



Fermi

Gamma-ray Space Telescope

A DETAILED ANALYSIS OF PSR J2021+4026, THE FIRST VARIABLE GAMMA-RAY PULSAR

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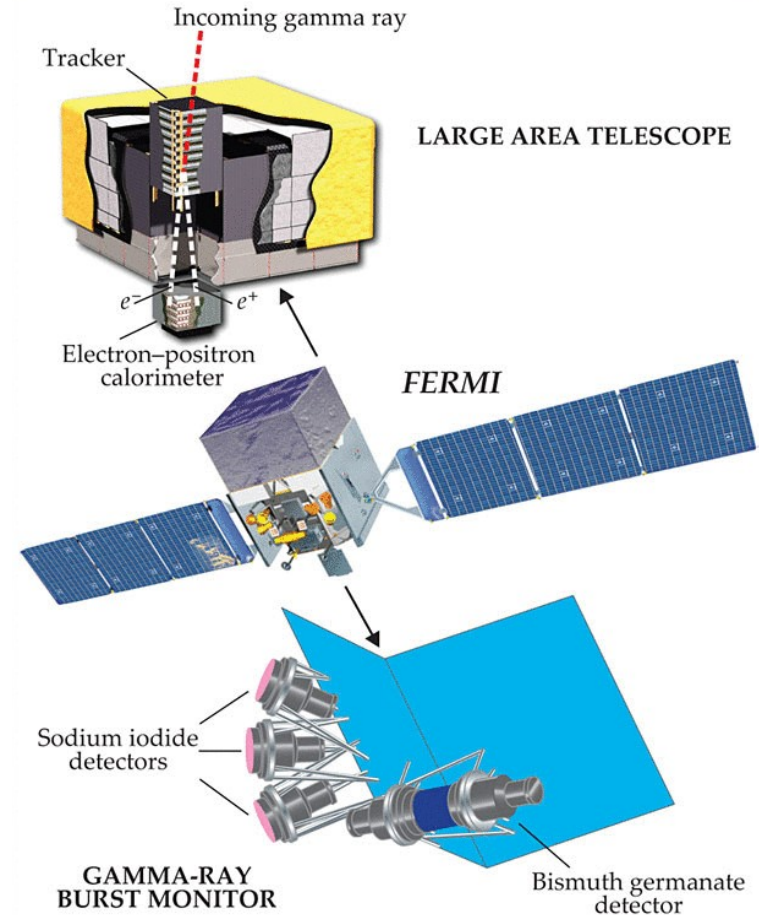
3 INAF IASF – Milano

FERMI LAT AND THE GAMMA-RAY SKY



- Operative since June 2008 (>12 years)
- **Pair-conversion** telescope
(Atwood et al. 2009. ApJ, 697, 1071)
- Energies **above 20 MeV**
- Continuously scanning the sky
- >5000 gamma-ray sources (**4FGL** catalog)
(Abdollahi et al. 2020. ApJS, 247, 33)
- **>250 gamma-ray pulsars** *

