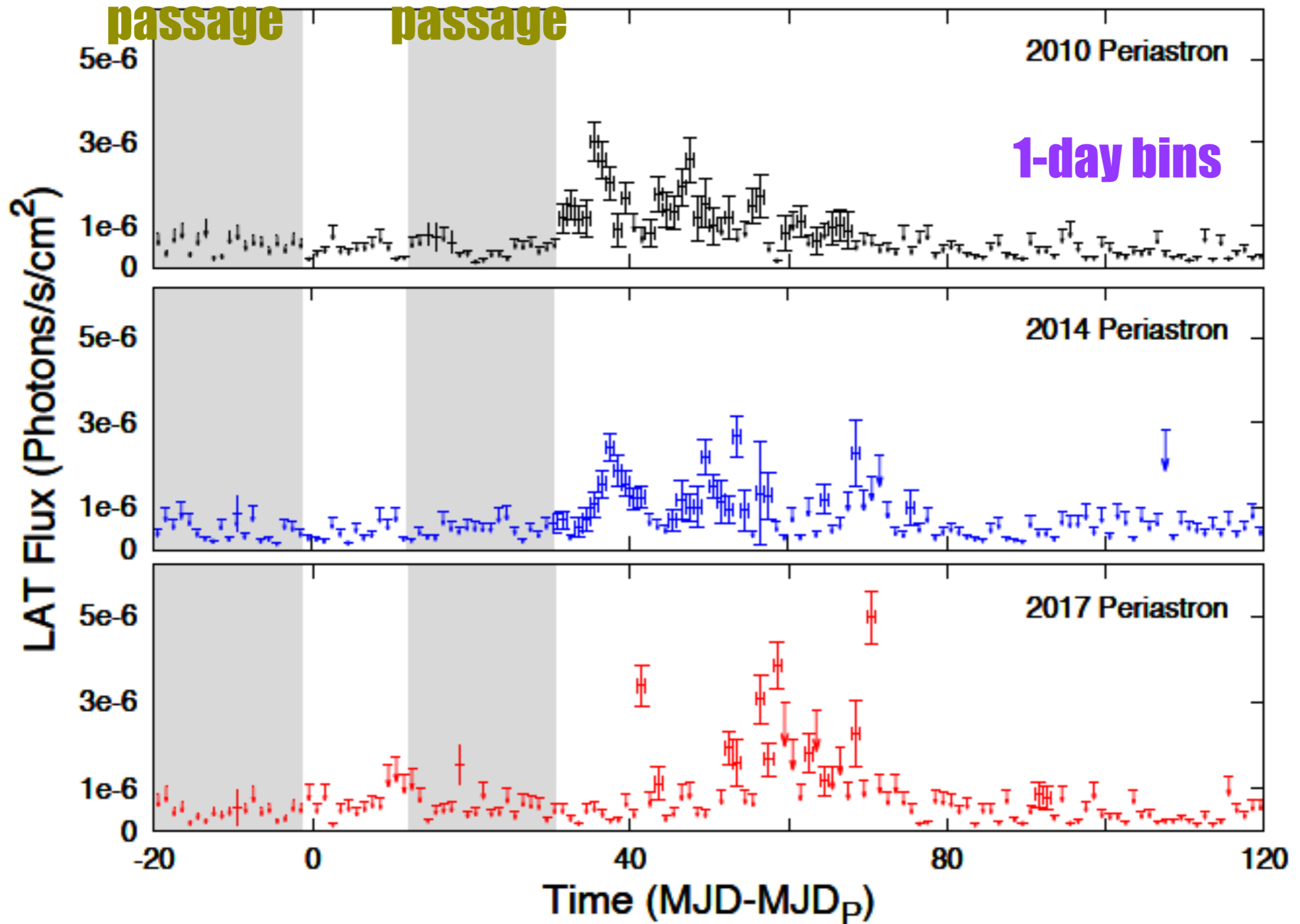


2.8



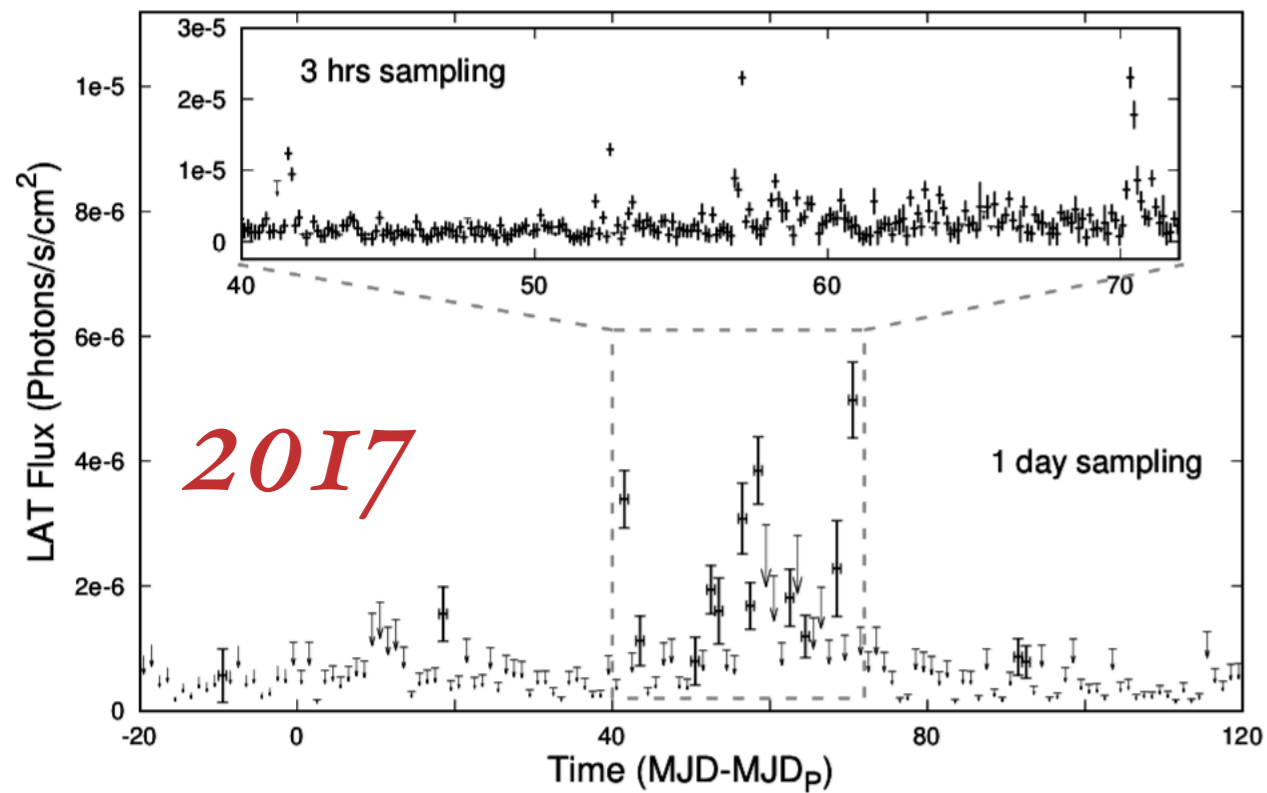
spectrum does not change!

