



H.E.S.S. detection and multi-wavelength study of the $z = 0.991$ blazar PKS 0346-27



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Abstract

Over the course of a ~ 1 month long target-of-opportunity observing campaign in October – November 2021, H.E.S.S. detected the FSRQ-type, $z = 0.991$ blazar PKS 0346-27 during only one night, at a significance of 7.7σ . This was a new VHE blazar redshift record at the time of the first report. The source thus shows day-scale VHE g-ray variability, but no evidence for intra-day variability. Remarkably, a HE g-ray flare detected by Fermi-LAT precedes the VHE flare by about 2 days, with no significant HE variability during the VHE flare. There is no evidence for correlated X-ray variability, although X-ray coverage was sparse. The VHE spectrum is very steep and connects smoothly to the contemporaneous Fermi-LAT spectrum. Single-zone SED modelling strongly prefers a hadronic origin of the γ -ray emission, due to the drastically different optical – UV (electron synchrotron) and γ -ray spectral shapes.

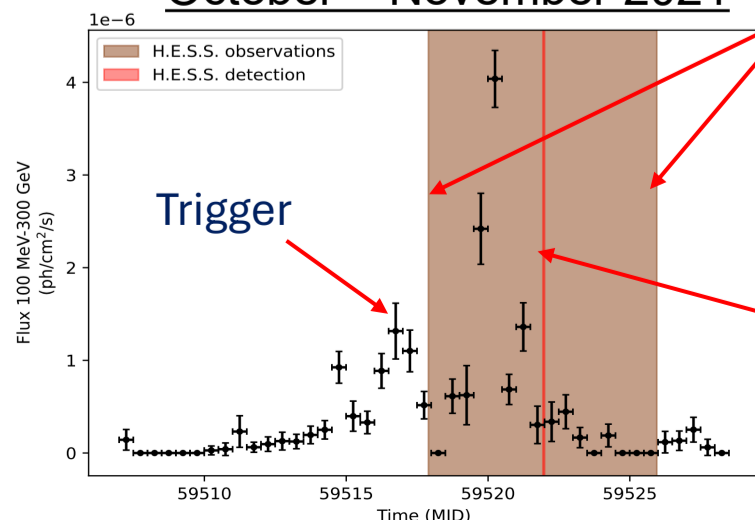
H.E.S.S. ToO programme on high- z blazars

- Goal to extend the VHE blazar horizon to $z > 1$
- Probe evolution of the EBL out to $z > 1$
- H.E.S.S. observations triggered by flaring in other wavebands (primarily Fermi-LAT)
- Co-ordinated multi-wavelength observations (usually H.E.S.S., Fermi-LAT, Neil-Gehrels Swift, ATOM)
- 7 blazars with $0.991 < z < 1.424$ observed since 2016

H.E.S.S. Observations of PKS 0346-27

- FSRQ at $z = 0.991$
- H.E.S.S. ToO observations triggered by Fermi-LAT high state on 30 Oct. 2021
- 53 runs (~ 26 hours) of H.E.S.S. Observations between 30th Oct. and 29th Nov. 2021
- Simultaneous coverage by Neil-Gehrels Swift (XRT + UVOT) and ATOM

