

Multi-waveband study of TeV blazar 1ES 1959+650 during a high state in 2016



Amit Shukla

on behalf of FACT collaboration, Katharina Leiter and other multi-waveband partners

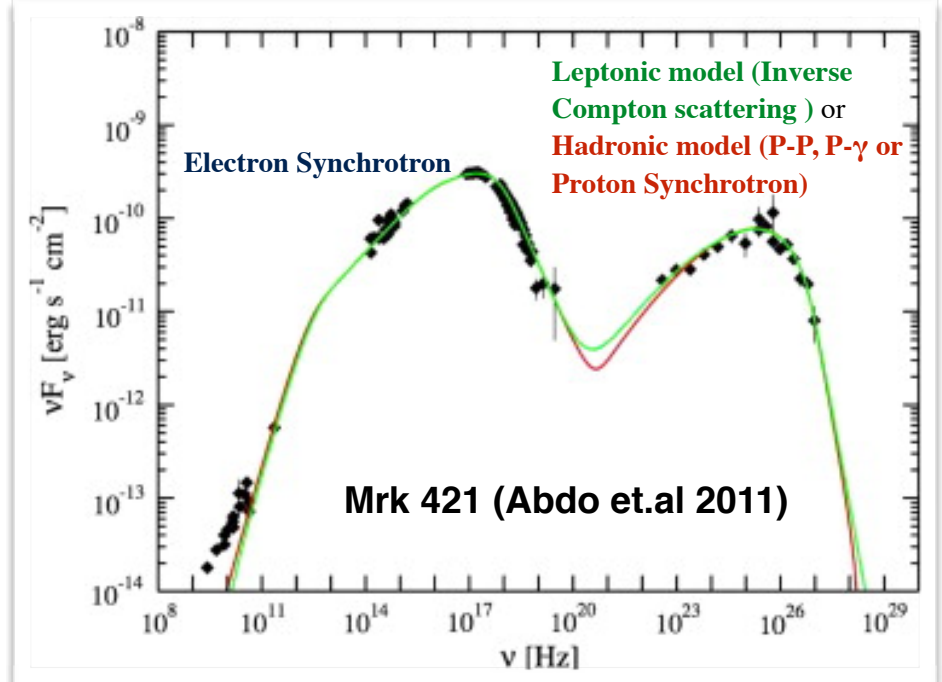
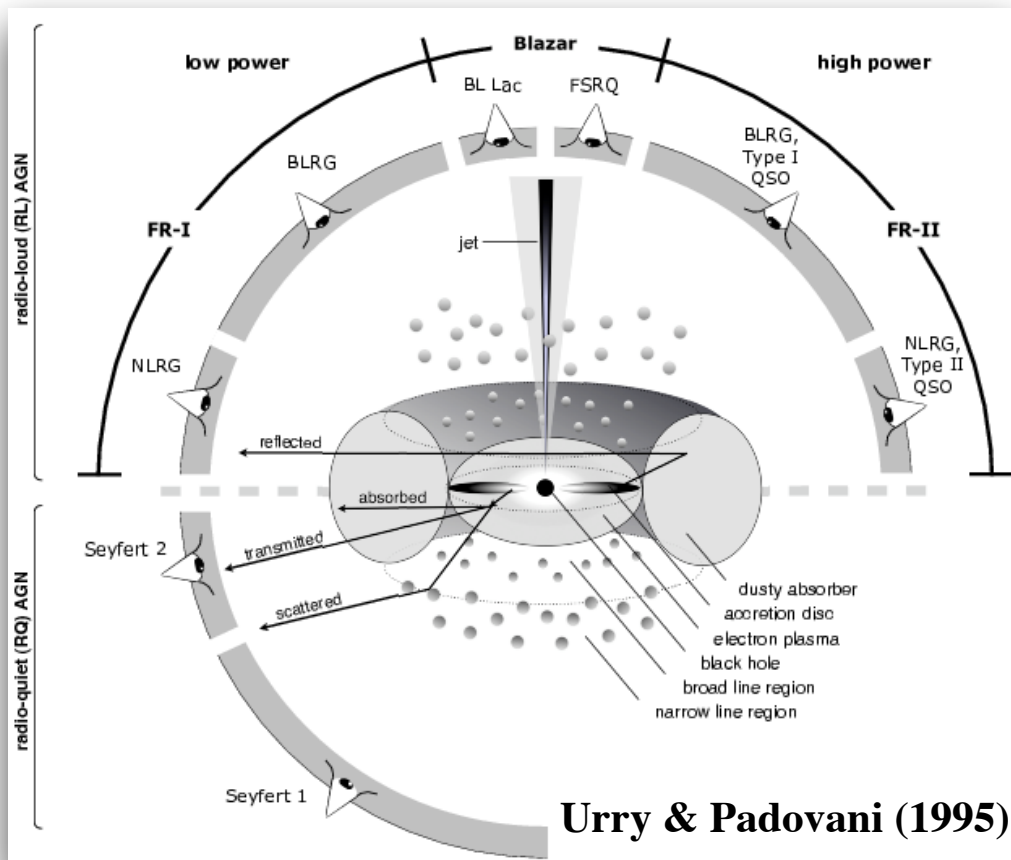