first disk passage **second disk passage**

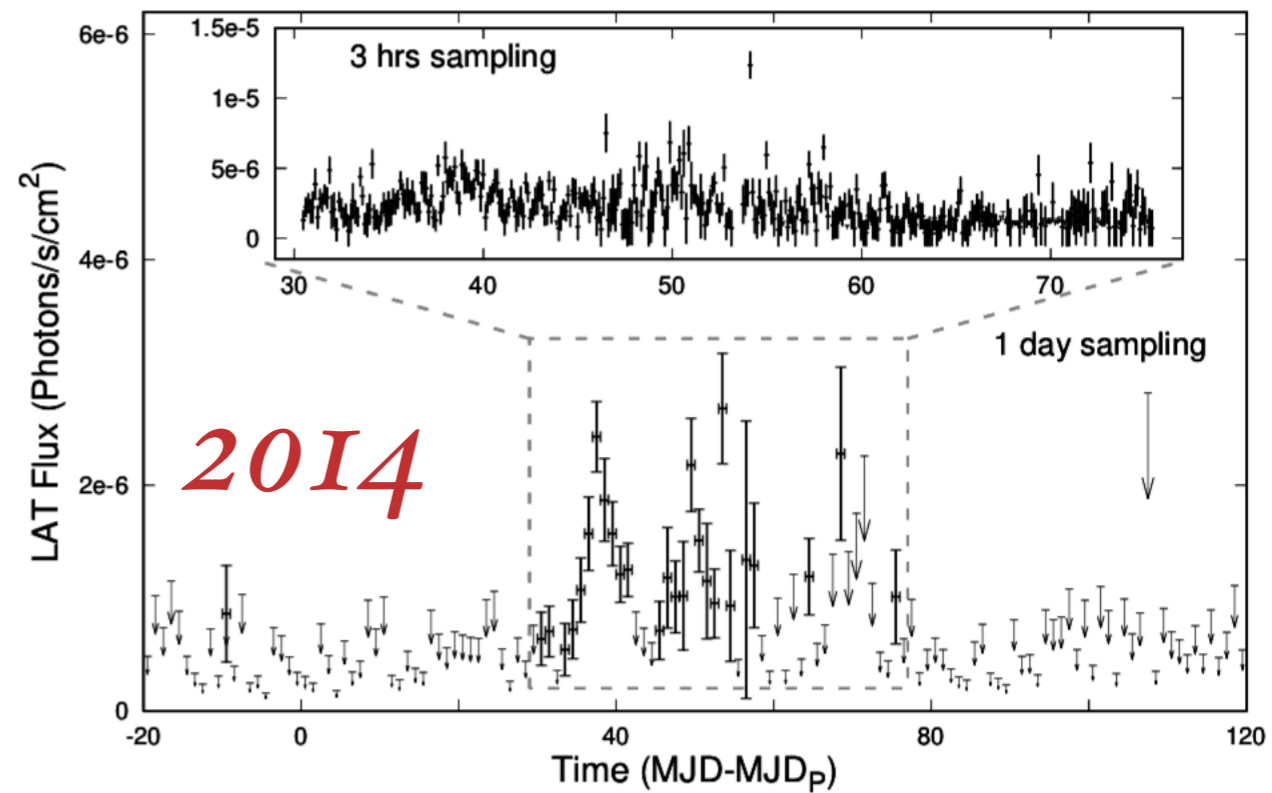


✦ clearly occurs at different orbital phase

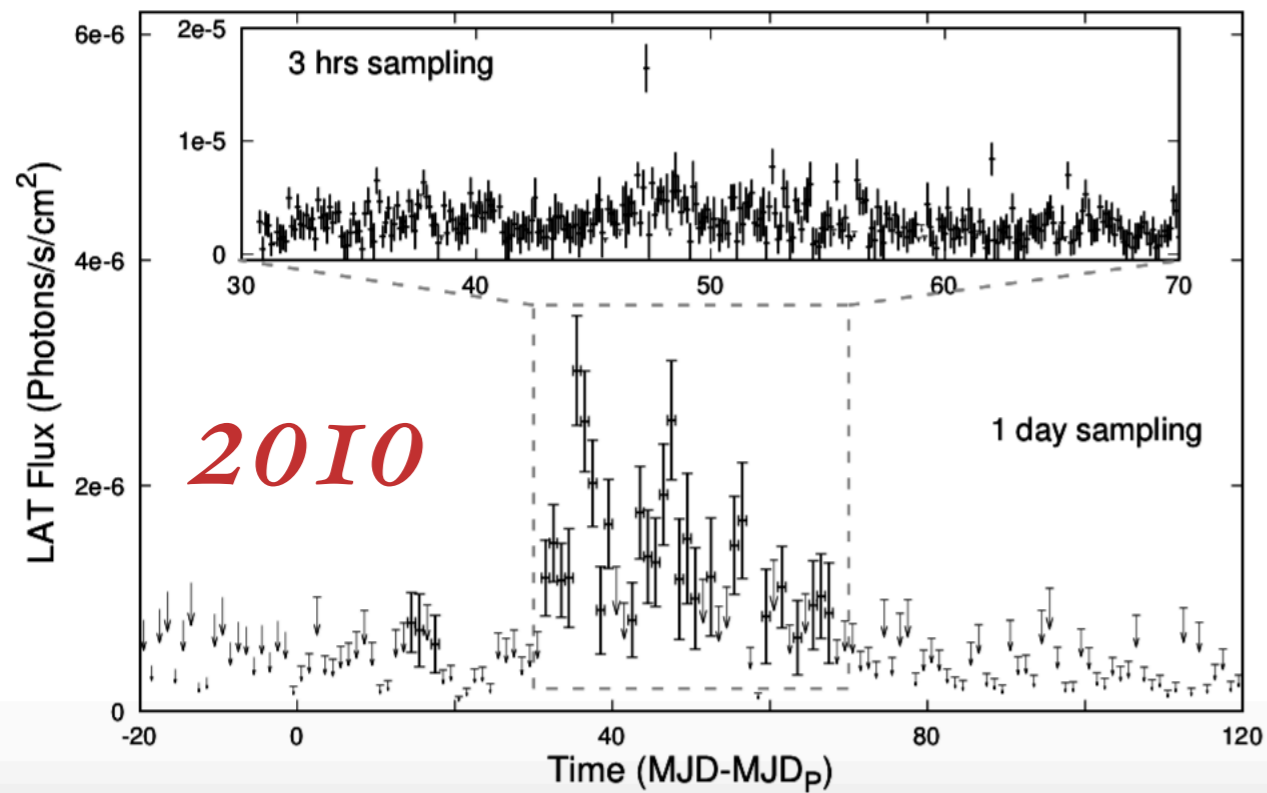
