

HESSII Results with a <math><100\text{ GeV}</math> Threshold



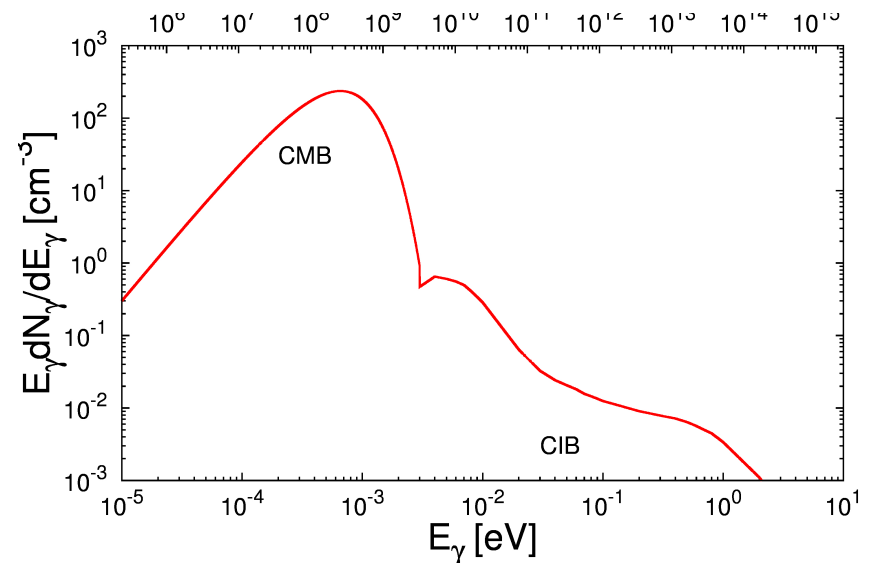
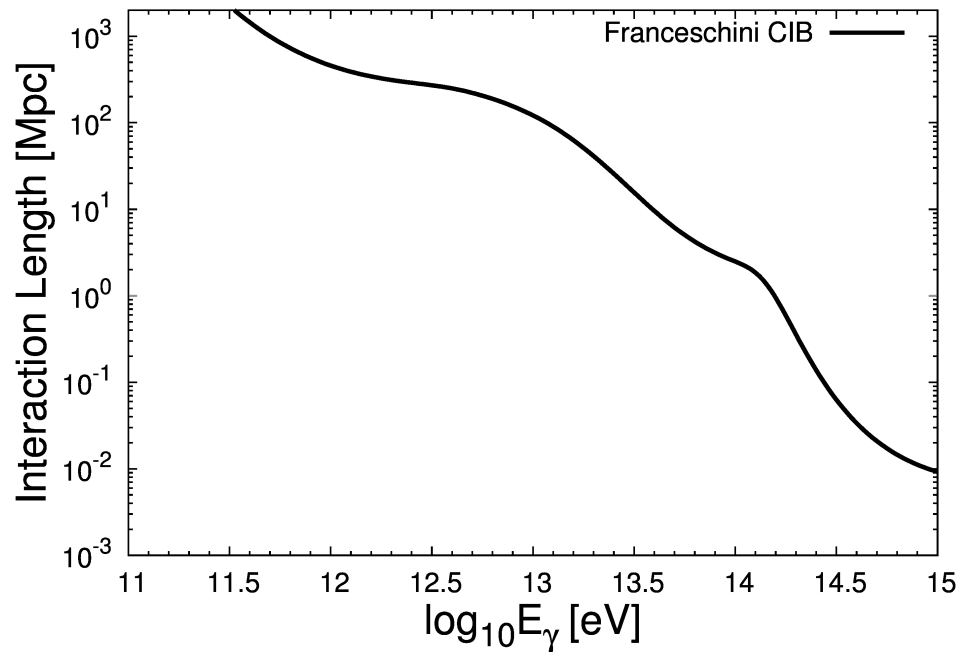
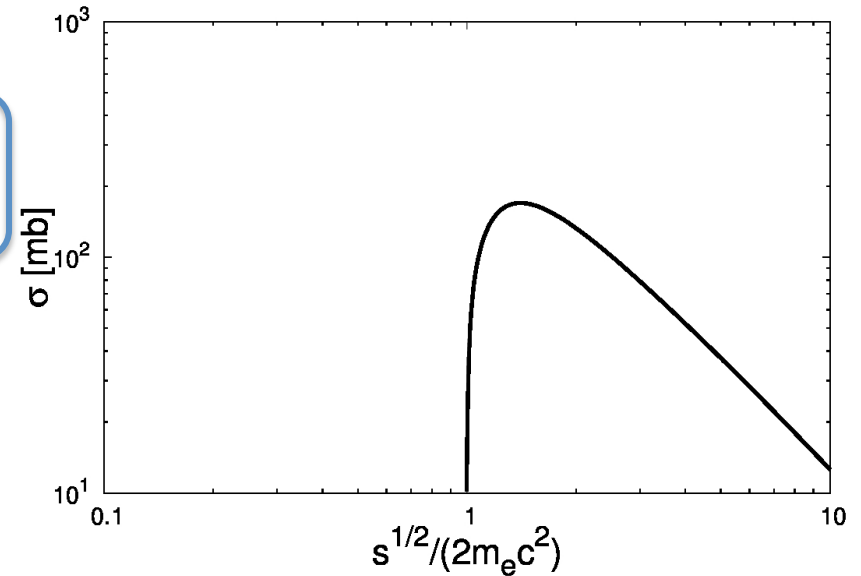
What's Special About <100 GeV?

