The Gamma-ray Spectrum of the Most Distant TeV-Emitting Blazar **PKS 1424+240**

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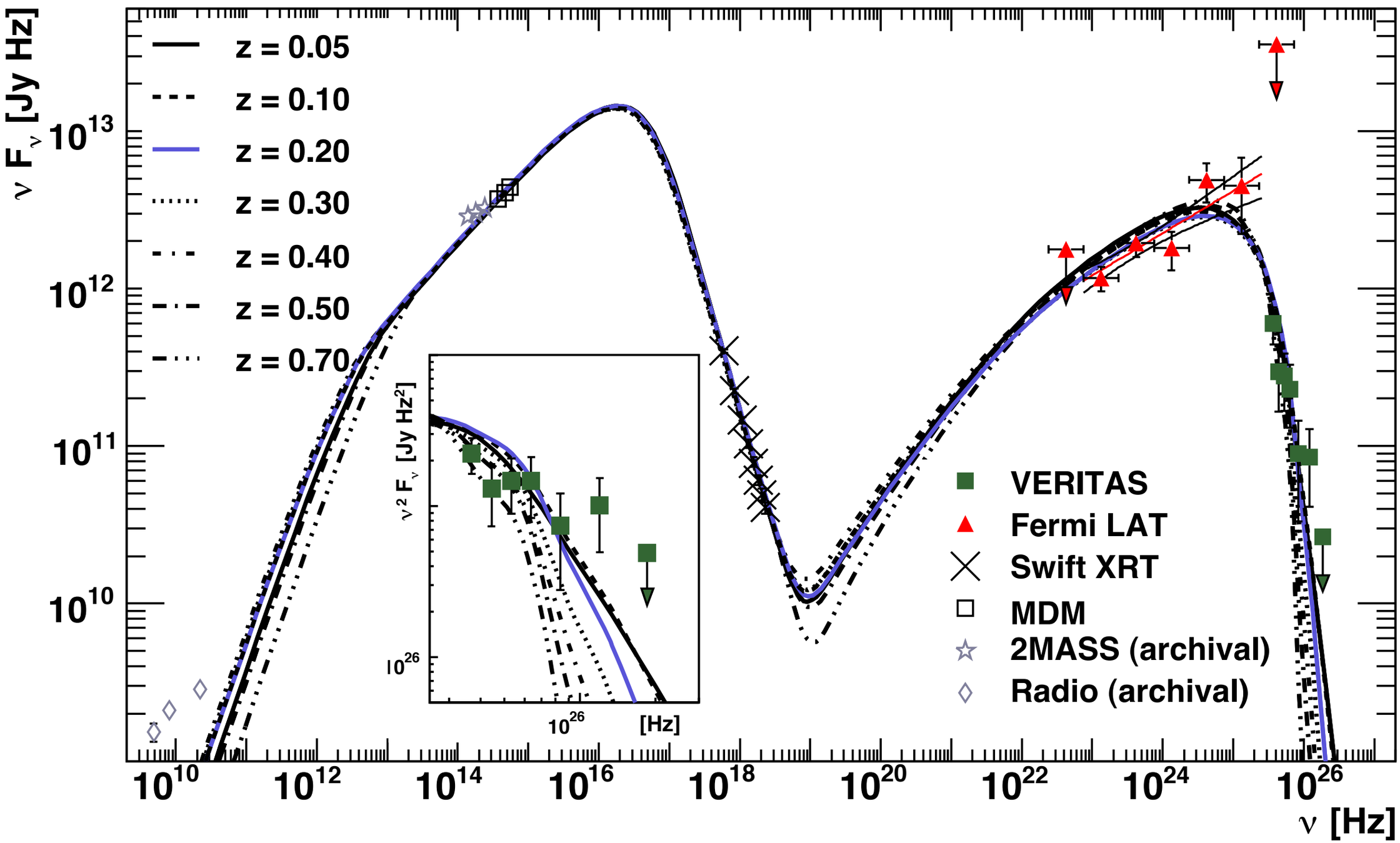
Turku, Finland EWASS
The Gamma-ray Sky in the Era of Fermi and Cherenkov Telescopes

First Fermi-LAT motivated blazar detection in June 2009

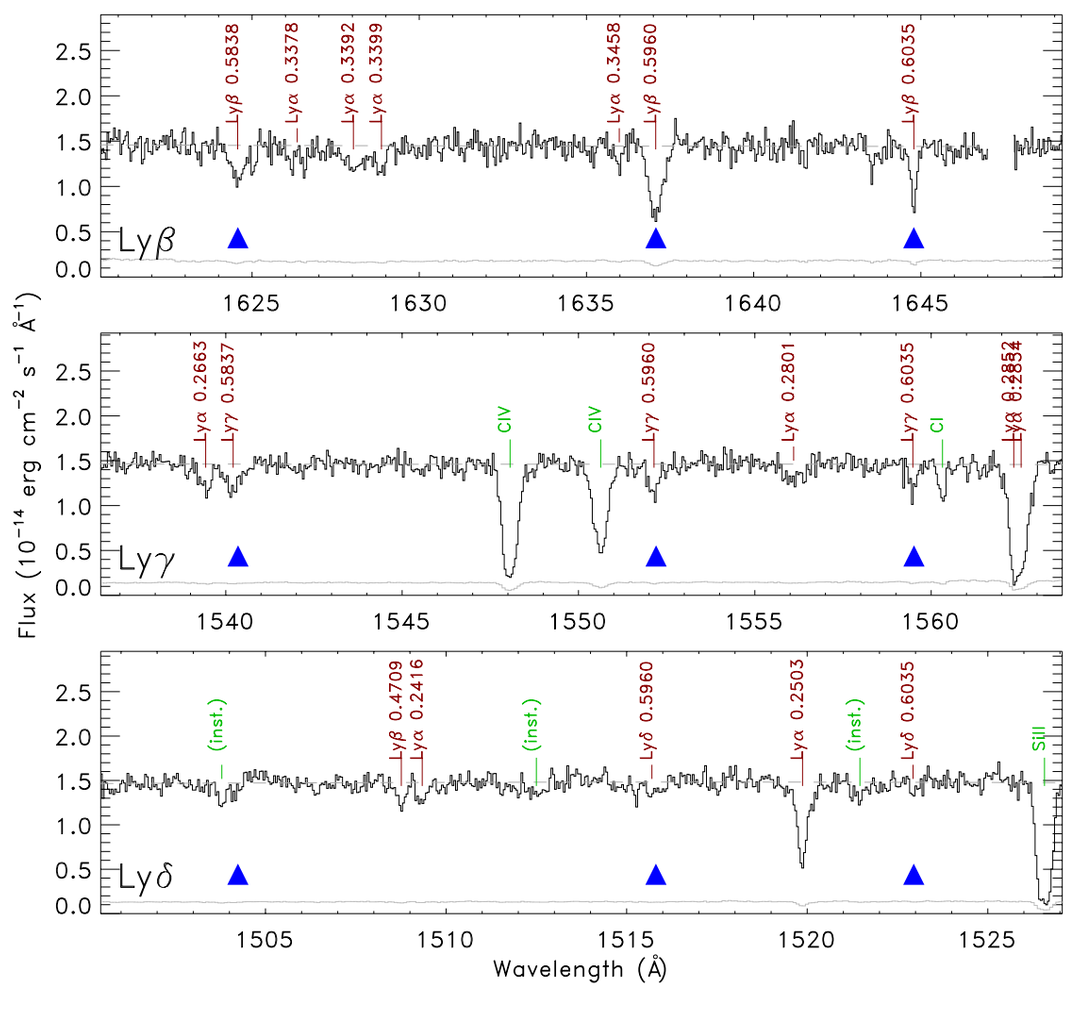
- No redshift information
- On the ISP/HSP cusp
- Soft X-ray spectrum