2017 Periastron

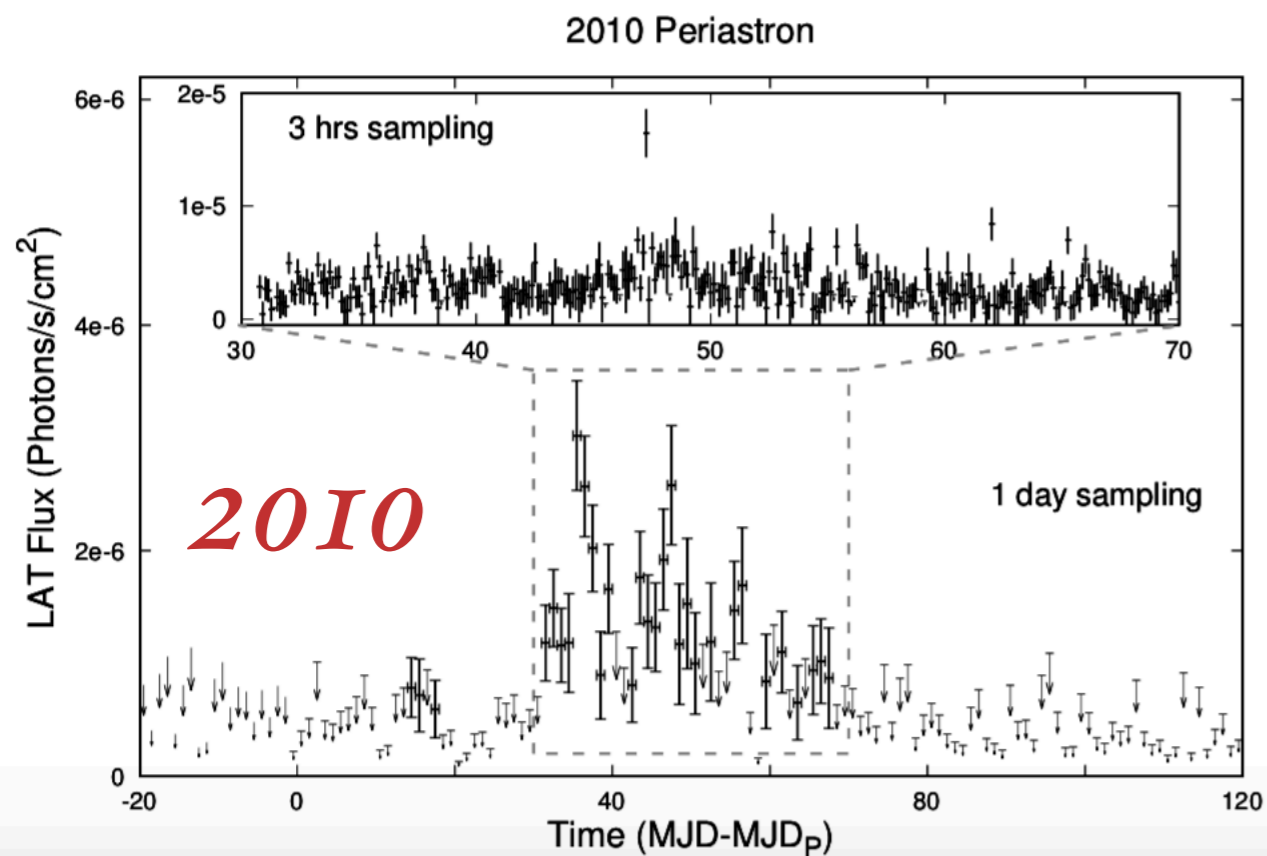
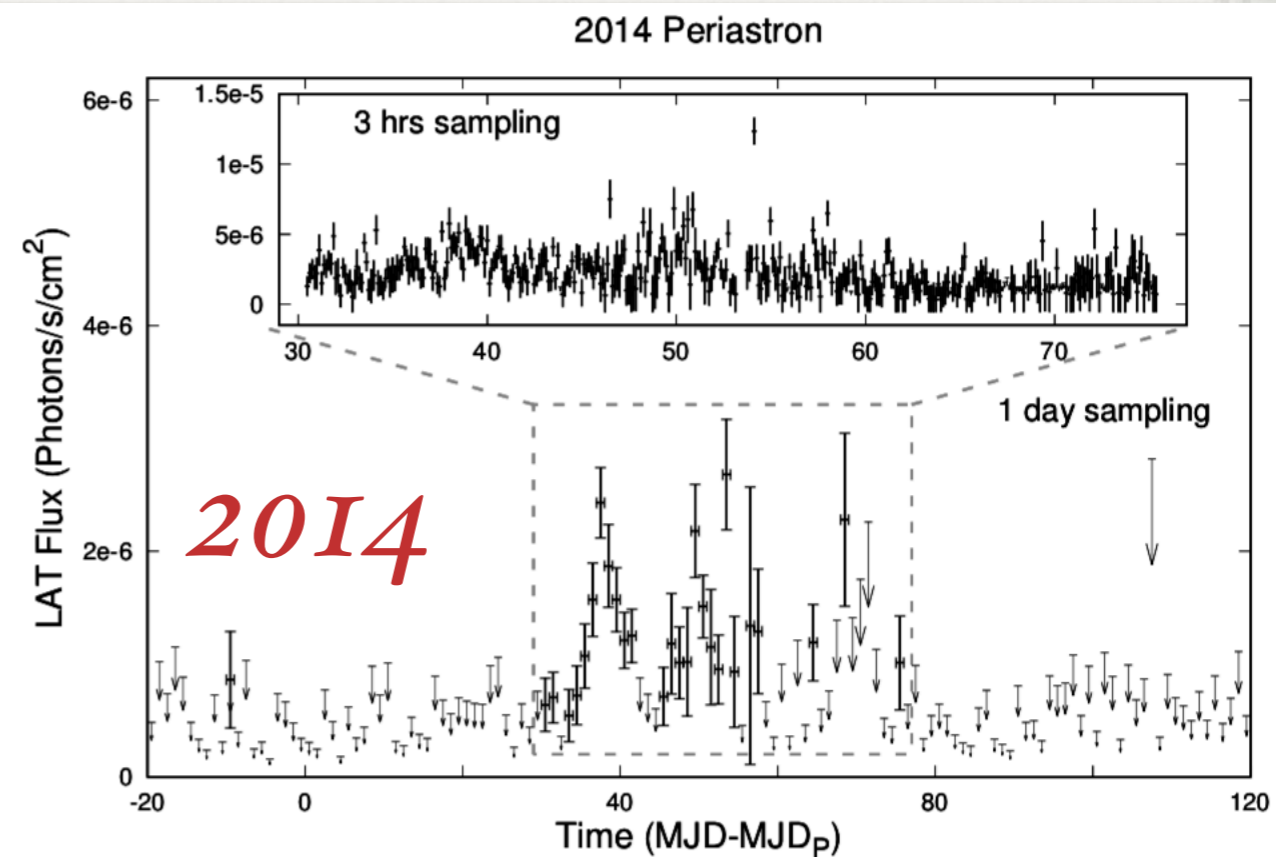
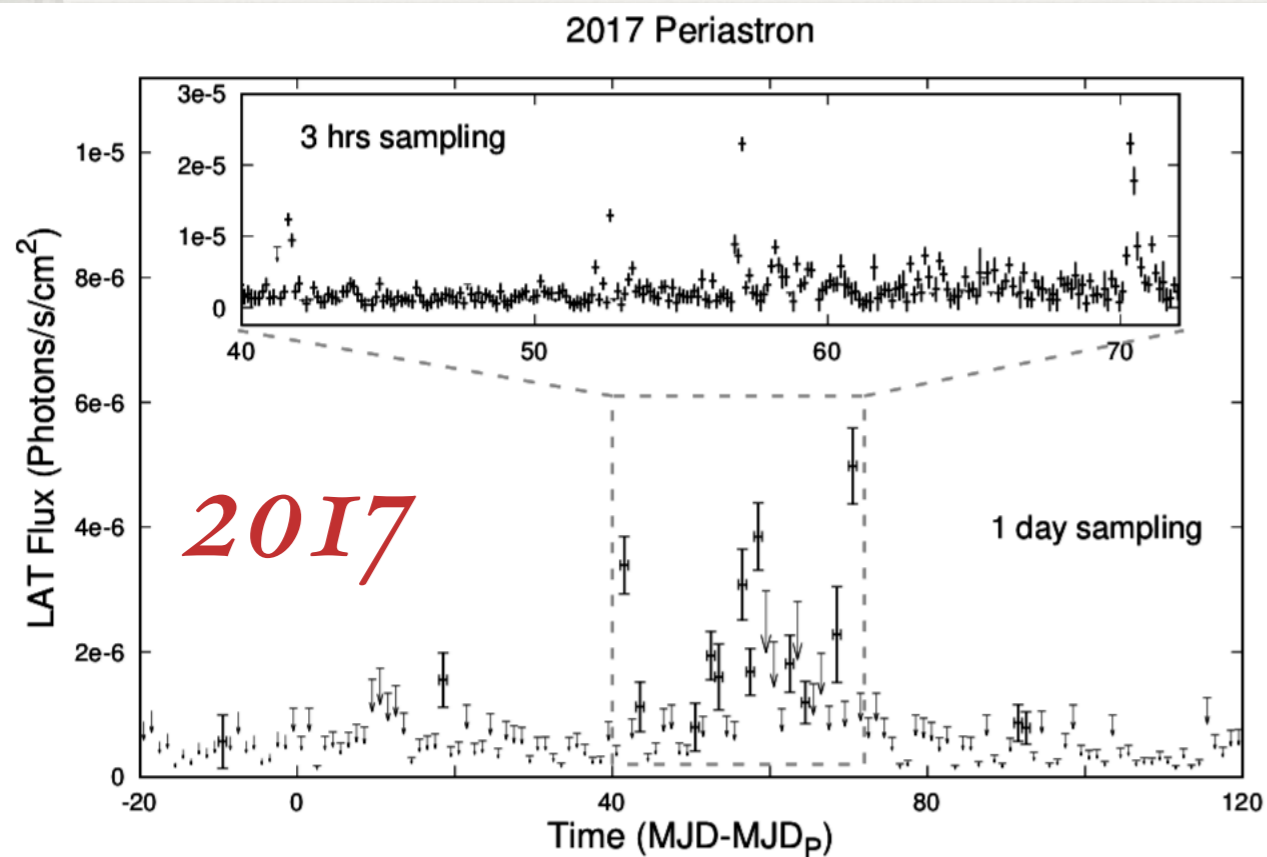