FACT

- **First - GAPD Cherenkov Telescope**
- **Site: Observatorio del Roque de los Muchachos, La Palma at altitude 2200 m**
- **Operational since October 2011**
- **9.5 m² mirror area**
- **4.5° FoV, 1440 pixels à 0.11°**
- **Silicon based photosensors (SiPM)**
- **Stable detector performance**
- **Observations during bright light**
- **Ideal for monitoring**
- **Energy threshold ~750 GeV**

Active Galactic Nuclei & Blazars

- Highly variable
- Blazar's broad band spectral energy distribution (SED) consists of typically two broad peaks.

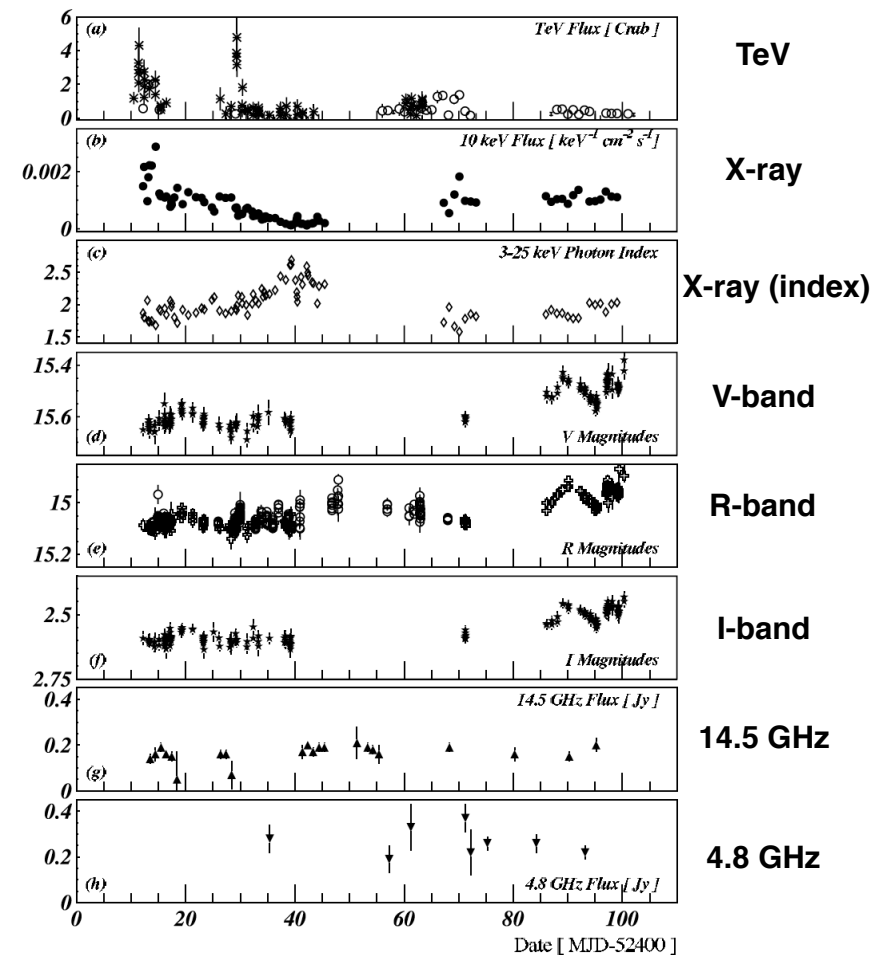


1ES1959+650

- 1ES 1959+650 is a HBL at $z=0.048$
- Two bright flares during 2002