- Used MWL data to show likely z<0.67
- Used SSC SED modeling to show likely z<0.2



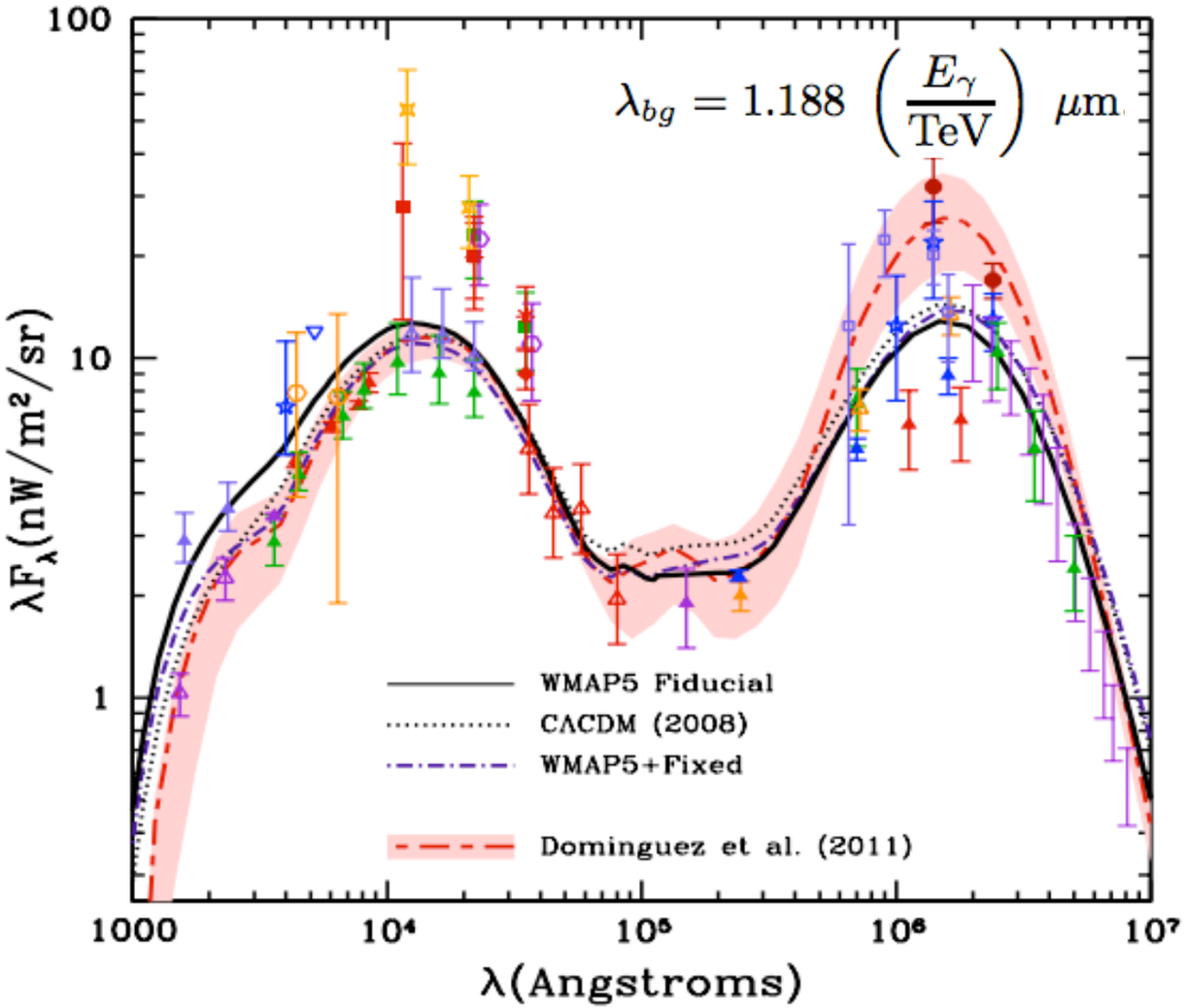
Redshift Lower Limit of PKS 1424+240 from Far UV Observations

