

Long-term multi-wavelength analysis Mrk 421 variability

Vitalii Sliusar, Roland Walter, Matteo Balbo
for the FACT Collaboration

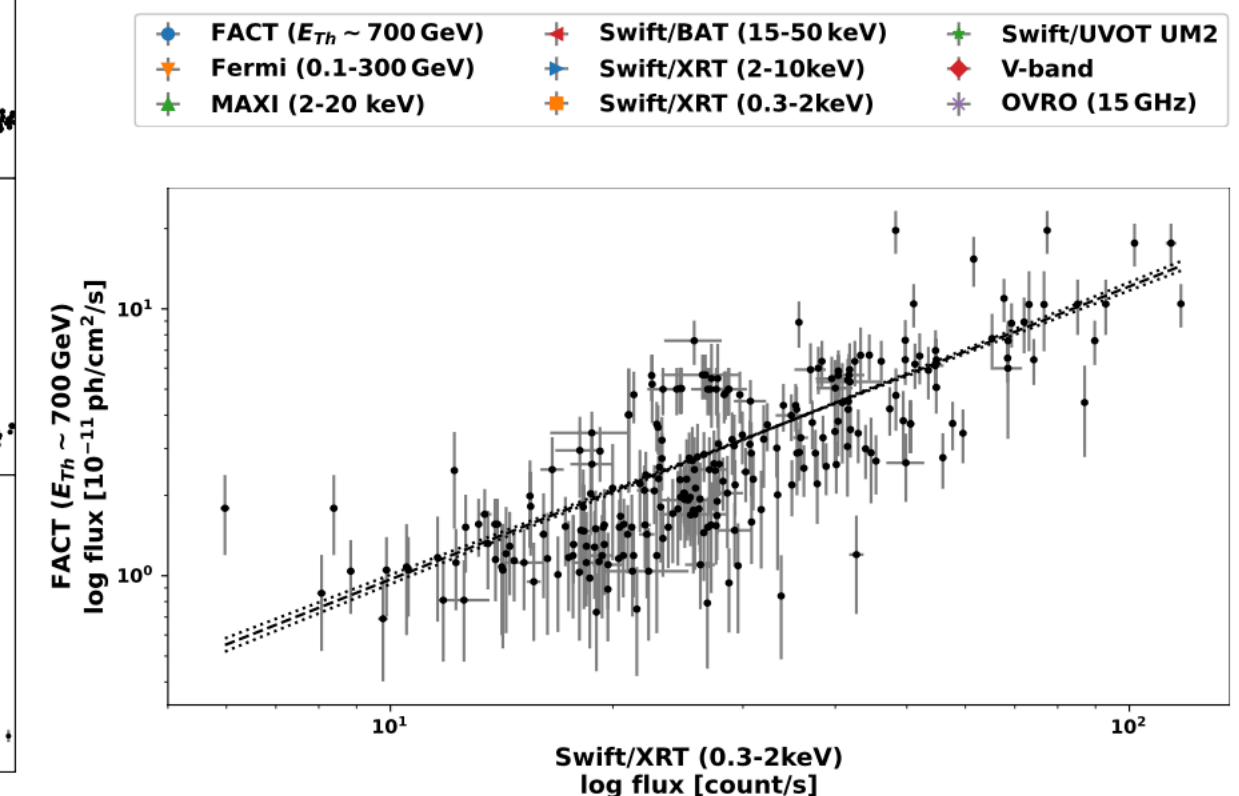
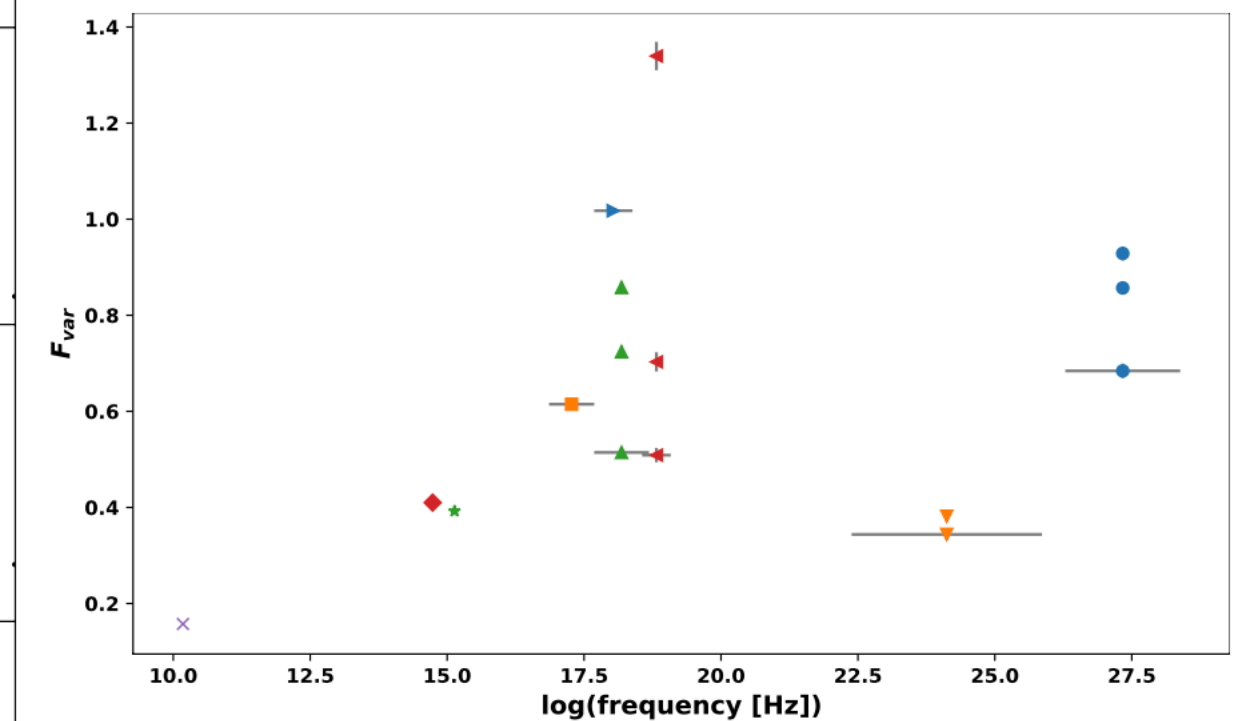