- EBL studies of AGN at “high” redshift
- Good overlap in energy with Fermi satellite observations
- Improvement in statistics during flaring events (particularly relevant for AGN + GRB)
- Exciting features at these energies for particular objects (eg. Sgr A*) hinted at



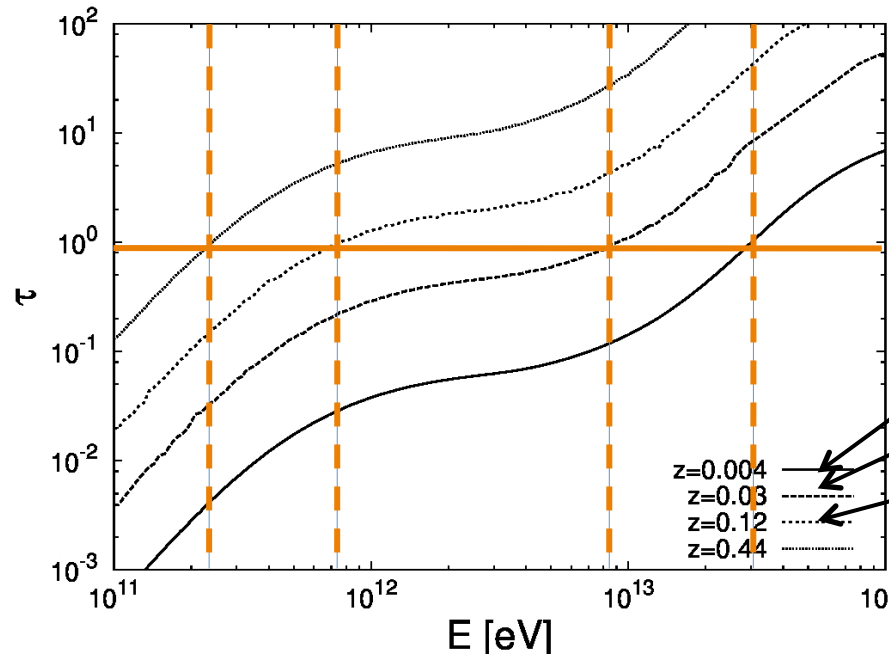
Extragalactic Background Light (EBL) Attenuation of Gamma-Rays

$$R = \frac{2m_e^2}{E_\gamma} \int \frac{1}{\epsilon^2} \frac{dn}{d\epsilon} d\epsilon \int_0^{E_\gamma \epsilon / m_e} \epsilon' \sigma_{\gamma\gamma}(\mathbf{E}_\gamma, \epsilon') d\epsilon'$$