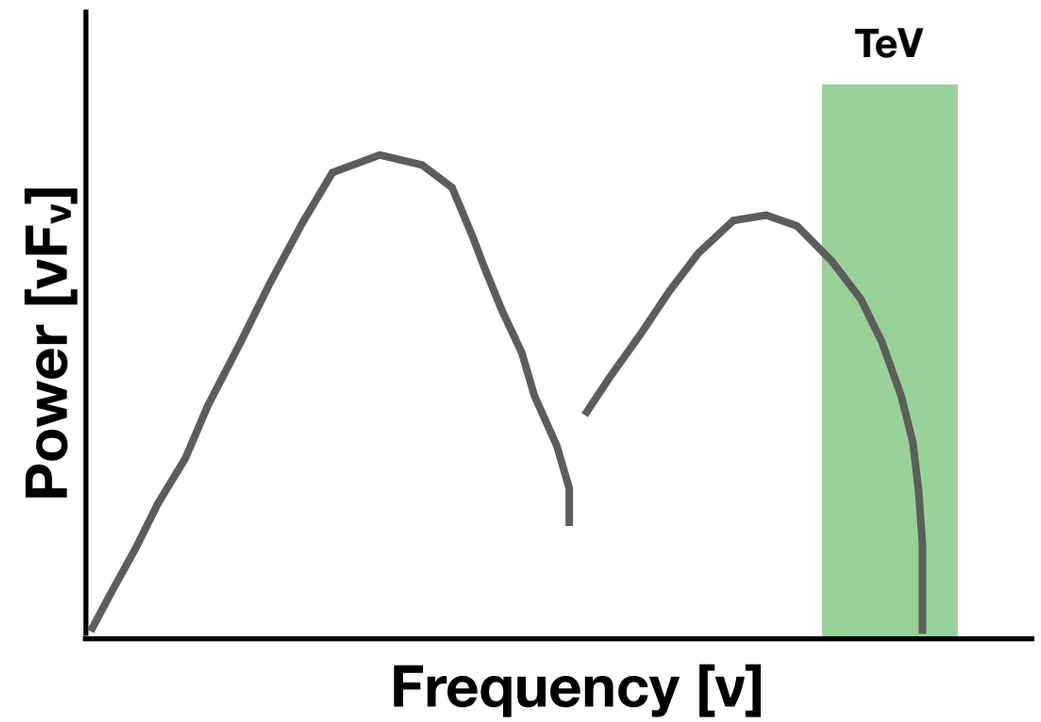
- Bright, featureless blazars are also used as background sources to study the intergalactic medium
- Lower limit of blazar distance can be derived from observation of intervening Lyman absorption with HST/COS
- Observations of PKS 1424+240 on April 19, 2012 show higher-order Lyman absorption at z=0.6035

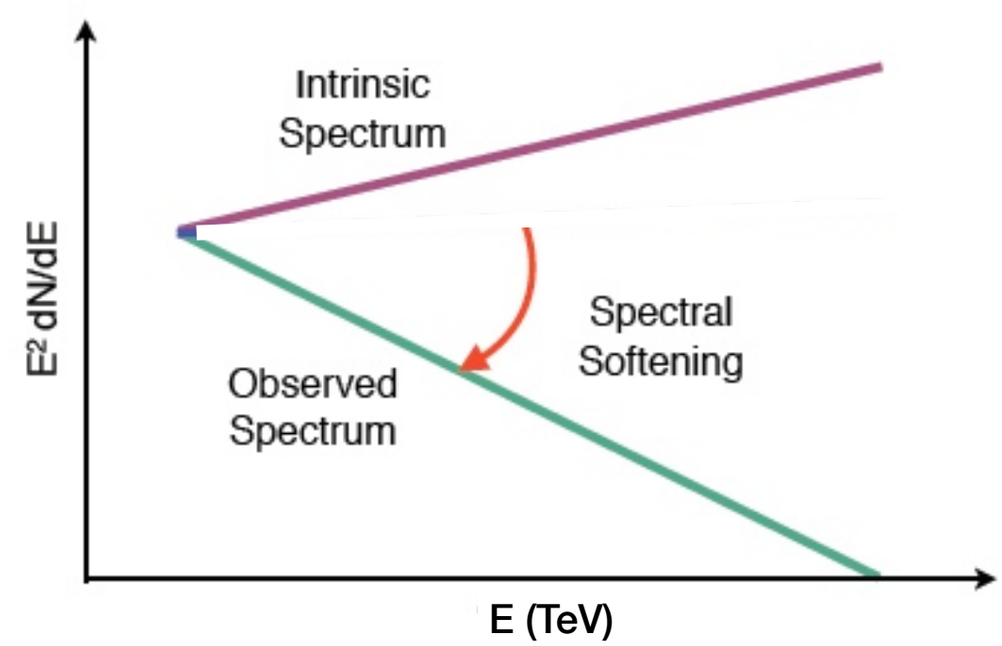


TeV-Emitting Blazars
and the
Extragalactic Background Light

- TeV photons interact with EBL
- EBL is the sum of all emitted and reprocessed starlight
- Interaction absorbs TeV flux
- Limits distance to which TeV emitters can be detected