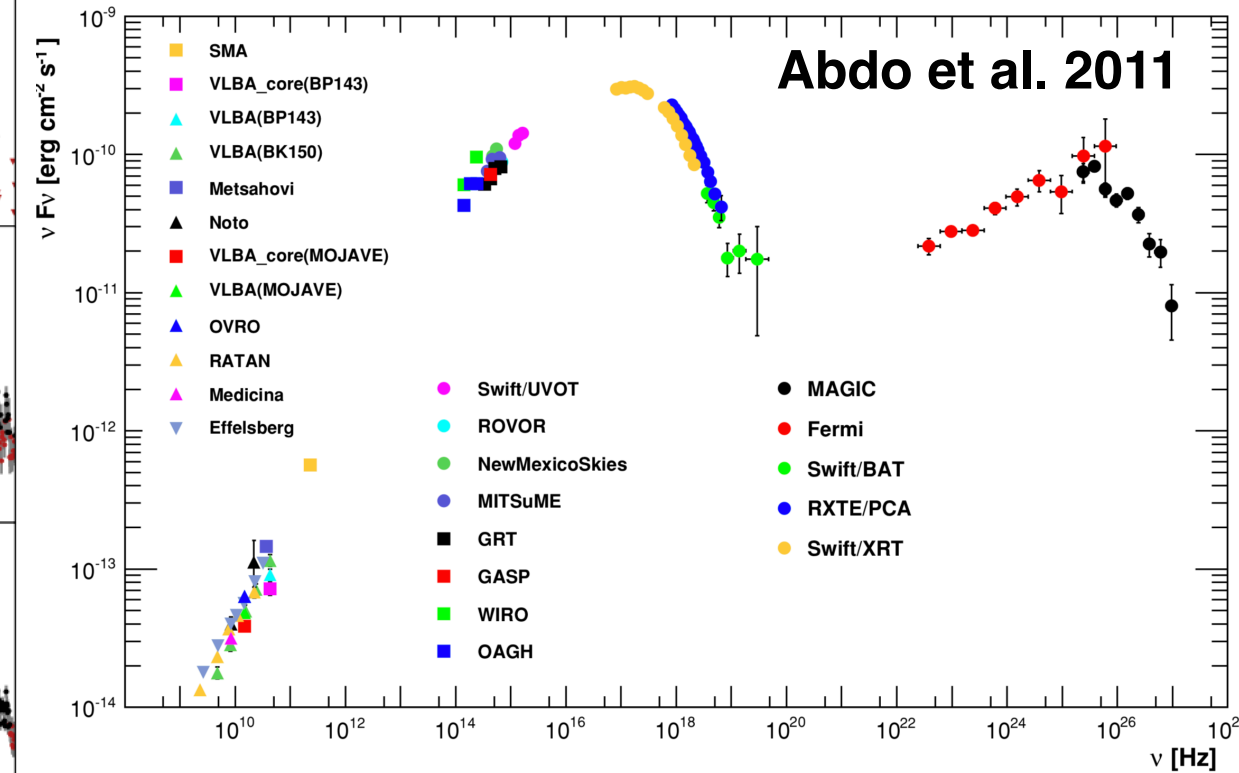
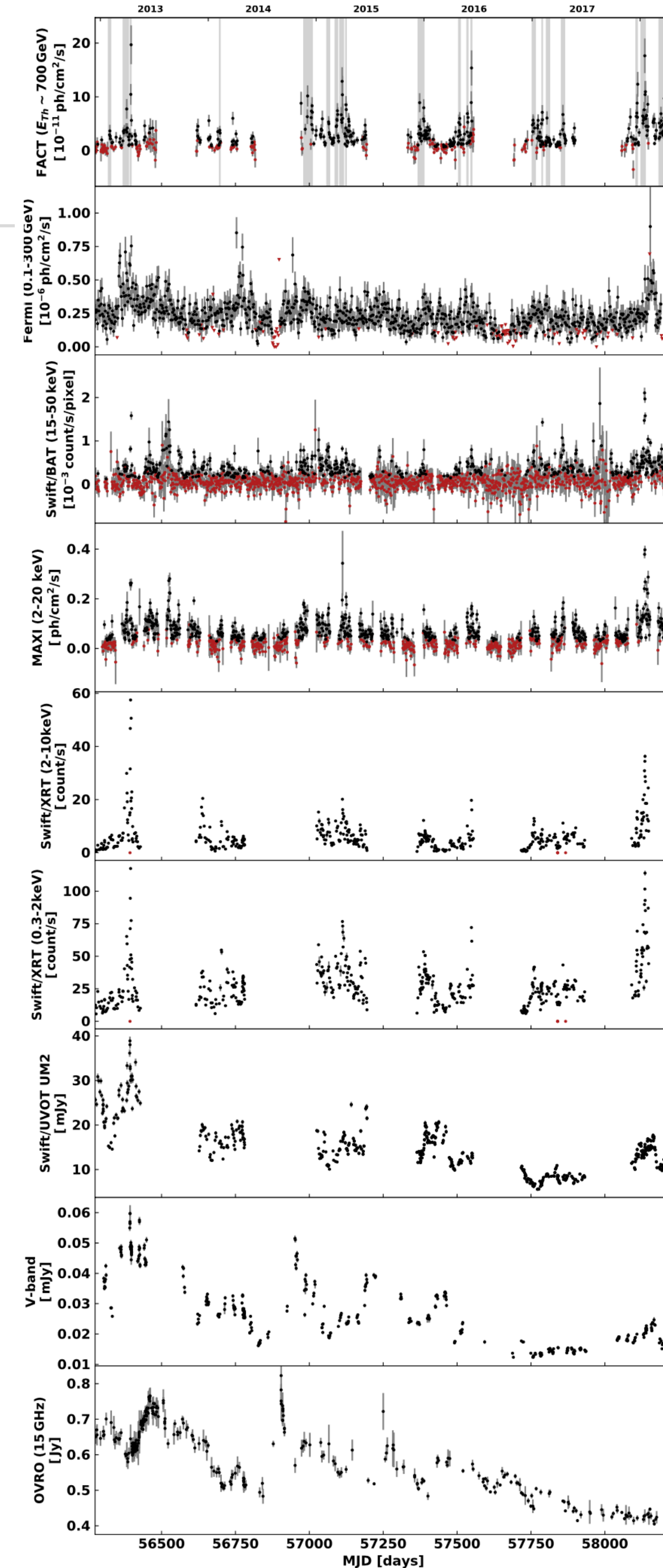
University of Geneva, Department of Astronomy, ISDC