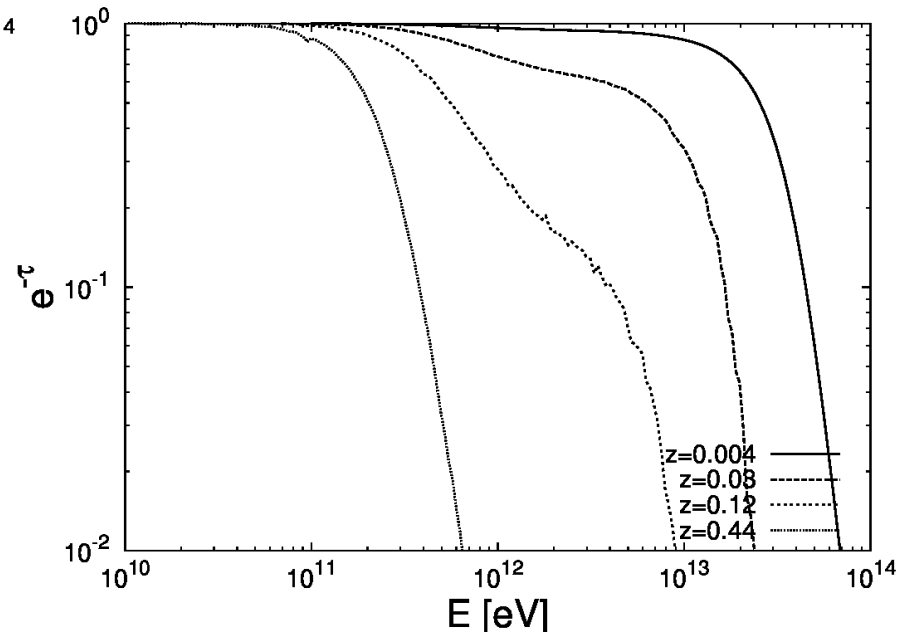
EBL studies of AGN at “high” redshift

EBL Attenuation



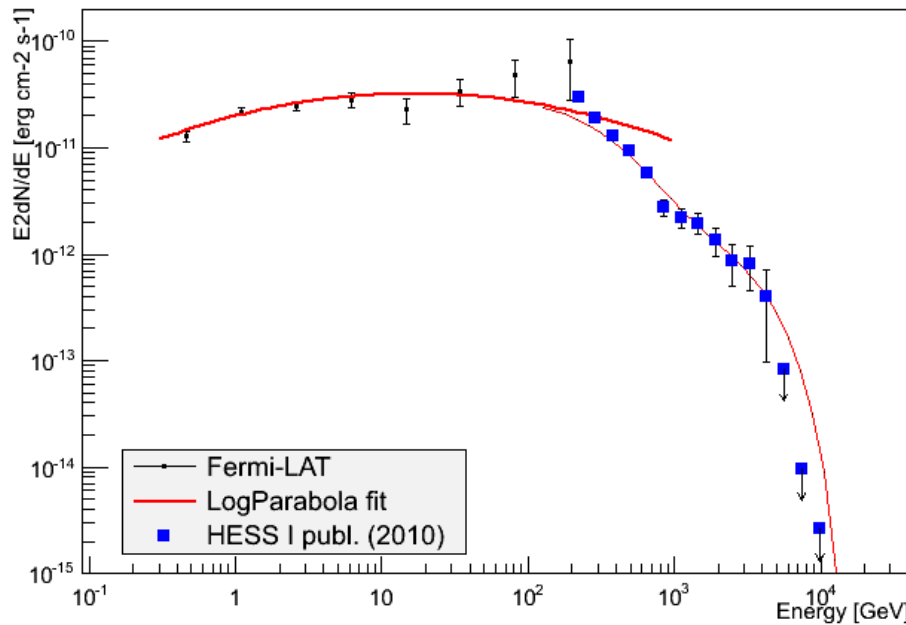
M87
Mkn 501
PKS 2155-304

$$\begin{array}{c}
 \sim \rightarrow \quad \leftarrow \sim \\
 \gamma \quad \quad \gamma \\
 E_{\gamma}^{\text{TeV}} \quad E_{\gamma}^{\text{eV}} \approx 1 \\
 \leftarrow \bullet \quad \bullet \rightarrow \\
 e^{+} \quad e^{-}
 \end{array}$$