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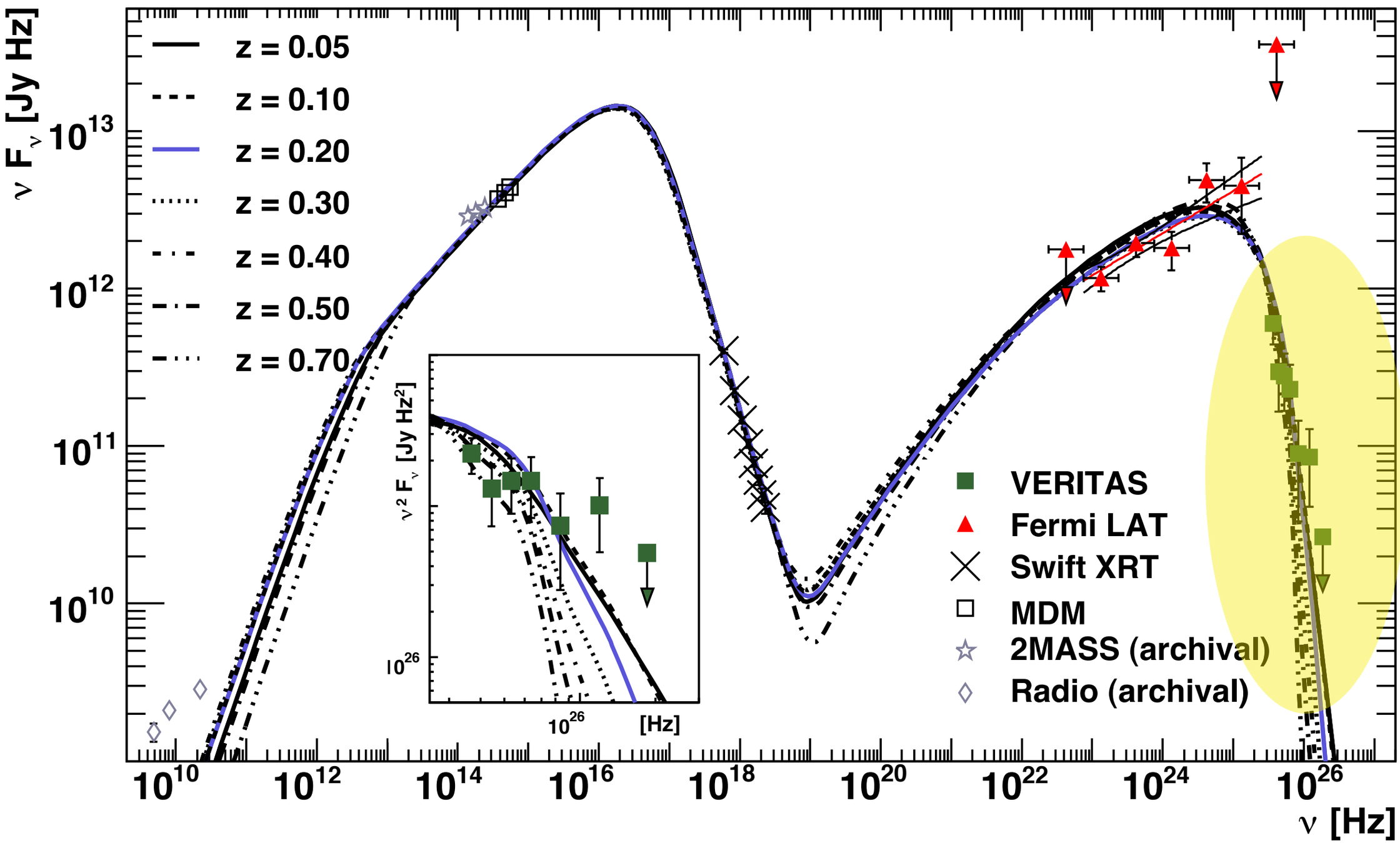
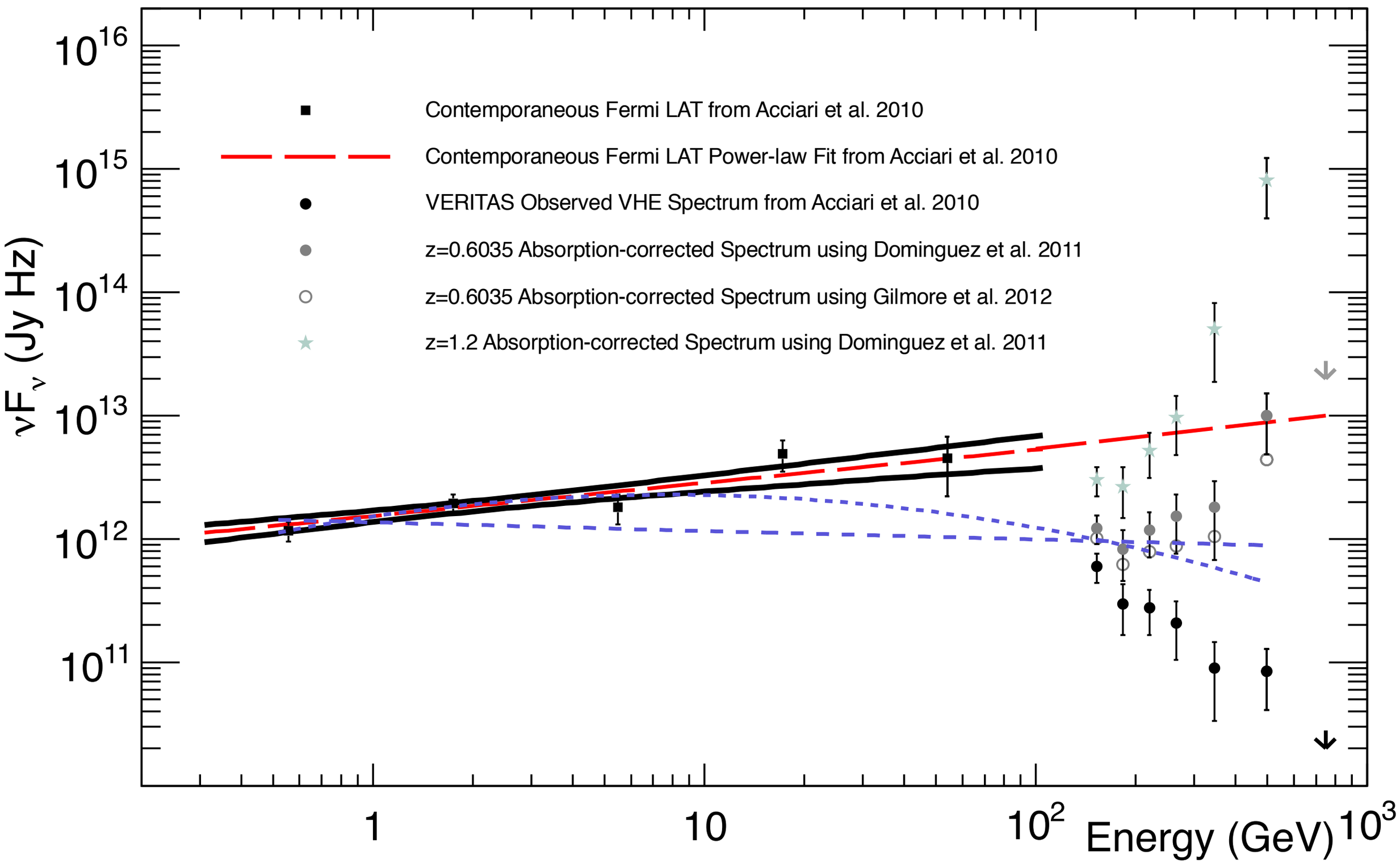


Absorption-corrected Gamma-ray Emission

A First Look...