Swiss CTA Day, Geneva, November 24, 2020

Multi-wavelength variability of Mrk 421



- Mrk 421 is HBL blazar, $z=0.031$
- Low energy hump:
 - synchrotron emission during relativistic electrons cooling
- High energy hump:
 - leptonic models:
 - one-zone SSC model (Celotti et al. 1998, Abdo et al. 2011)
 - multi-zone SSC model (Abdo et al. 2011, Aleksić et al. 2015, Zhu et al. 2016)
 - hadronic models (Mastichiadis et al. 2013, Zech et al. 2017)
 - lepto-hadronic models:
 - synchrotron-proton model (Mücke & Protheroe 2001)
 - etc.
- Variable on different time scales in all bands. 5.5 years of multi-wavelength data were used: radio (OVRO), optical (Bok & Swift/UVOT), X-rays (Swift/BAT, Swift/XRT, MAXI), GeV gamma-rays (Fermi LAT) and TeV gamma-rays (FACT, $E_{th} \sim 700$ GeV).
 - Variability increased from radio to X-rays and from MeV to TeV
 - Highest variability in hard X-rays
- TeV and X-ray are correlated, the slope is 1.098 ± 0.033 and can be related to variable electron cut-off energy

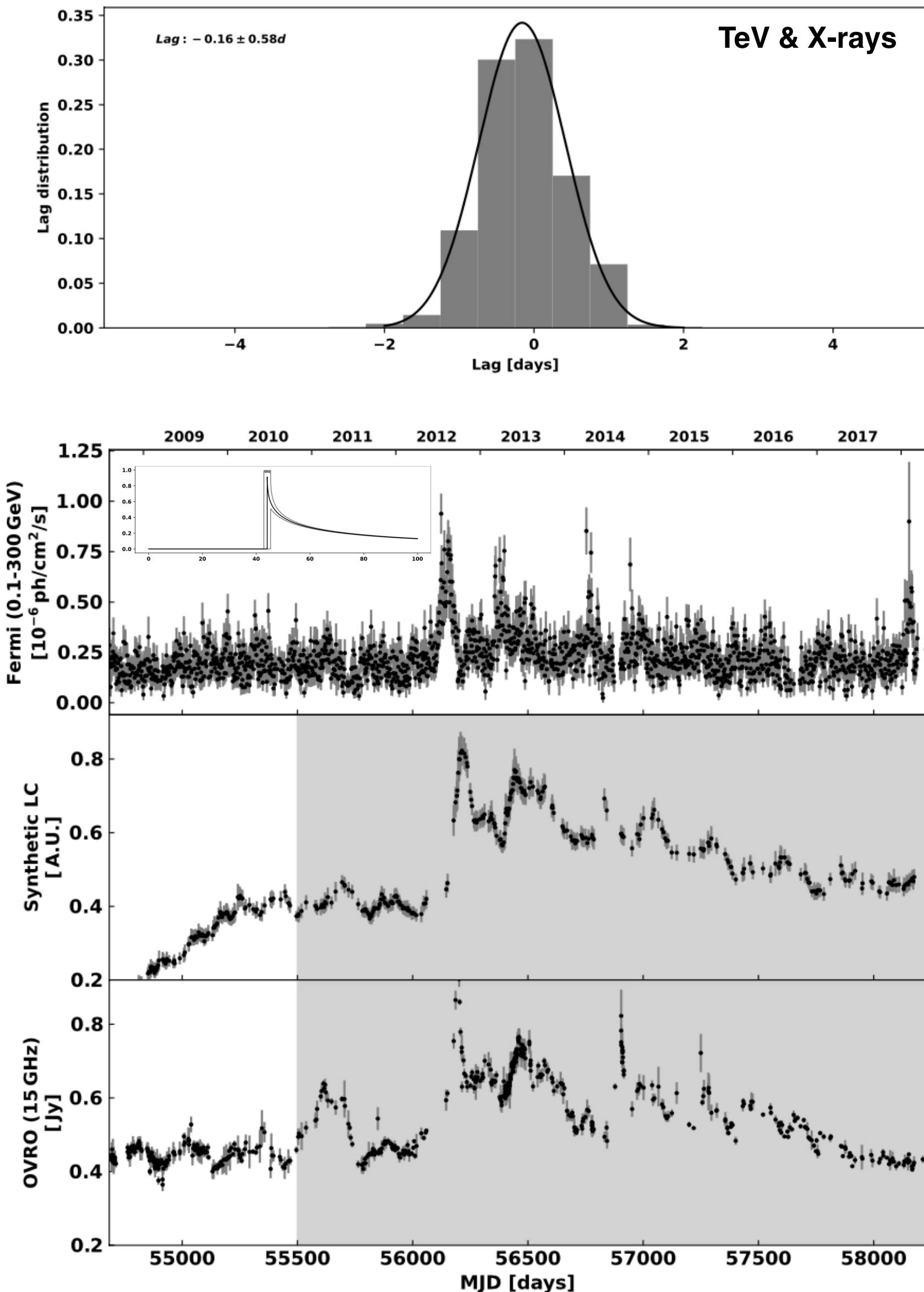


Results

(more info on the poster)



- TeV and X-ray are strongly correlated with -0.16 ± 0.58 (1σ) days lag
 - Variability on the same few days timescales
 - All TeV flares are coincident with ones in the X-rays
- TeV and X-rays flares have spacing of 7.5 - 30 days
 - Lense-Thirring precession for an inclined accretion disk may explain such timing
- Optical and radio light curves are broadly correlated
 - Optical variability is leading by 30-70 days
- GeV and radio light curves are broadly correlated
 - GeV variability leads by 40-70 days
 - Delayed (43 days) fast-rising-slow-decay profile may be used to derive radio variability from GeV one
 - Fast radio flares cannot be reproduced using such an approach (different emission zones?)
- GeV is not correlated with TeV and X-rays
 - Variability in TeV and GeV, and radio/optical and X-rays are driven by different parameters
- Observed variability is compliant with leptonic SSC scenario



Thank you for your attention!

CTA follows up

FACT
monitors in TeV
and triggers