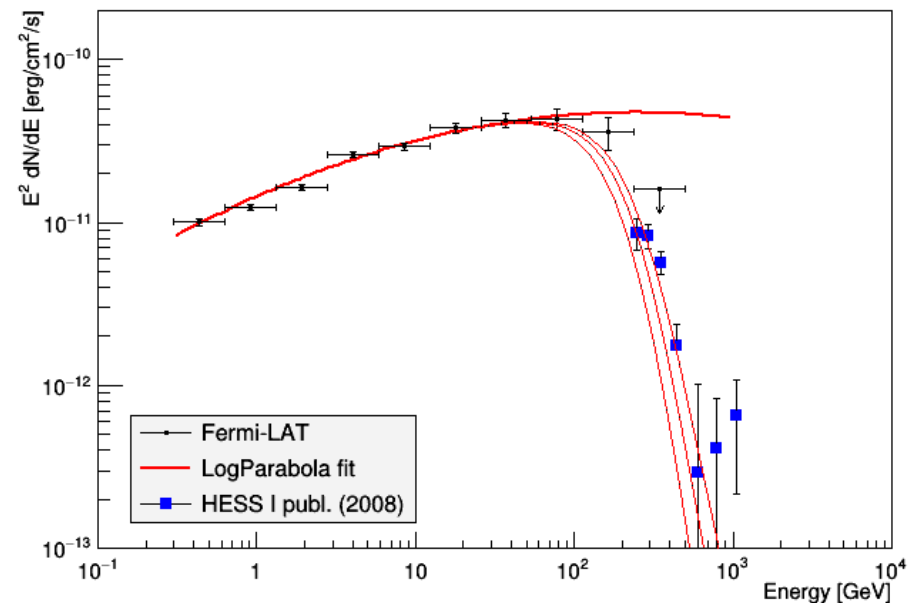
Good Overlap in Energy with Fermi Satellite Observations

PKS 2155-304 SED ($z \sim 0.12$)

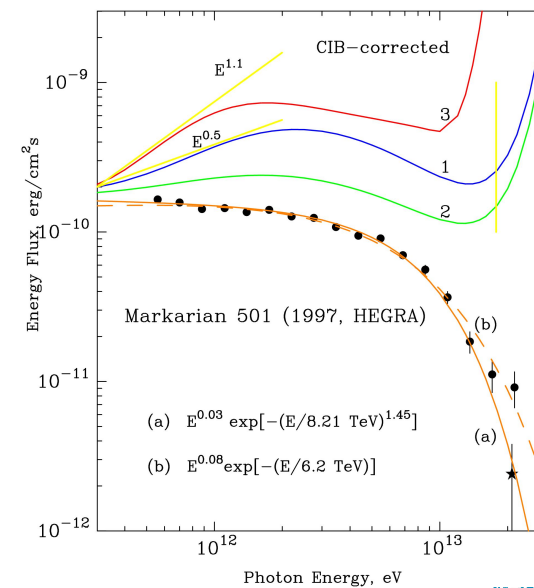
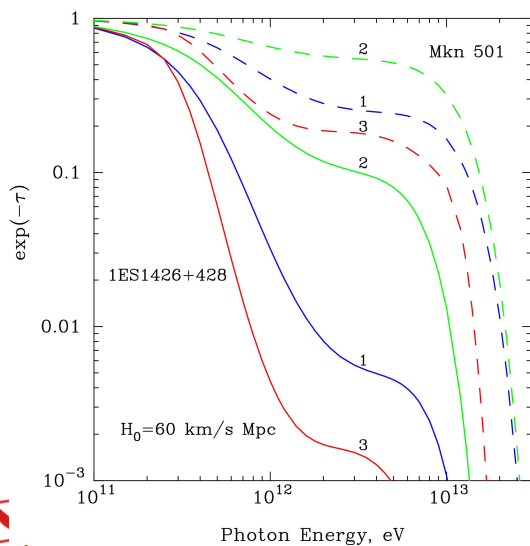
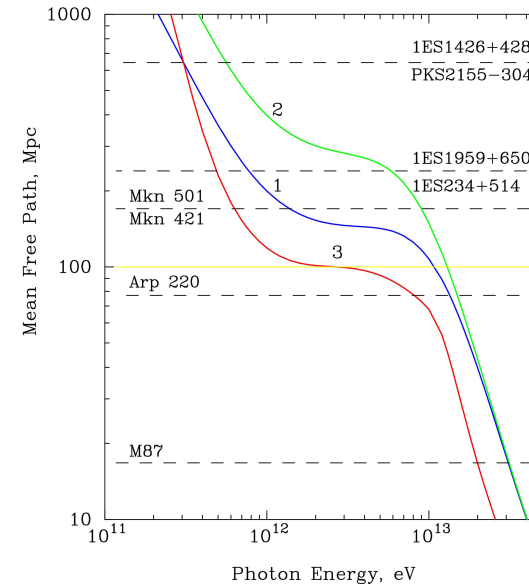
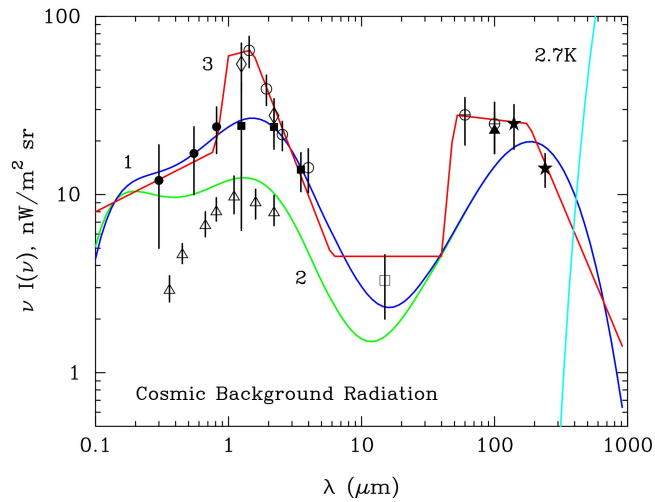