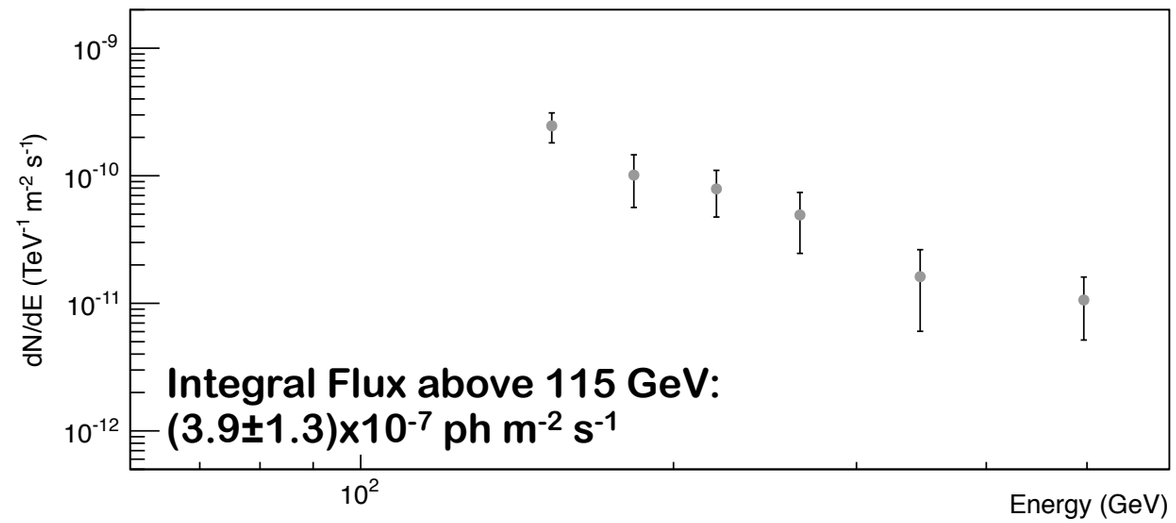
Furniss et al. (2013)

VERITAS Observations by Year

2009

- 25 hours
- 8.5 sigma
- 140 GeV threshold
- Γ=3.8±0.5 (~8% Crab above 115 GeV)

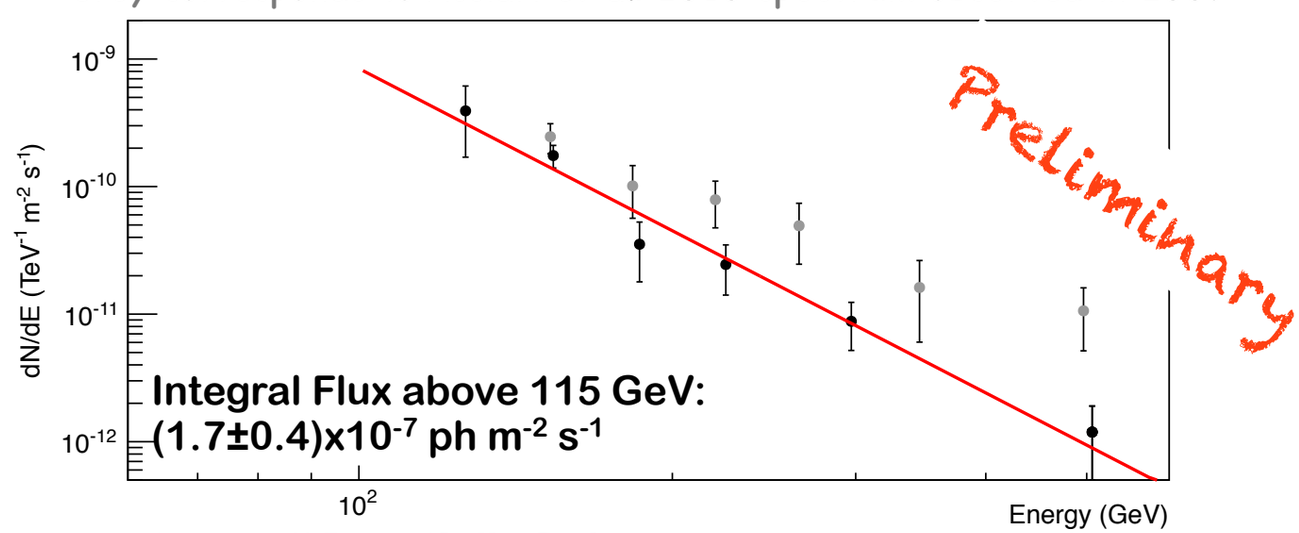
From Acciari et al. (2010)