2014 Periastron



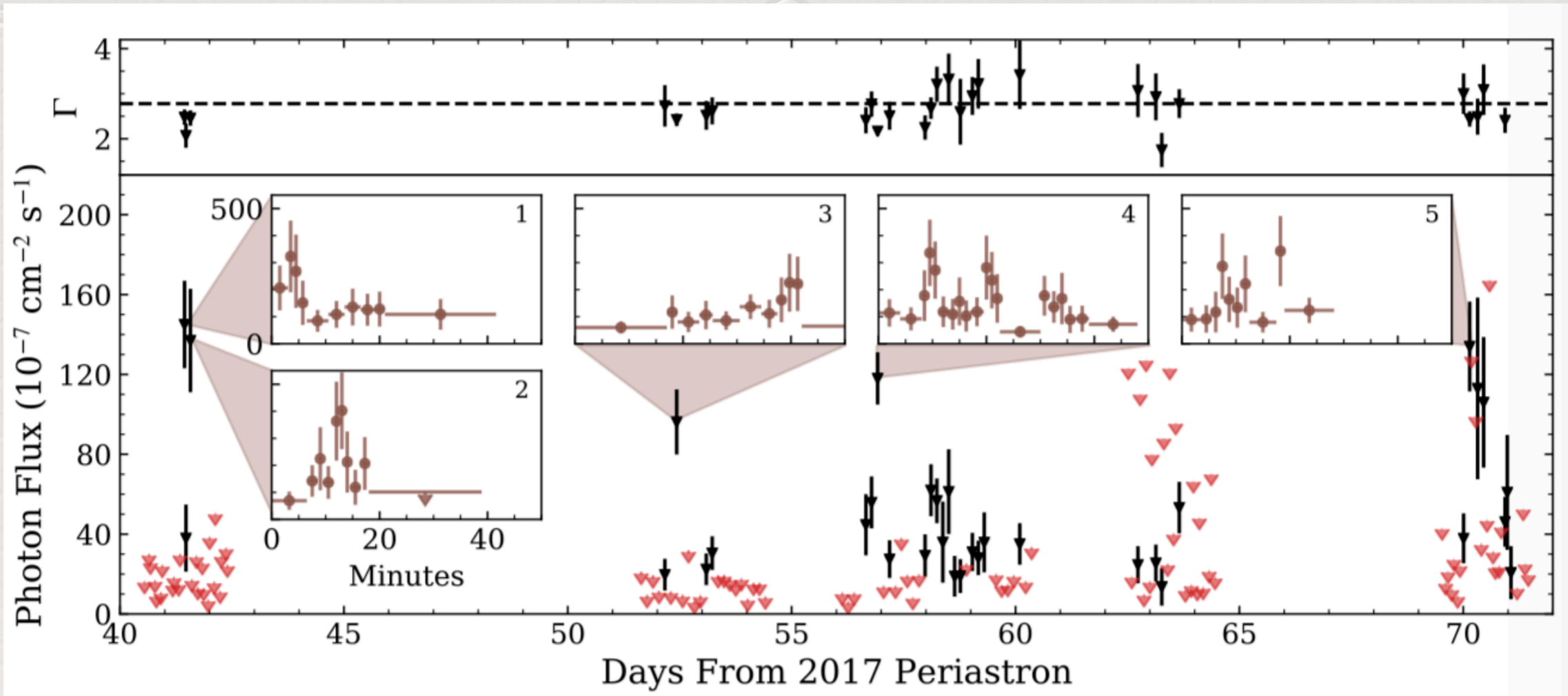
2010 Periastron





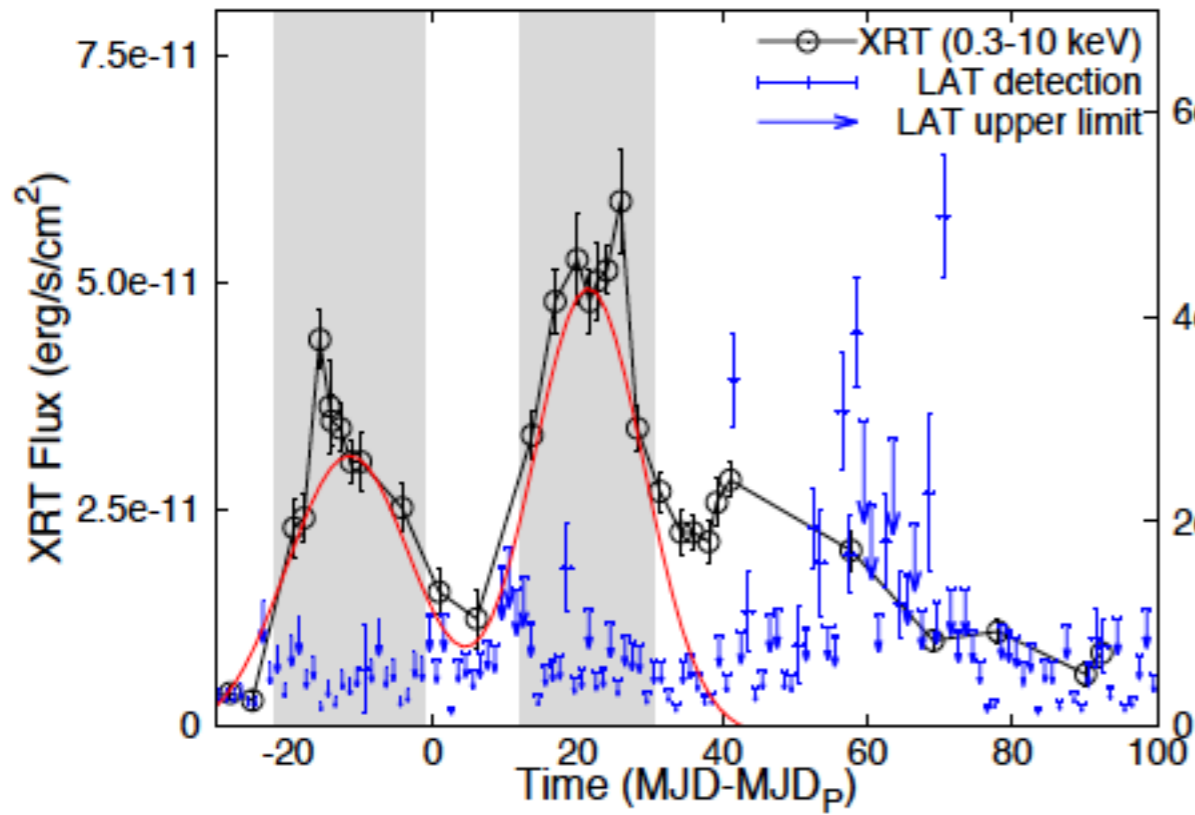
- ★ **2017 flares are different:**
- ★ **orbital phase different than 2011/14**
- ★ **duration of flares ~3-12 hr, shorter than 2011/14**
- ★ **previous works only show 0.5-7 day bins for 2010 & 2014**

Some flares may be even as short as a few minutes!