- X-ray and gamma-ray fluxes are correlated in general (Kr04)
- Optical flux shows variability but no correlation was found with X-ray or gamma-ray flares (Kr04)
- Fastest gamma-ray flux doubling timescales based on the Whipple data was ~ 7 hrs (Kr04)

Source had undergone a long term low state of activity after 2002 ..

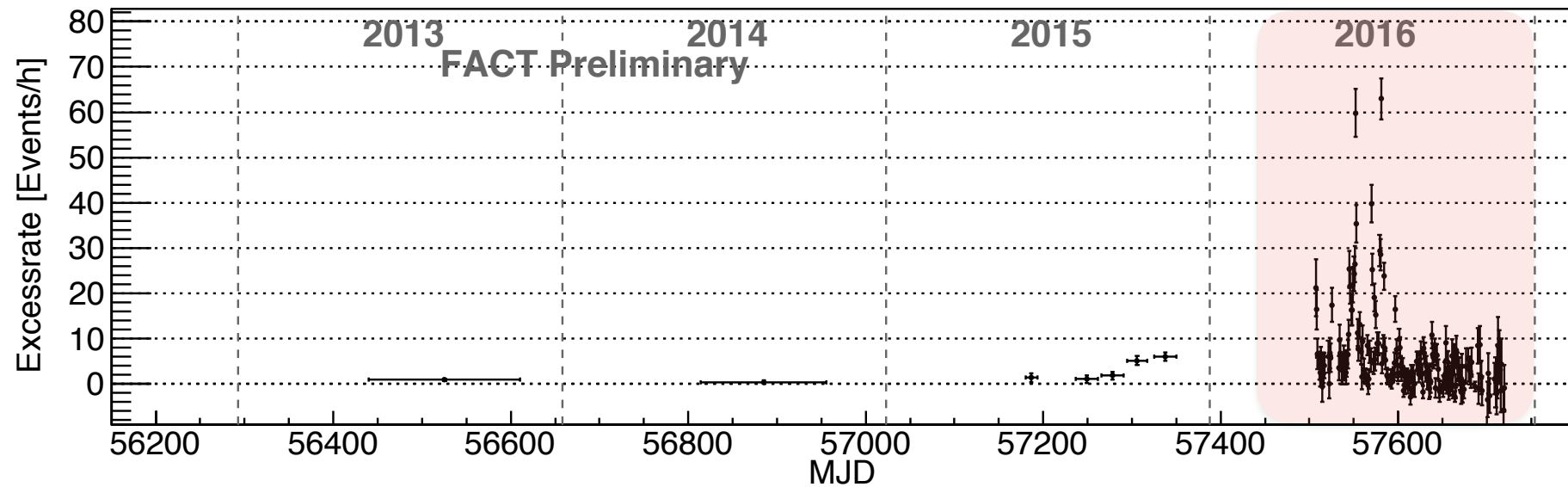
- MAGIC (2004) ~ 20 % of the Crab Nebula
- VERITAS (2007-2011) ~ 23 % of the Crab Nebula
- FACT (2013-2014) $\sim < 20$ % of the Crab Nebula
- VERITAS detected enhanced activity on October 8, 2015, with flux ~ 50 % Crab Nebula
- Swift-XRT observed high flux on 2015 August 25, 2015 ~ 11 cts/s