2011

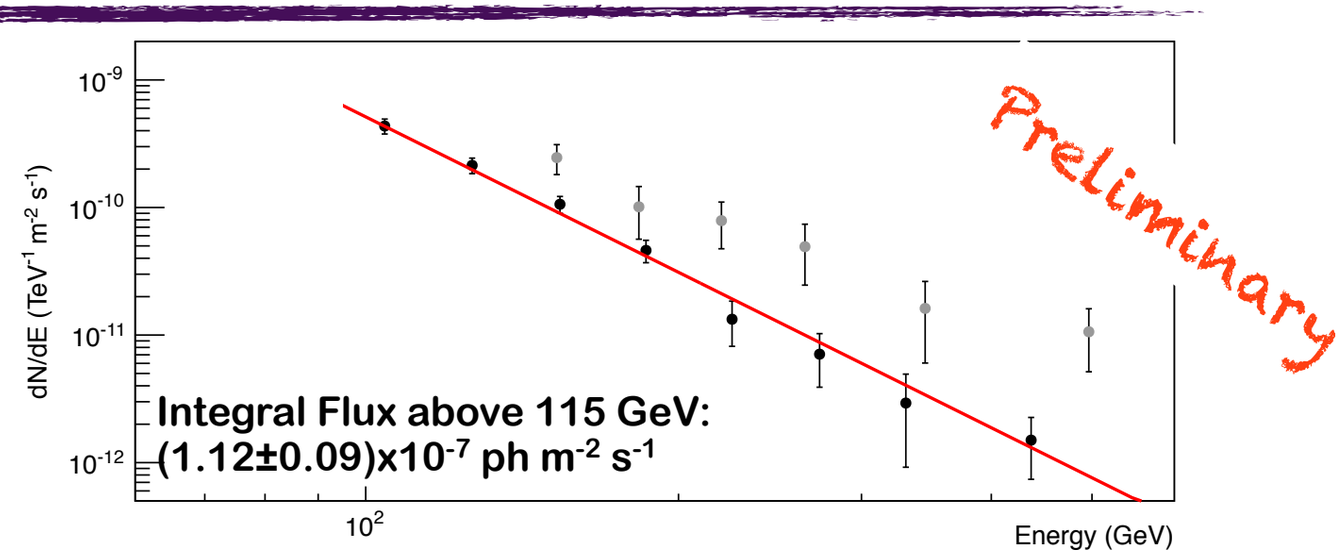
- 14 hours
- 8.5 sigma
- 115 GeV threshold
- Γ=4.4±0.6 (~4% Crab above 115 GeV)

Grey corresponds to Acciari et al. 2010 spectrum observed in 2009

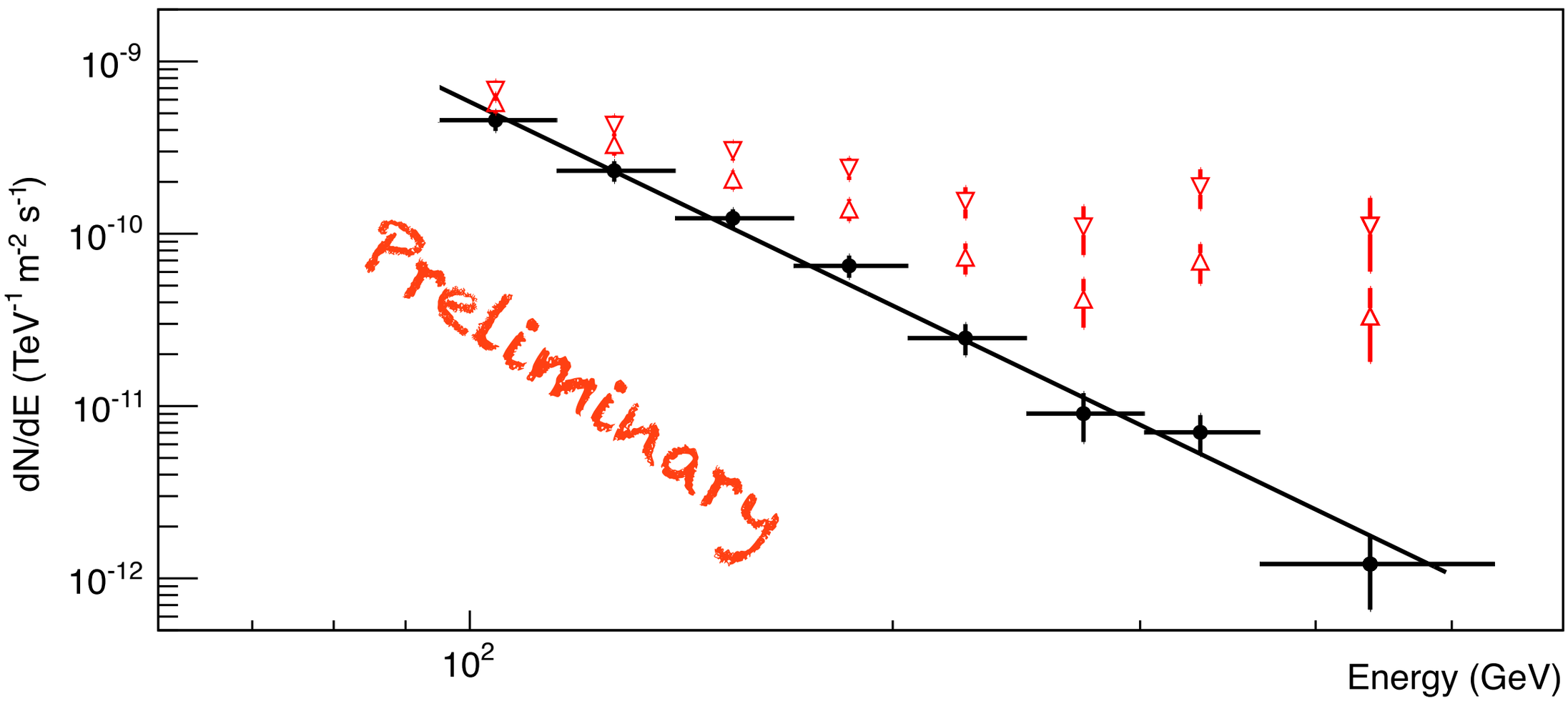


2012

- 67 hours
- 16.4 sigma
- 75 GeV threshold
- Γ=3.9±0.2 (~2% Crab above 115 GeV)