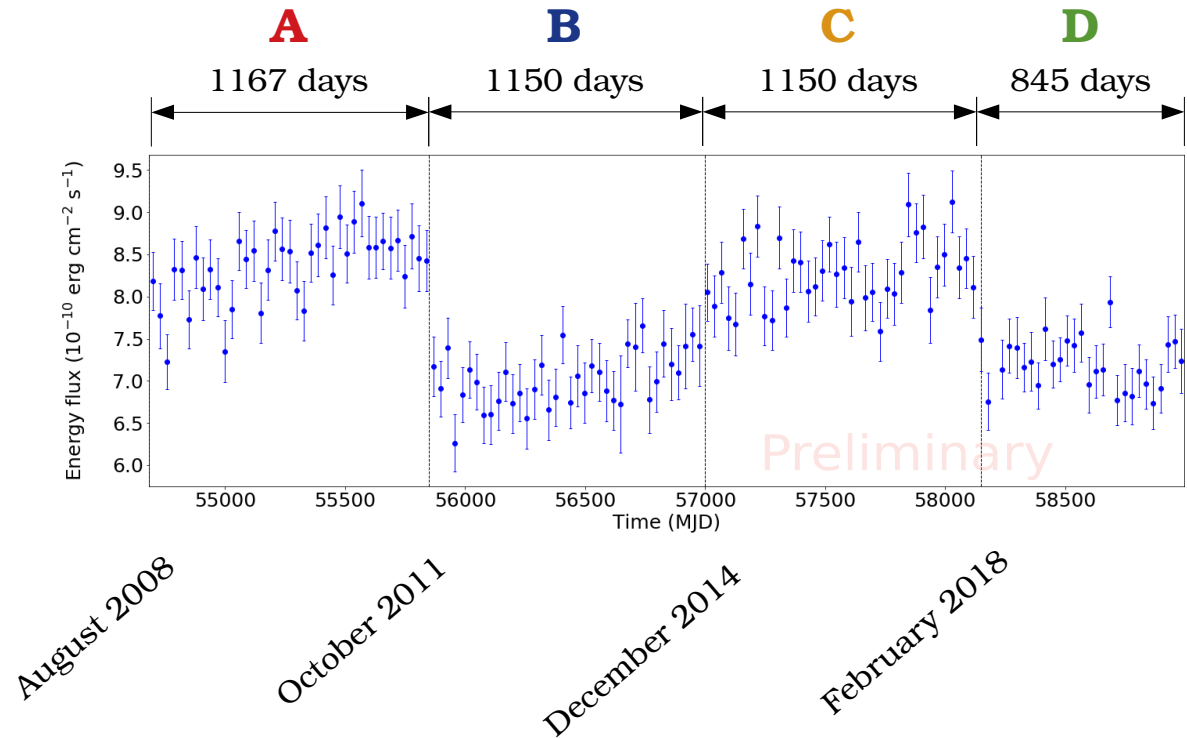
* <https://confluence.slac.stanford.edu/display/GLAMCOG/Public+List+of+LAT-Detected+Gamma-Ray+Pulsars/pulsars>



PSR J2021+4026: THE FIRST VARIABLE GAMMA-RAY PULSAR



- **Young, radio-quiet** gamma-ray pulsar
- Period ~ **256 ms**
(Abdo et al. 2009. Science, 325, 840;
Saz parkinson et al. 2010. ApJ, 725, 571)
- Lies in the Cygnus region
- **Flux** and **spin-down** variability discovered by the *Fermi* LAT Collaboration
(Allafort et al. 2013, ApJL, 777, L2)
- **Rapid state changes** at intervals of ~3 years
- Advanced **maximum likelihood** analysis of *Fermi* LAT data