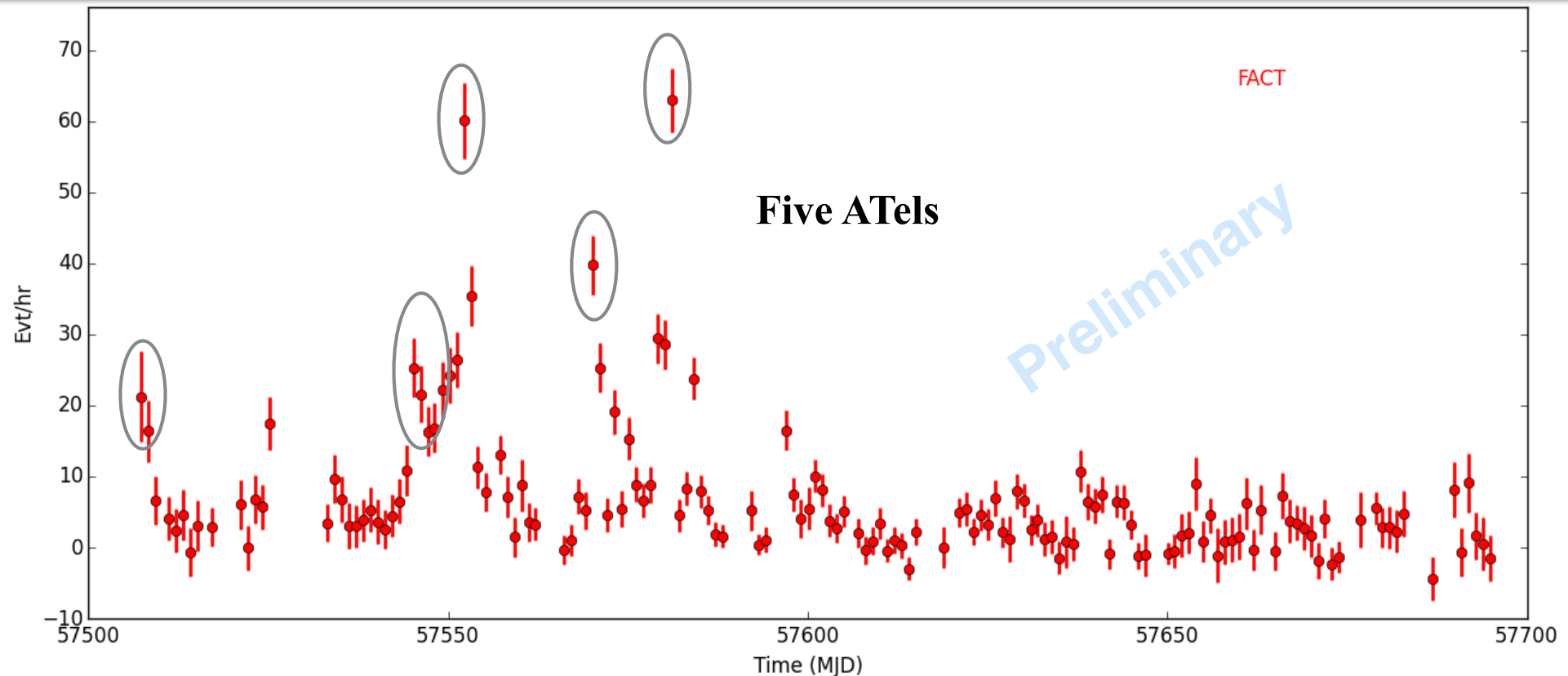
Krawczynski et al. 2004 (Kr04)