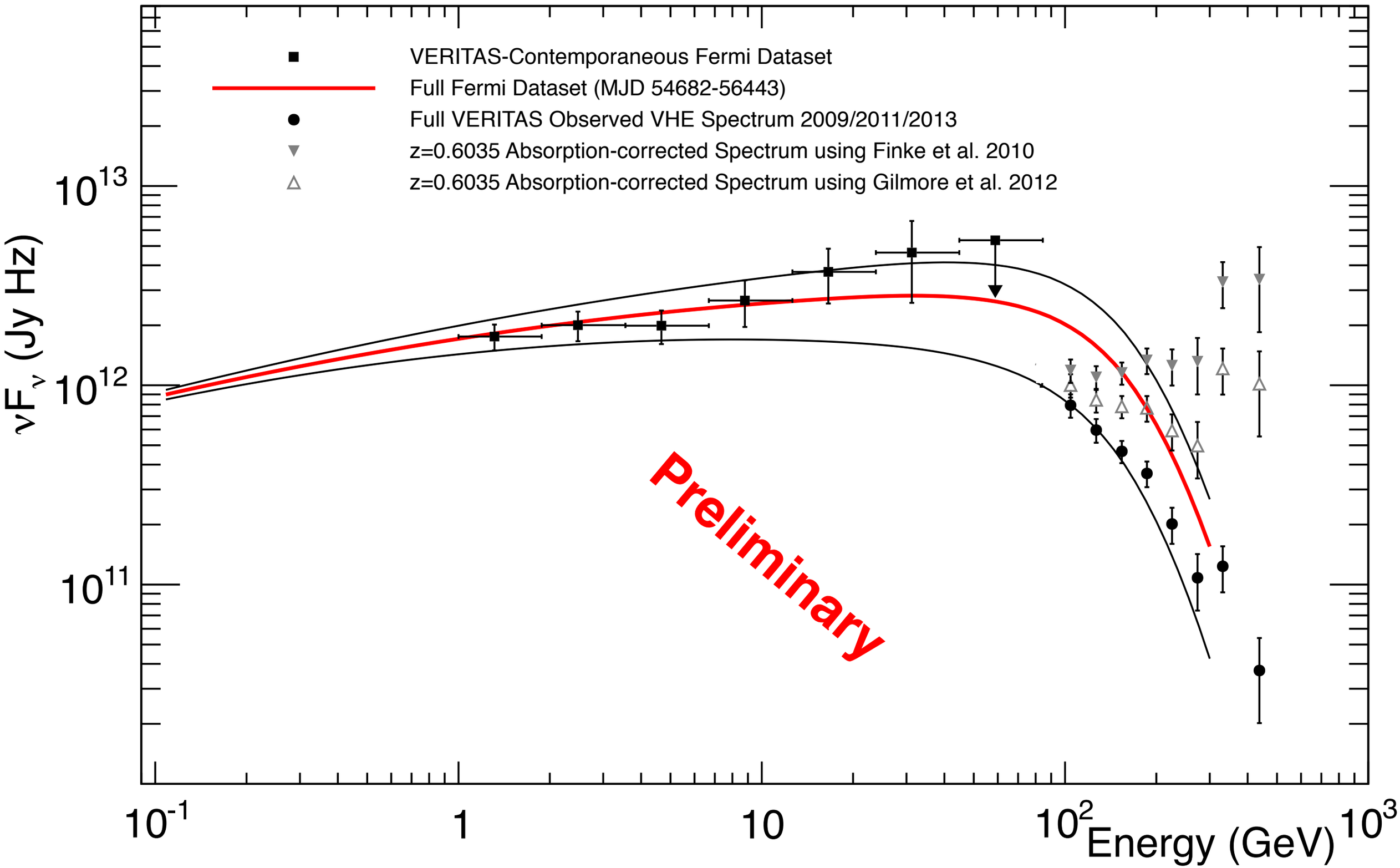
Absorption-Corrected VHE Spectrum



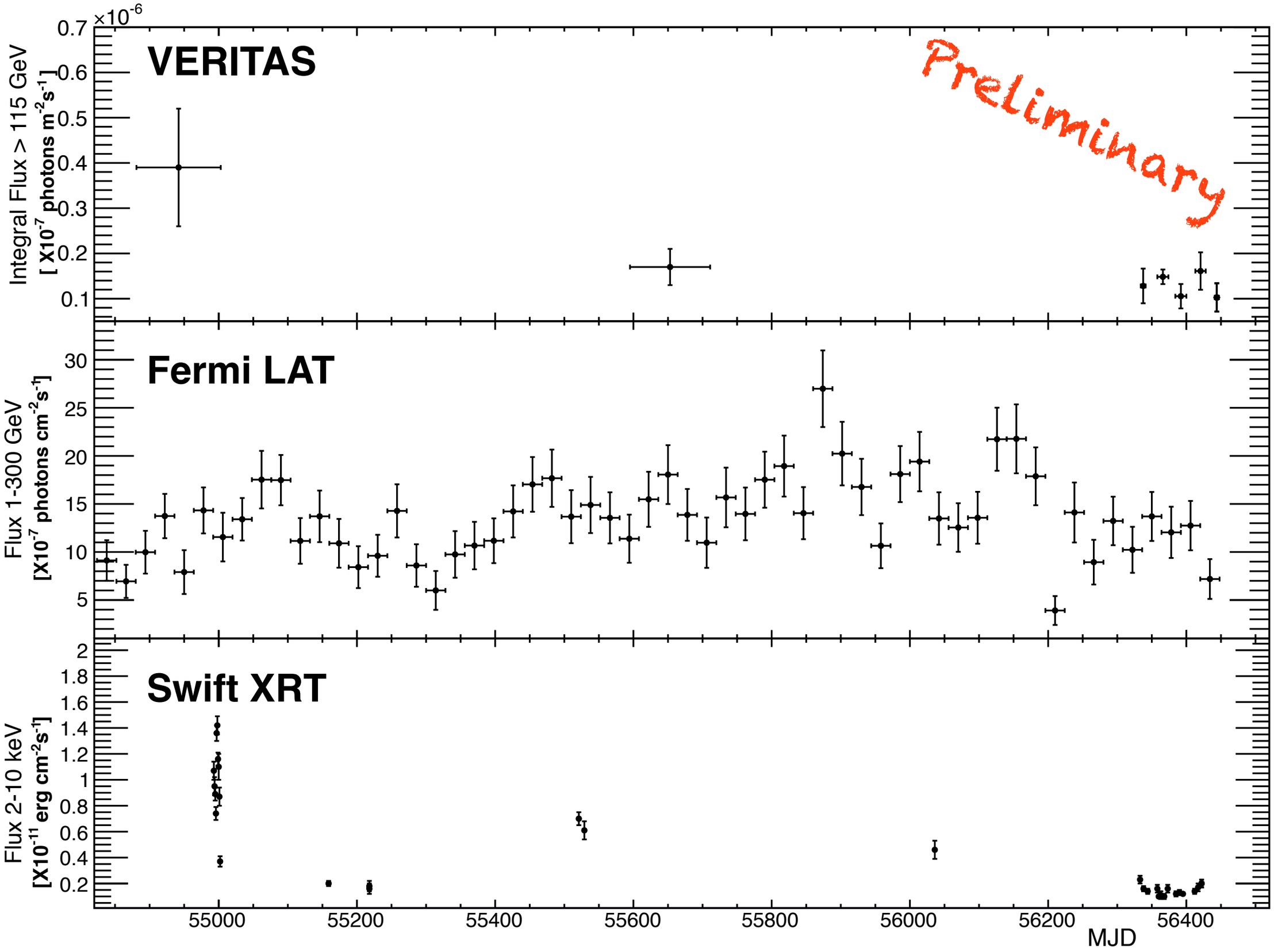
- Gilmore: Γ=2.4±0.2
- Finke: Γ=1.7±0.2

Neither is strictly constraining by Γ>1.5, but the spectral shape starts to curve upward above 300 GeV with even the lowest density EBL models

Gamma-ray SED Peak

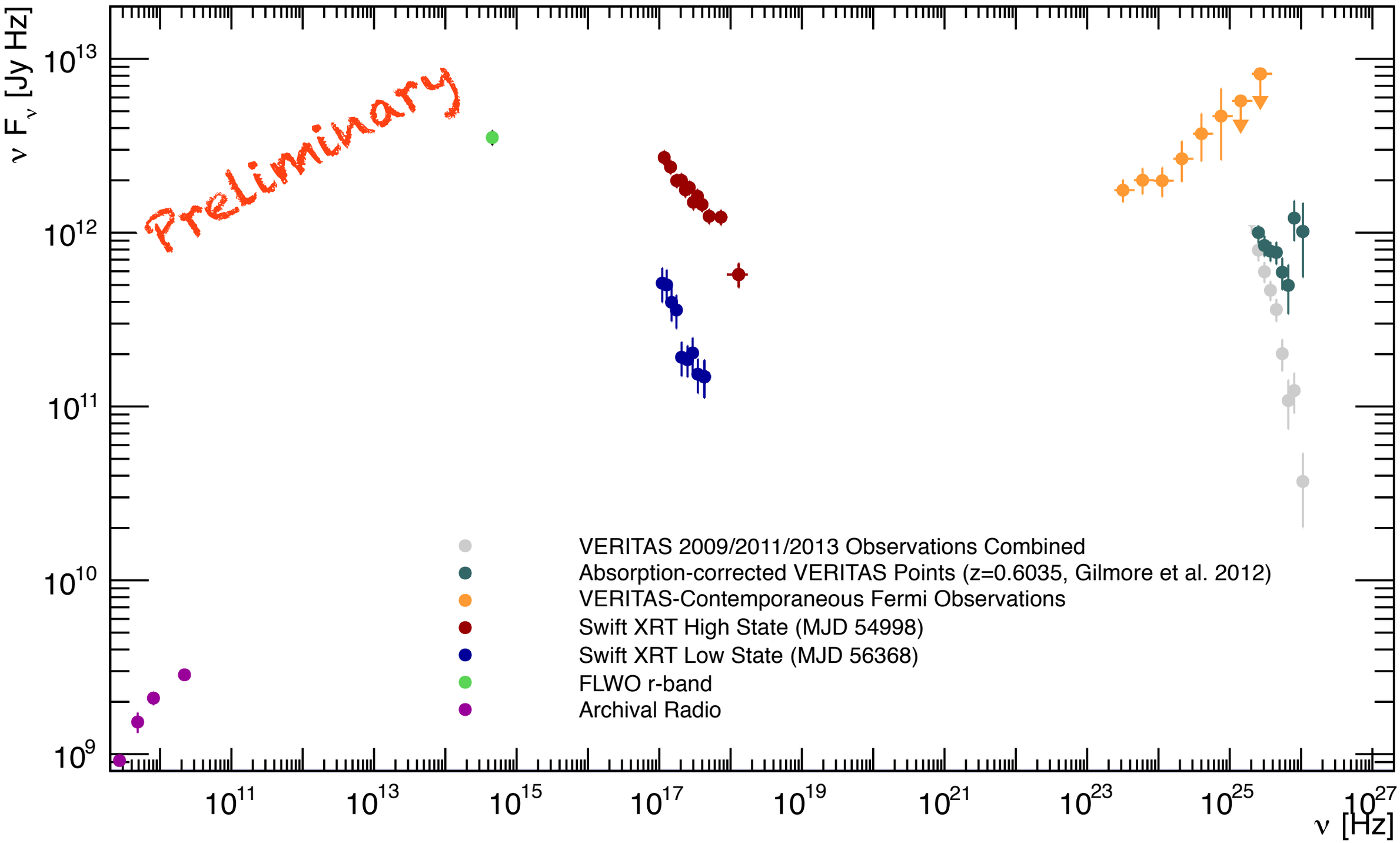


High Energy Light Curve



Broadband Absorption-corrected SED

Modeling In Progress....



Conclusions

- PKS 142+240 shows slight gamma-ray variability and considerable X-ray variability
- The EBL density is not immediately constrained by standard relativistic spectral limitations
- The gamma-ray spectrum has an atypical shape which might indicate a higher redshift
- If the source resides at z>0.6035, VHE extragalactic photon propagation and/or production need some new ideas
- Possible that we are seeing a natural signature of cascade emission initiated by PeV proton photo-pion production
- HST/STIS observations of this source may push the lower limit to a higher redshift and will provide an upper limit on the distance
- Independent of what the source of the intrinsic SED is, PKS 1424+240 is a unique blazar that will benefit from continued studies

Stay tuned....