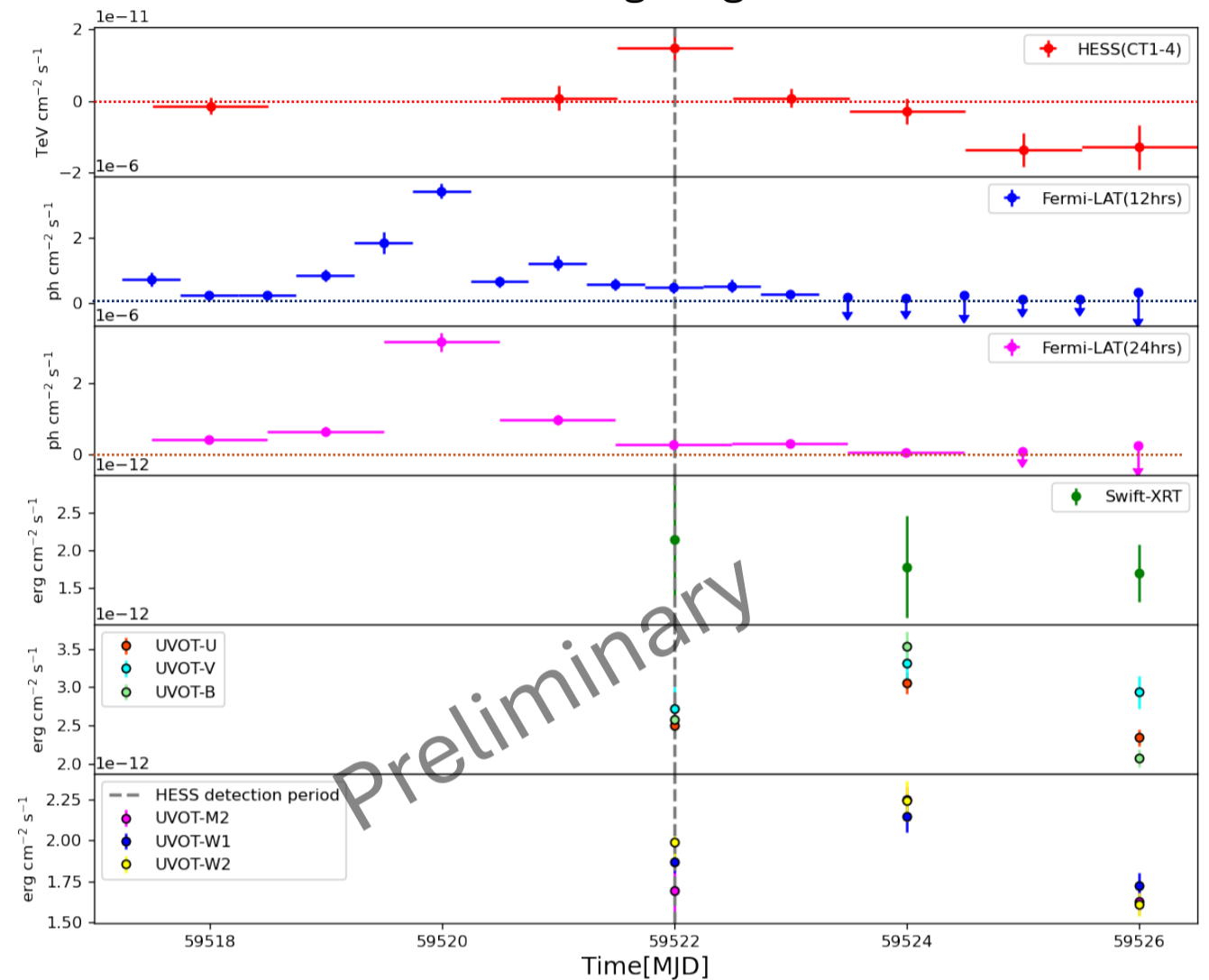
October – November 2021



Period of H.E.S.S. observations

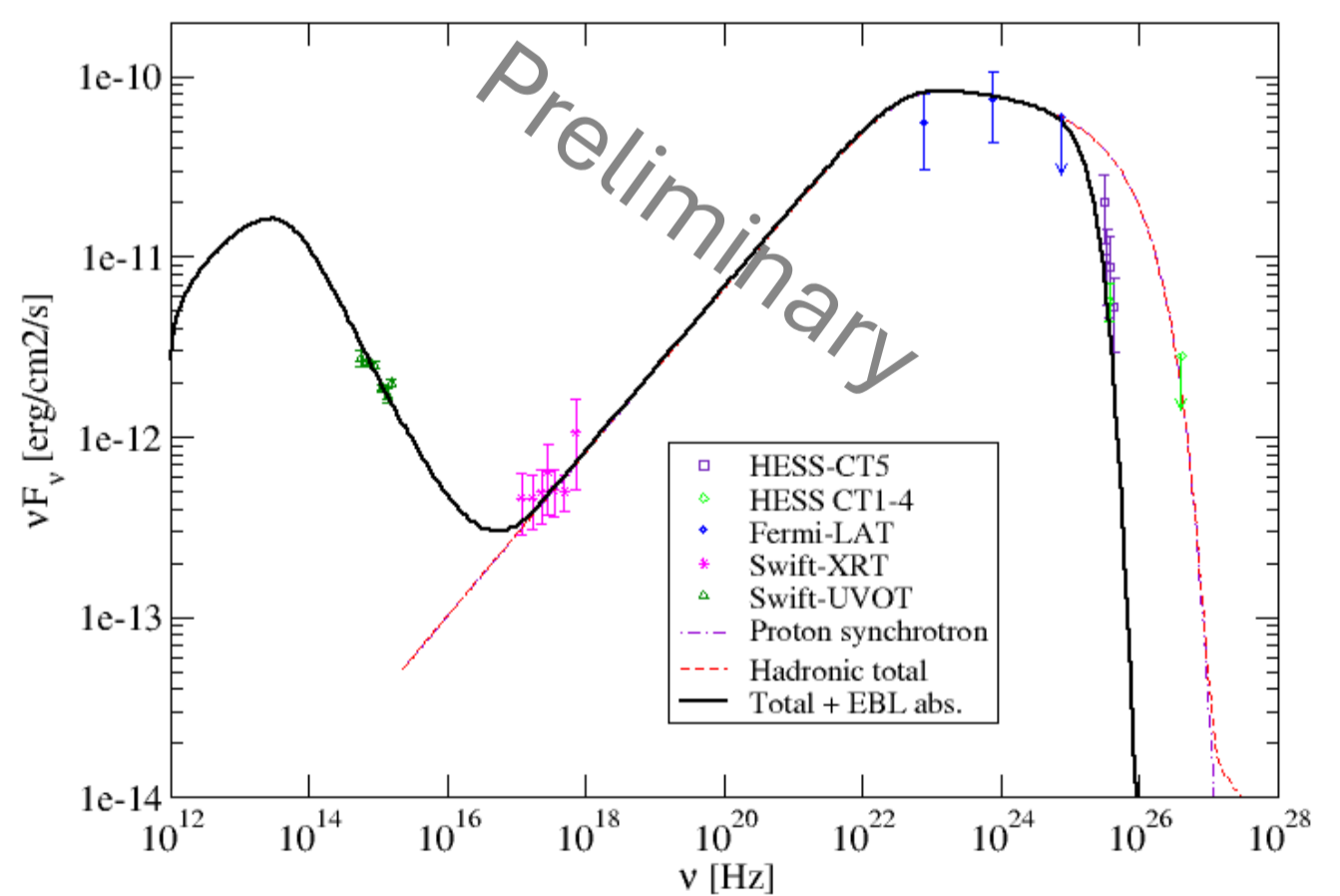
H.E.S.S. detection on 3rd Nov. 2021: 4 runs, 7.7σ (ATel: # 15020) New blazar redshift record at the time!

Multi-wavelength light curves



- H.E.S.S. flare ~ 2 days delayed w.r.t. Fermi-LAT!
- No evidence for significant activity in X-rays.
- No evidence for intra-night variability.

SED modeling



- Proton-synchrotron dominated model with jet power dominated by B-field.
- EBL absorption clearly significant, but can't distinguish between 3 considered EBL models: Franceschini et al. (2008), Gilmore et al. (2009), Finke et al. (2010).
- Leptonic fit not plausibly feasible due to drastically different optical vs. HE γ -ray spectra.