1ES1959+650 with FACT

FACT four years light curve



1ES 1959+650 FACT light curve during 2016



FACT detected several flares including five ATels on the source during 2016

ATel #9239 : FACT collaborations

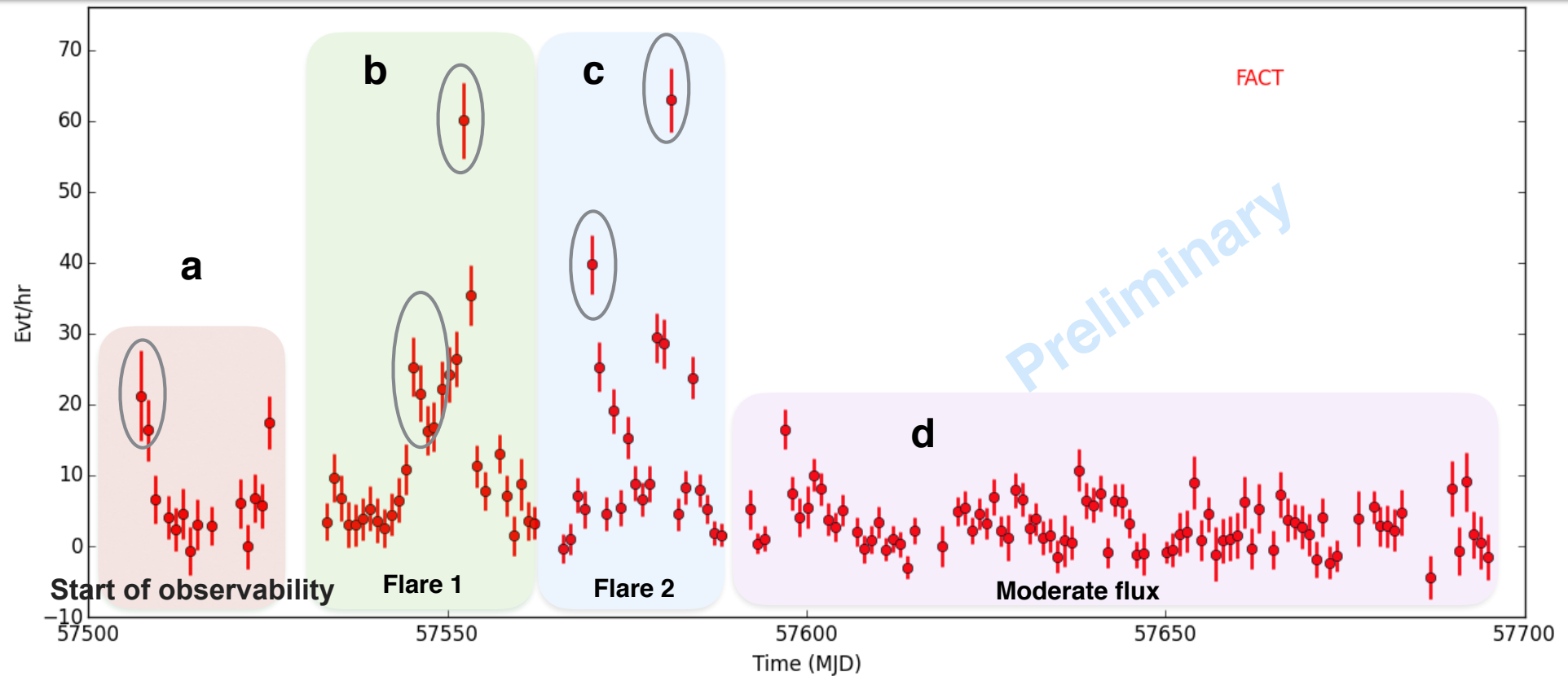
ATel #9203 : FACT and MAGIC collaborations