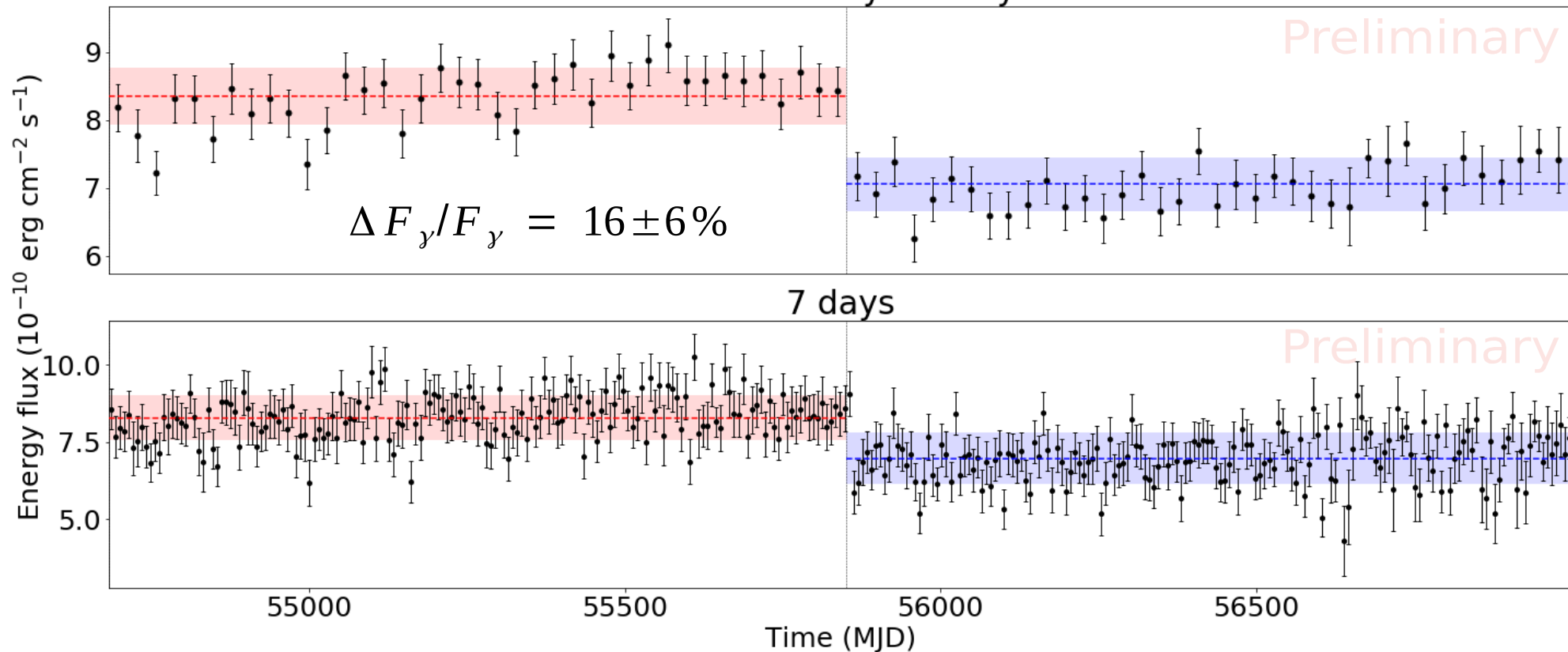


FLUX VARIABILITY AT SHORT TIMESCALES (1)

A

flux variability: 30 days

B

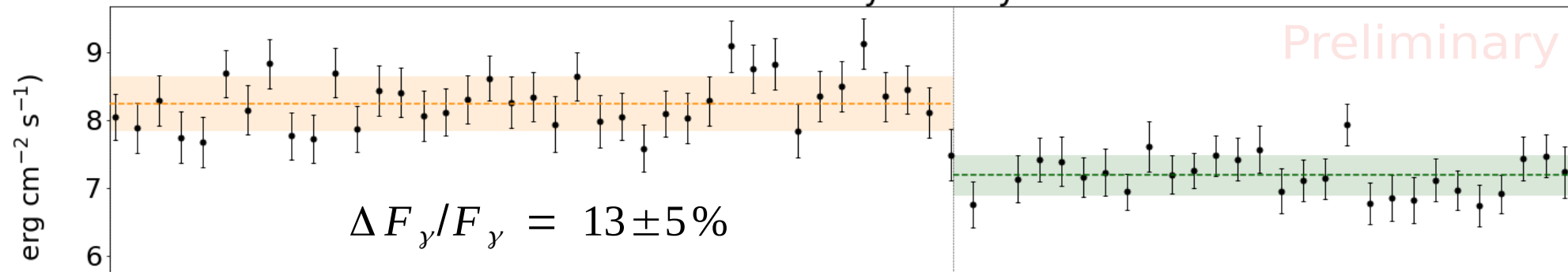


FLUX VARIABILITY AT SHORT TIMESCALES (2)