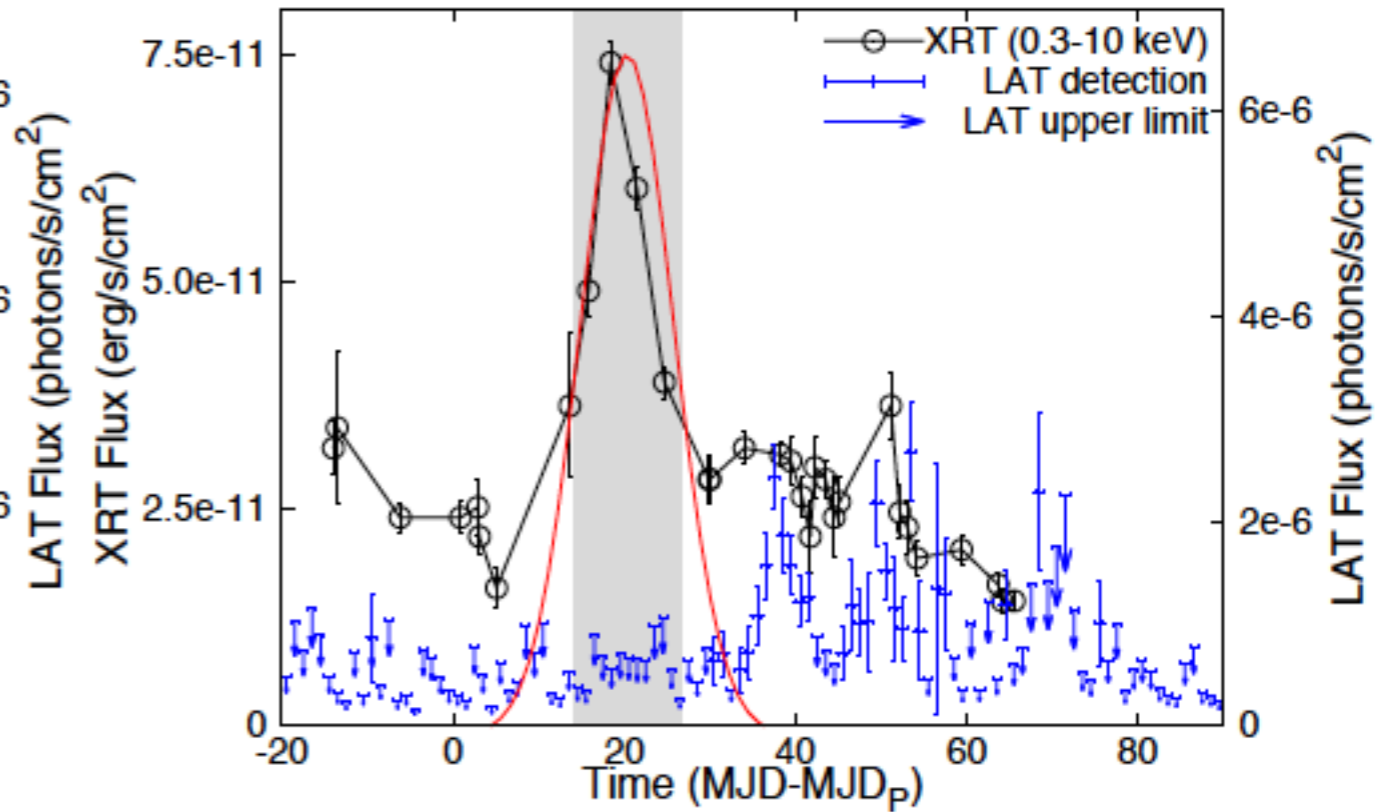


Johnson et al. (arXiv:1805.03537)