ATel #9148 : FACT, MAGIC, VERITAS and Fermi-LAT collaborations

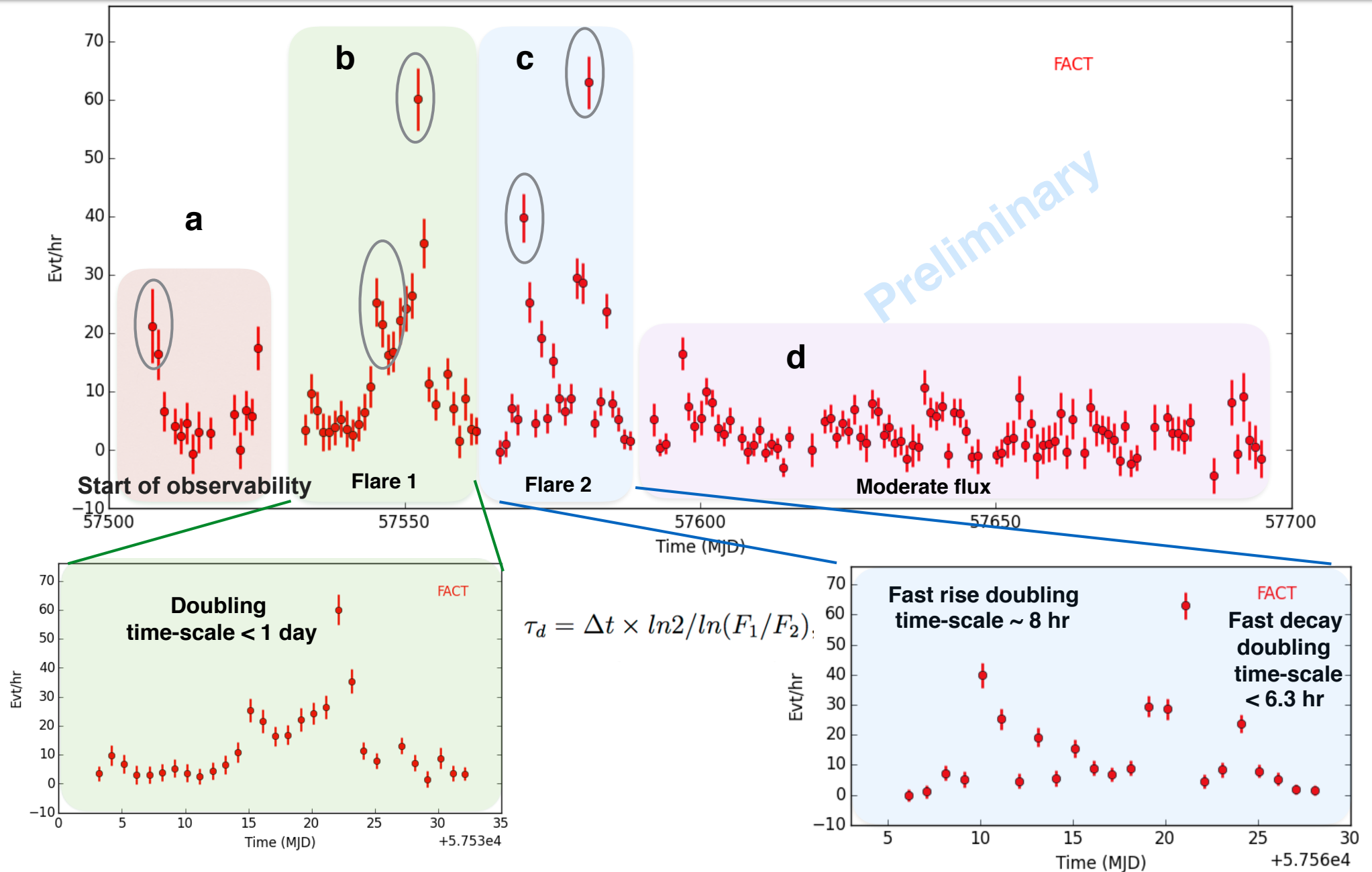
ATel #9139 : FACT and MAGIC collaborations