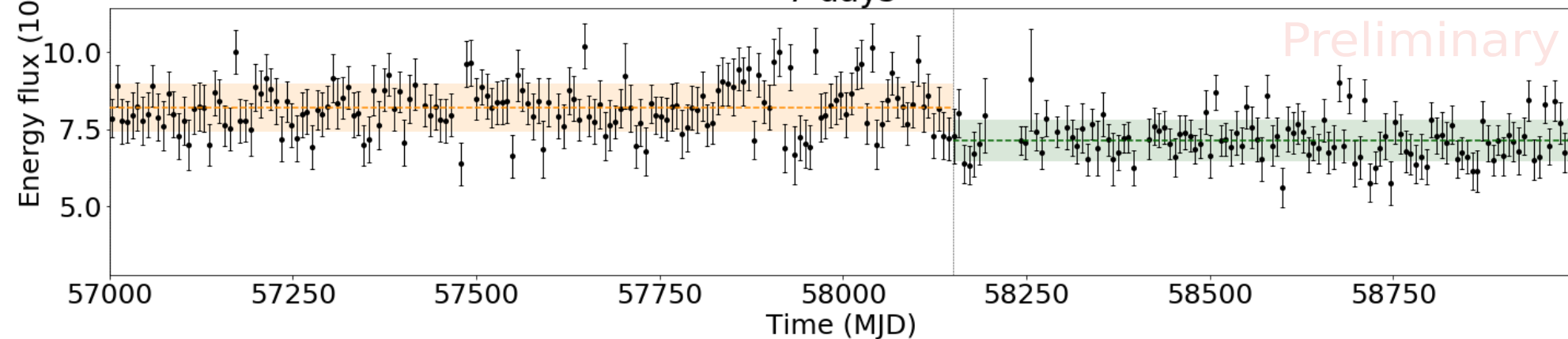
C

flux variability: 30 days

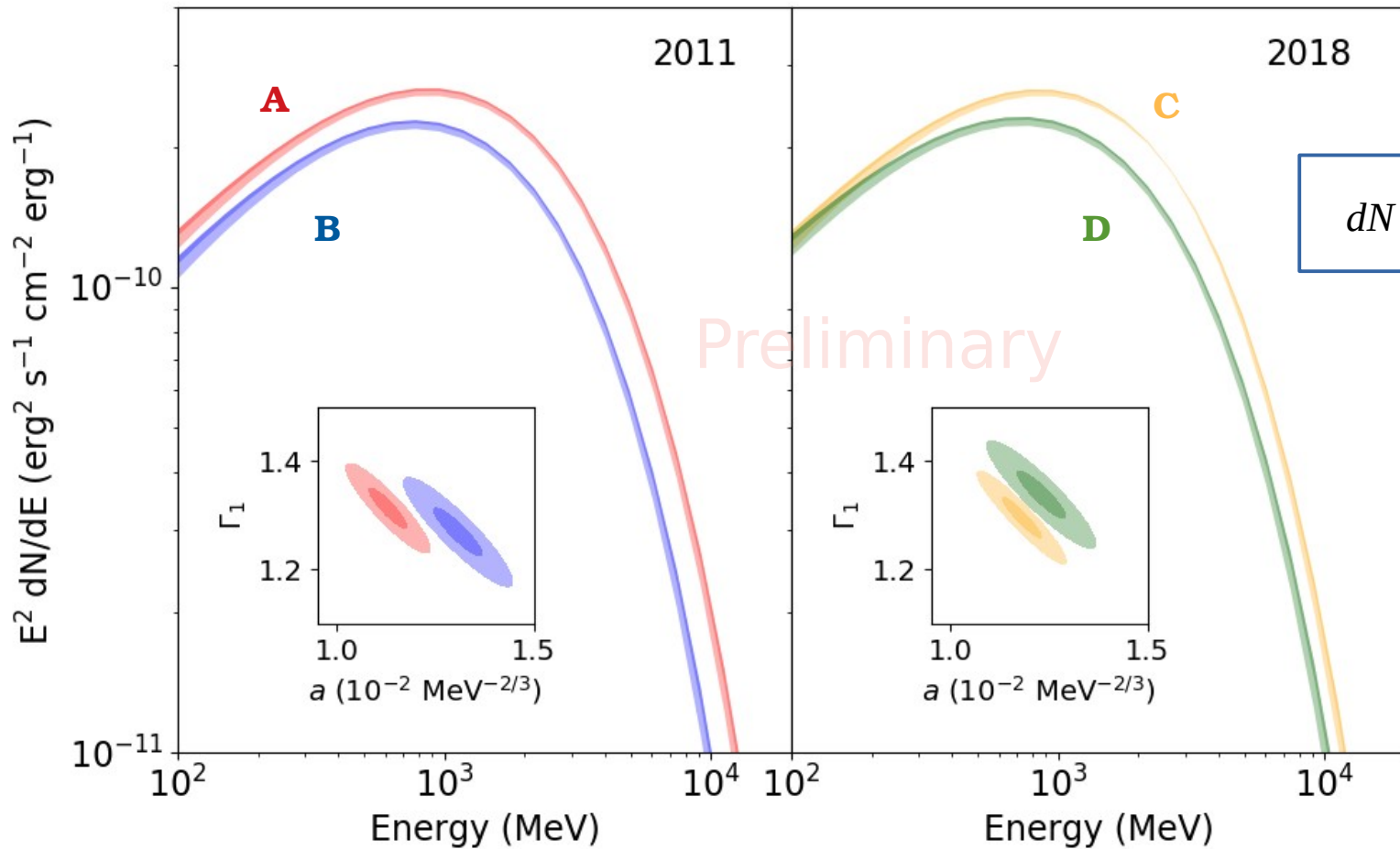
D



7 days



SPECTRAL VARIABILITY AT THE STATE CHANGES

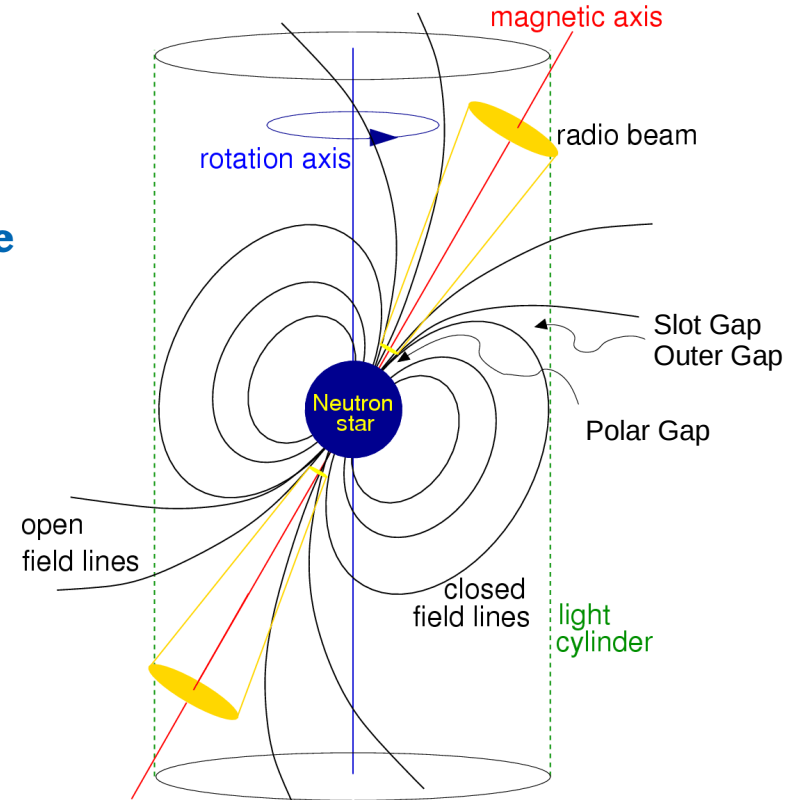


$$dN/dE \propto E^{-\Gamma_1} \exp[-a E^{2/3}]$$

THE ROLE OF PSR J2021+4026

- Unique source in the gamma-ray sky
- **Glitch** (as suggested by Ng et al. 2016. ApJ, 825, 18)
 - ~6% change in the **magnetic inclination angle**
- **No proper model** for variability of gamma-ray pulsars
- **More detailed analysis** in progress