2017 Periastron



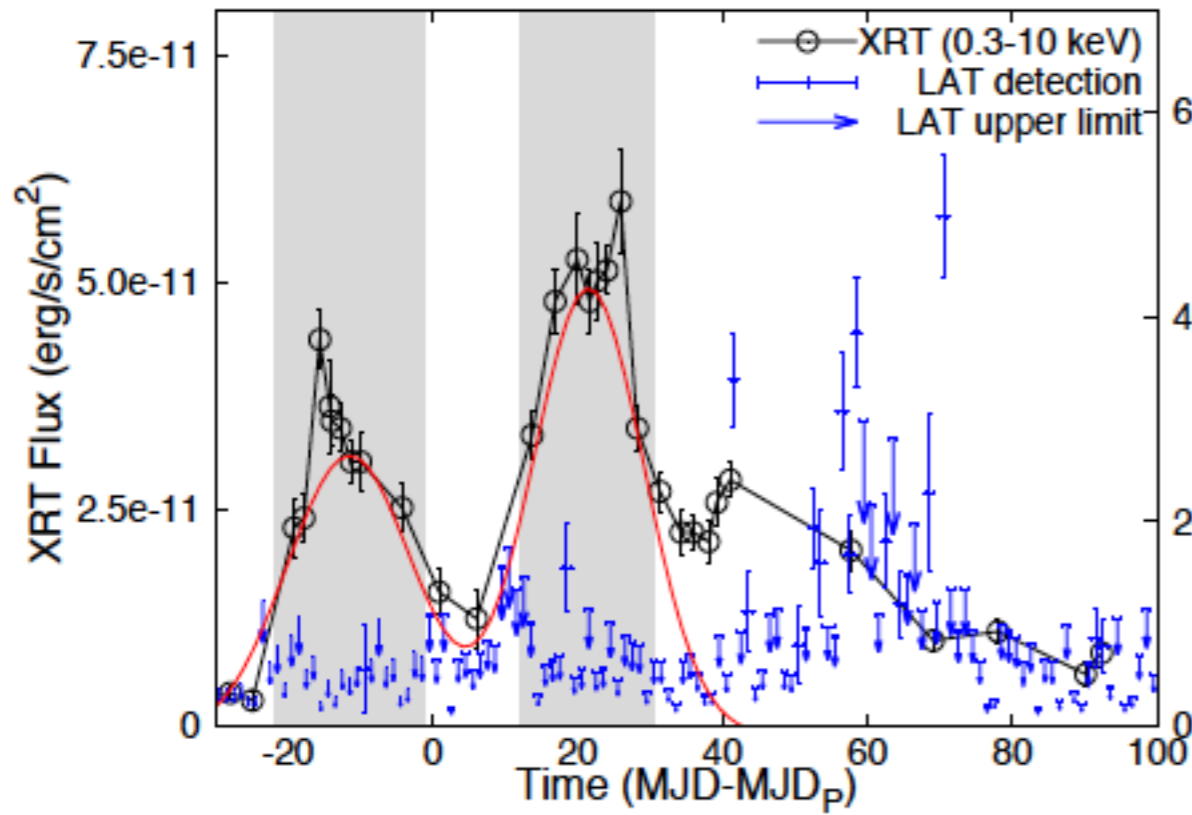
2014 Periastron



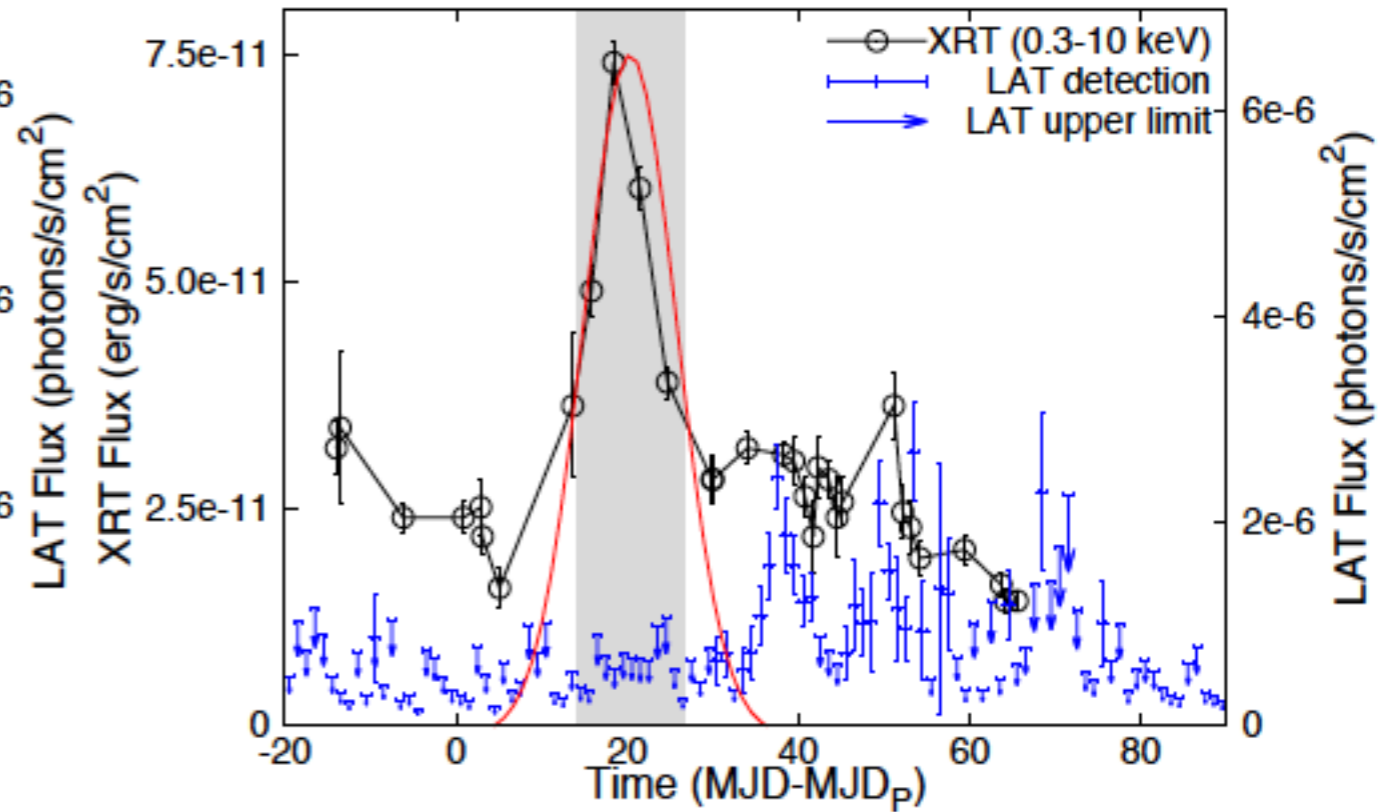
No obvious correlated
X/ γ activities in 2017

correlated X/ γ activities
in 2014 (Tam+ 2015)

2017 Periastron



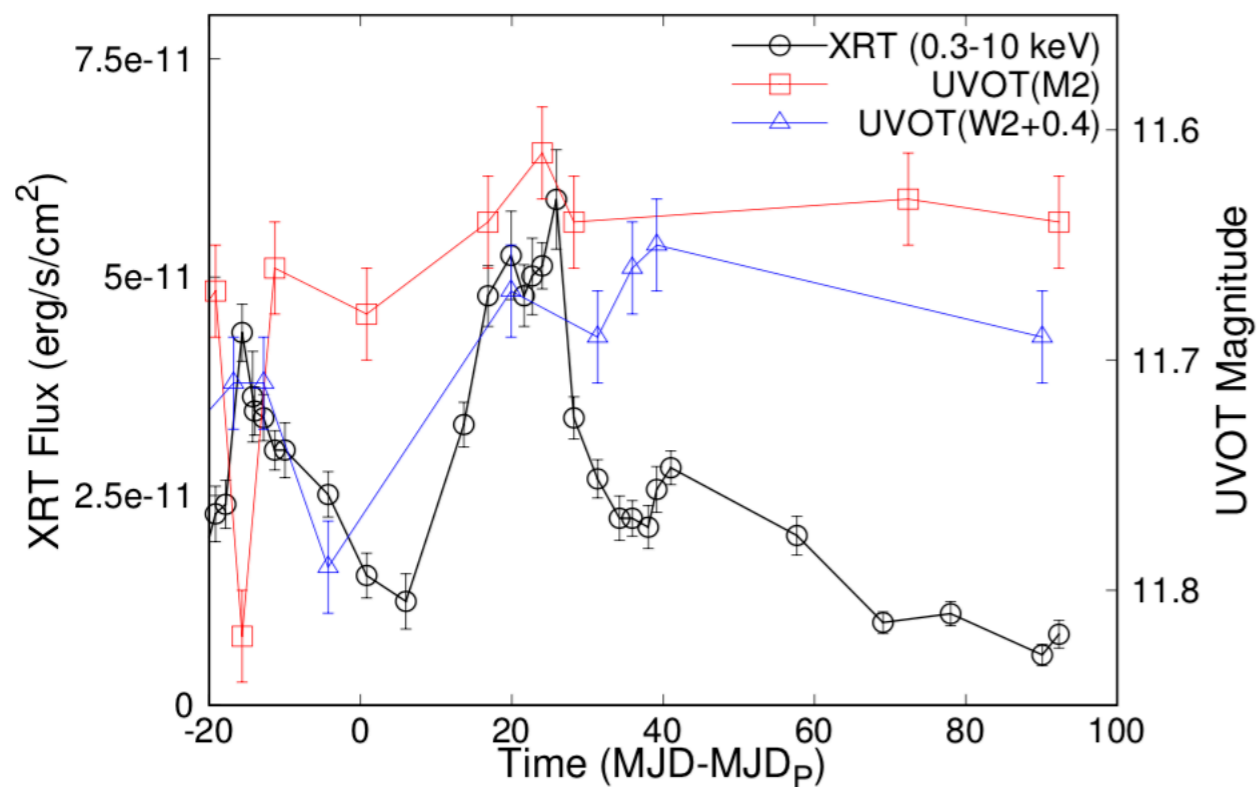
2014 Periastron



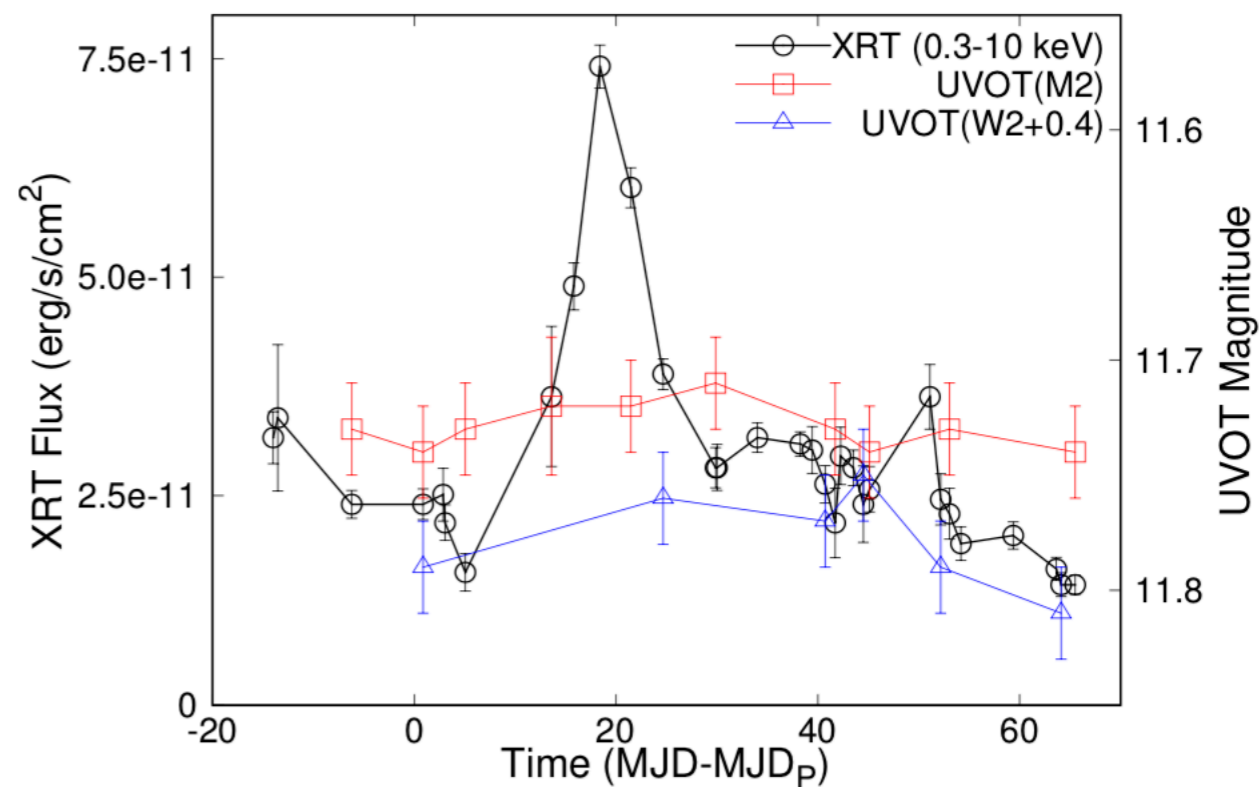
No obvious correlated
X/γ activities in 2017
but bad data coverage..