ATel #9010 : Fermi-LAT, FACT, MAGIC and VERITAS collaborations

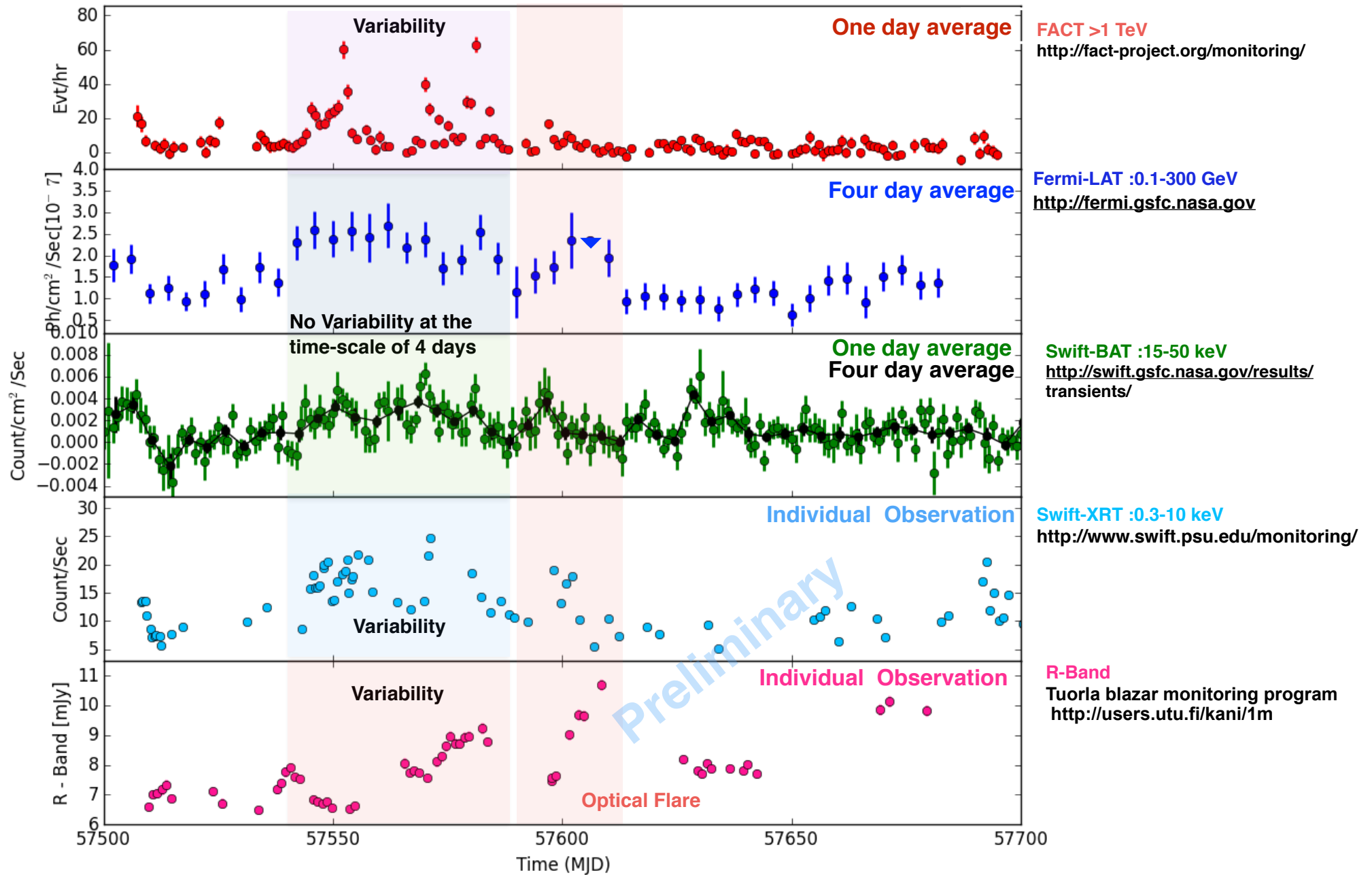
1ES 1959+650 FACT light curve during 2016