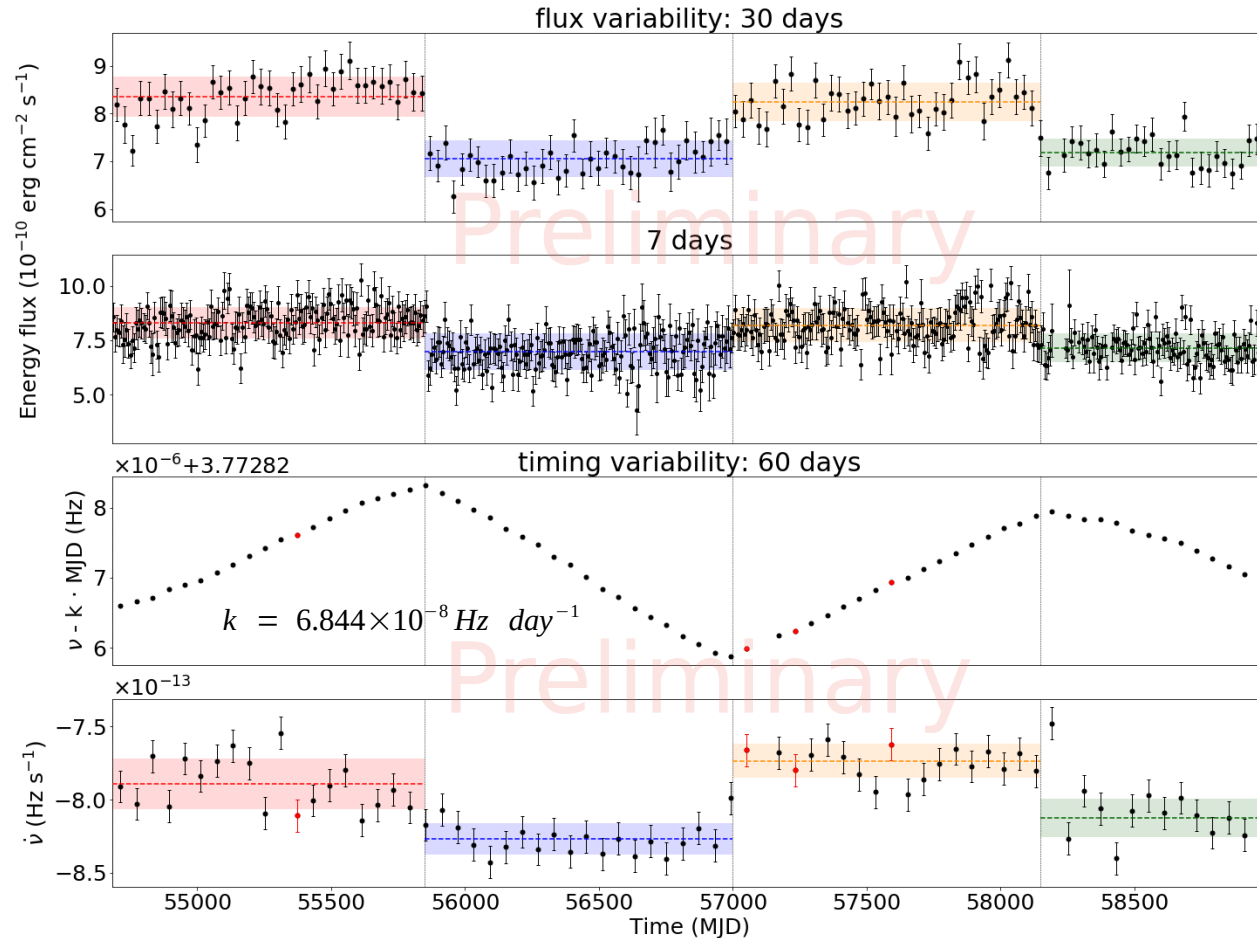
STAY TUNED!





BACKUP

EVOLUTION OF THE ROTATION



- Periodicity test (**H-test**)
(de Jager 1989. A&A, 221,180)
- 60-day bins
- ~ **5%** spin-down variations