correlated X/γ activities
in 2014 (Tam+ 2015)

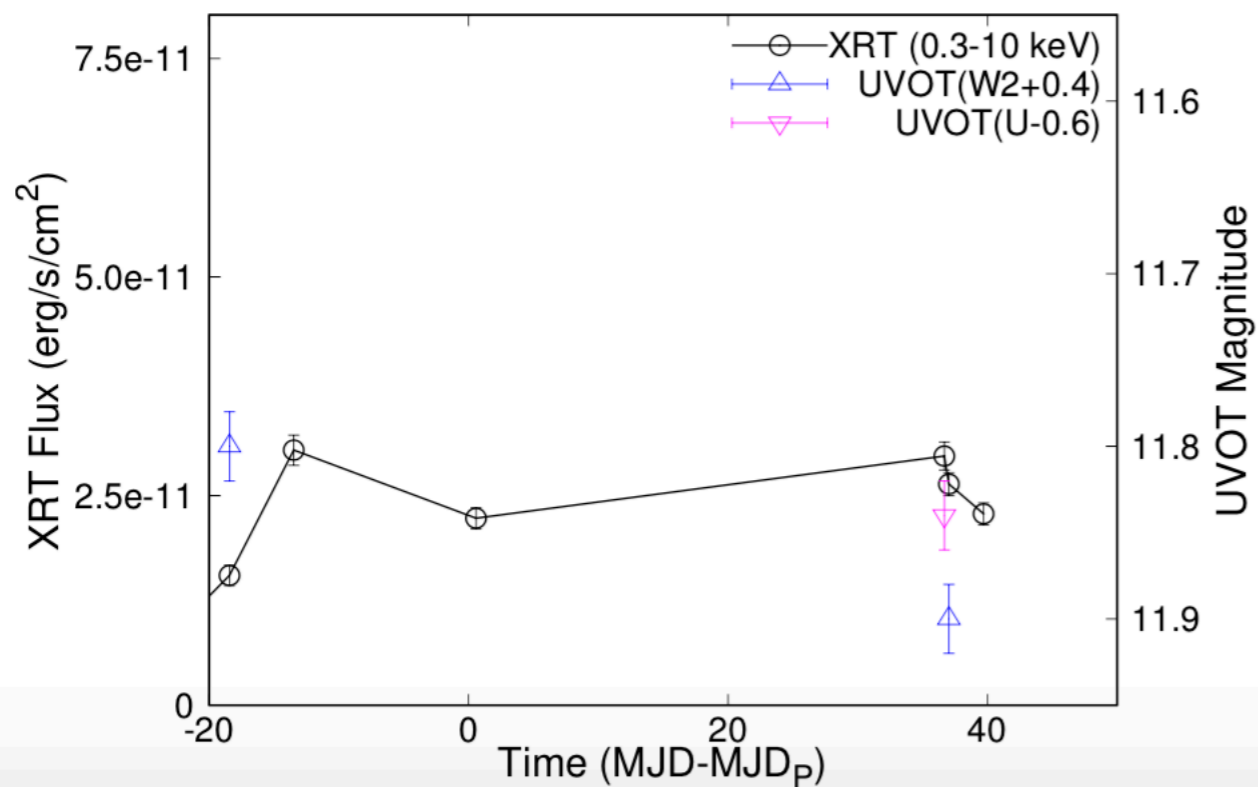
2017 Periastron



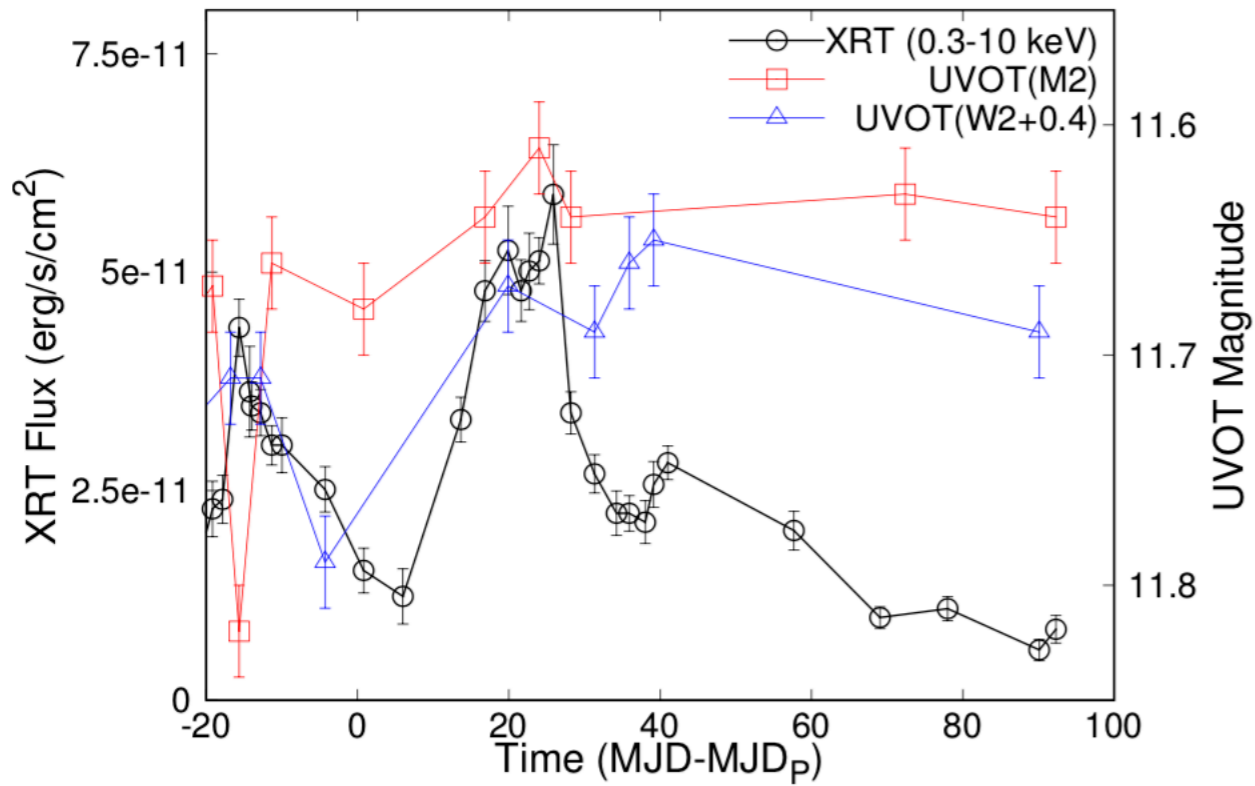
2014 Periastron



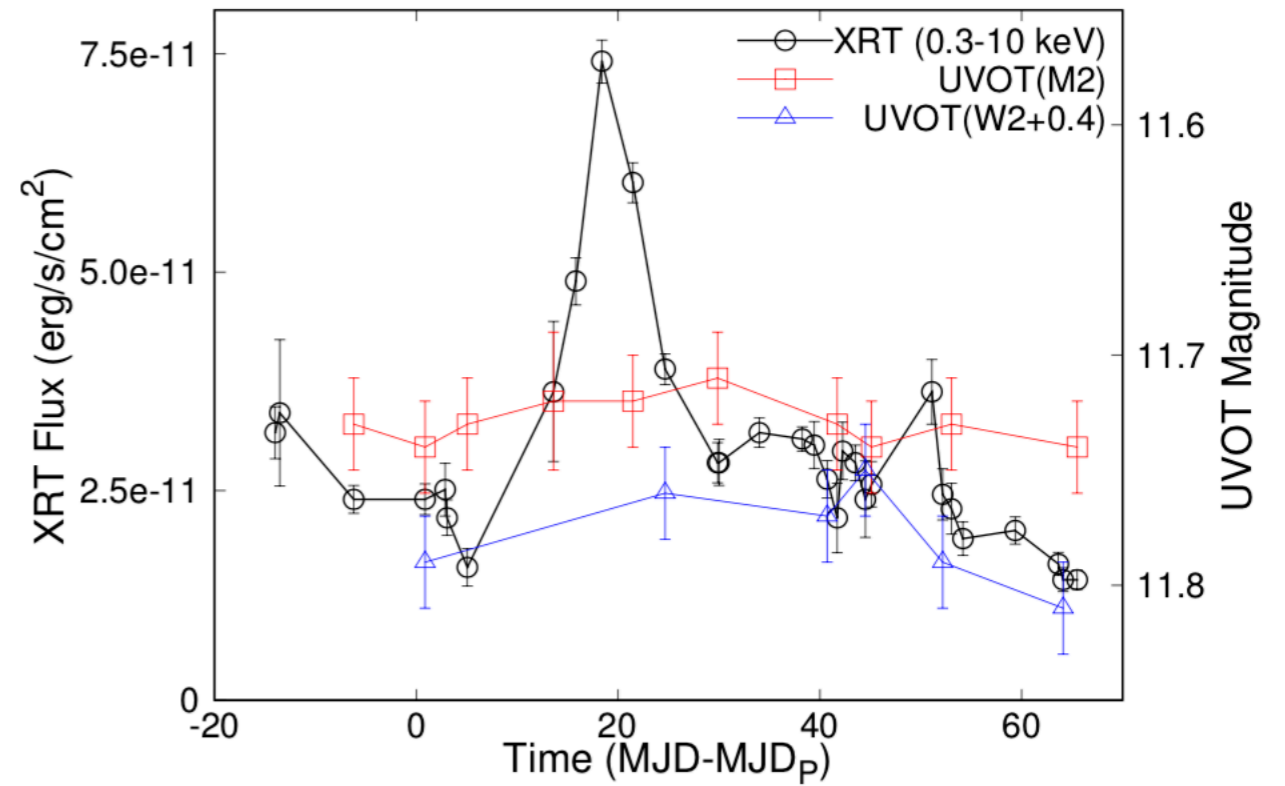
2011 Periastron



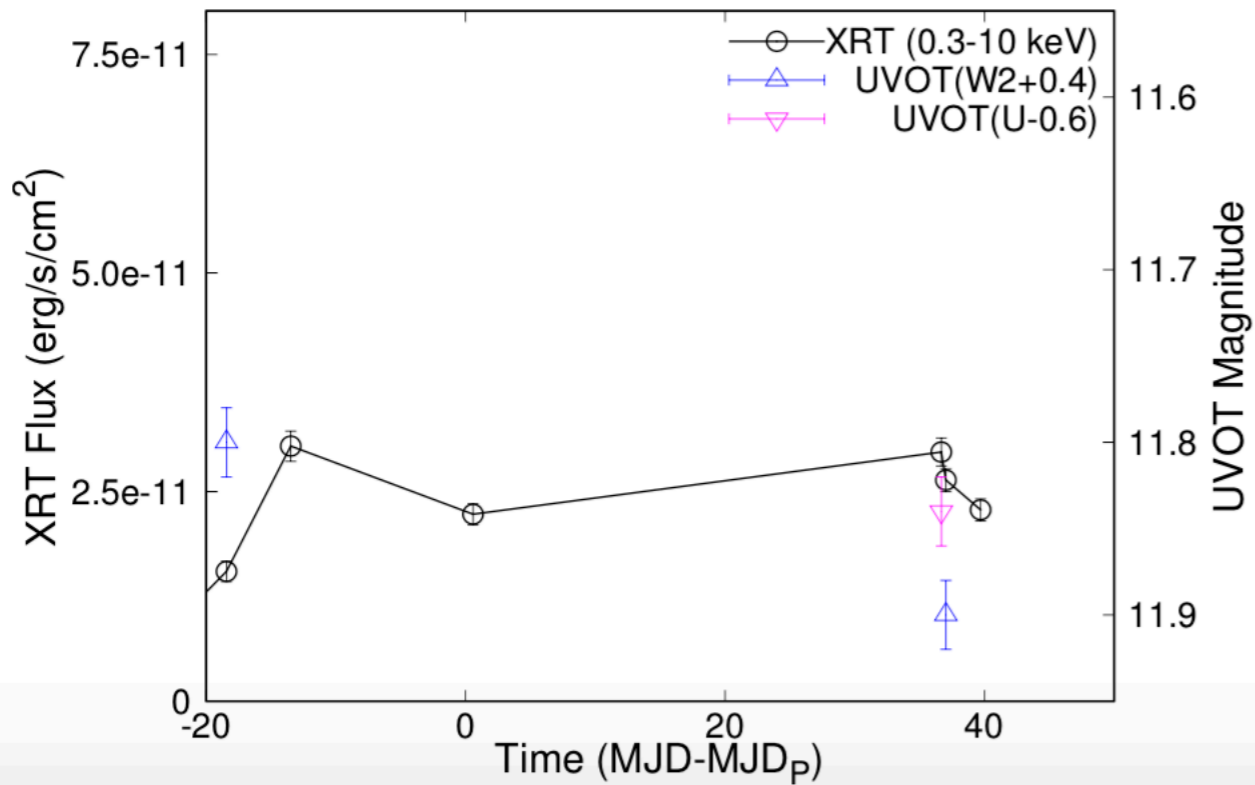
2017 Periastron



2014 Periastron



2011 Periastron



correlated X/UV activities in 2017 ?
What causes it?

origin of GeV flares

- ✿ *Models predicting IC/synchrotron at GeV cannot explain the GeV flares delayed compared to X-rays (e.g., Tam+ 2015)*
- ✿ *Models based on geometrical effects (Doppler boost, e.g., Kong+2012)*
- ✿ *Models predicting smooth(1-5 day) GeV emission*
- ✿ *Accretion-disk model (Yi & Cheng 2017)*

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- ✦ ~~Models predicting smooth(1-5 day) GeV emission~~
- ✦ Accretion-disk model (Yi & Cheng 2017), *no evidence for pulsar timing change due to disk torque (Yi & Cheng 2018)*

Summary

- *The GeV flares from PSR B1259-63 are a major unresolved phenomenon among binary studies*
- *Every time Fermi/LAT sees GeV flares since launch, in 2011, 2014 & 2017*
- *The flares are clearly delayed compared to other wavelengths*
- *The 2017 flaring period consists of short-lived but powerful GeV flares on time scales of down to hours/minutes*
- *What can we expect next?*