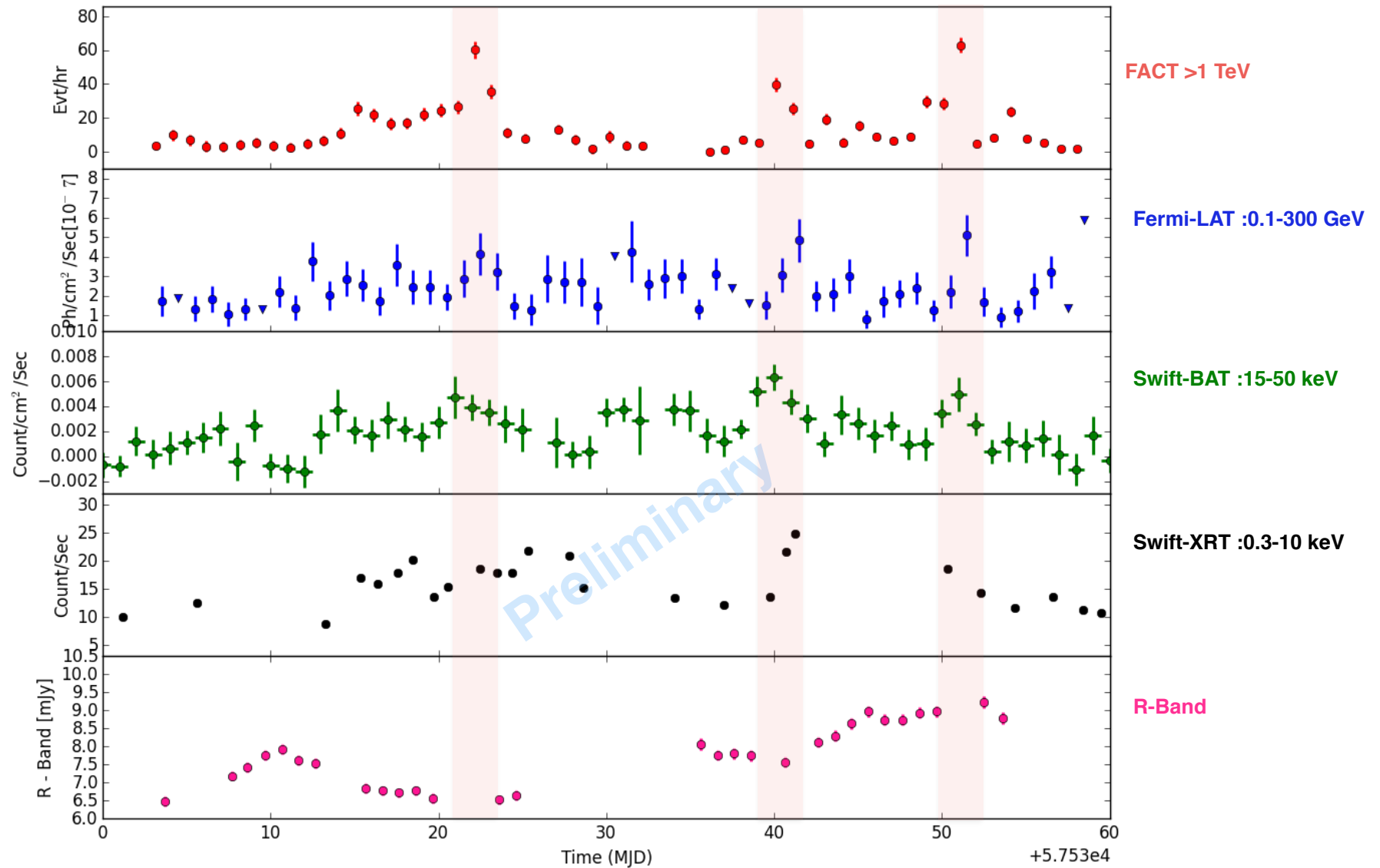
1ES 1959+650 FACT light curve during 2016



Multi-waveband light curve during 2016



Multi-waveband light curve during high activity



Flux variability at one day time-scales is observed

Summary

- FACT has observed several flares from the source during 2016 and five ATels were sent
- Brightest flux was observed on 12 July 2016 ~ 3.5 Crab units (ATel #9239)
- Flux doubling time-scale (decay) of < 6.3 hr is observed by FACT
- Mild correlation between X-ray and TeV fluxes is found
- Enhance activity is observed in Fermi-LAT and Swift-XRT during the period when FACT had observed high activity in the source.