Note EBL induced break features for “high” redshift AGN occur at Fermi/HESS transition energy range

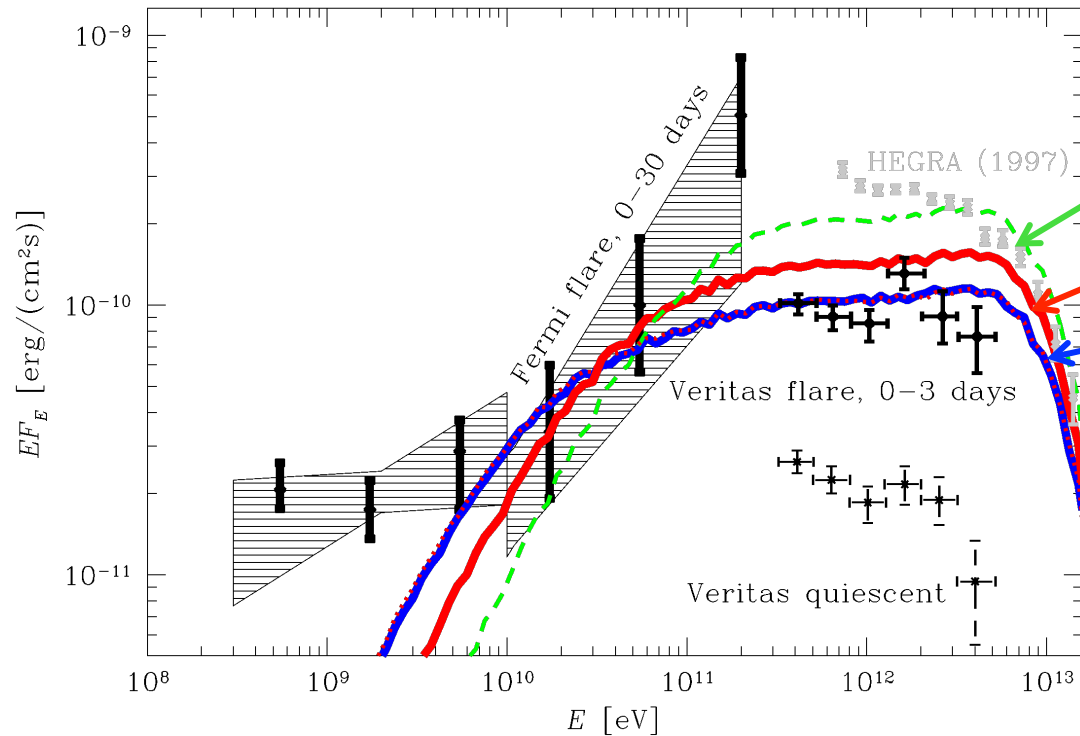
PG 1553+113 SED ($z \sim 0.5$)



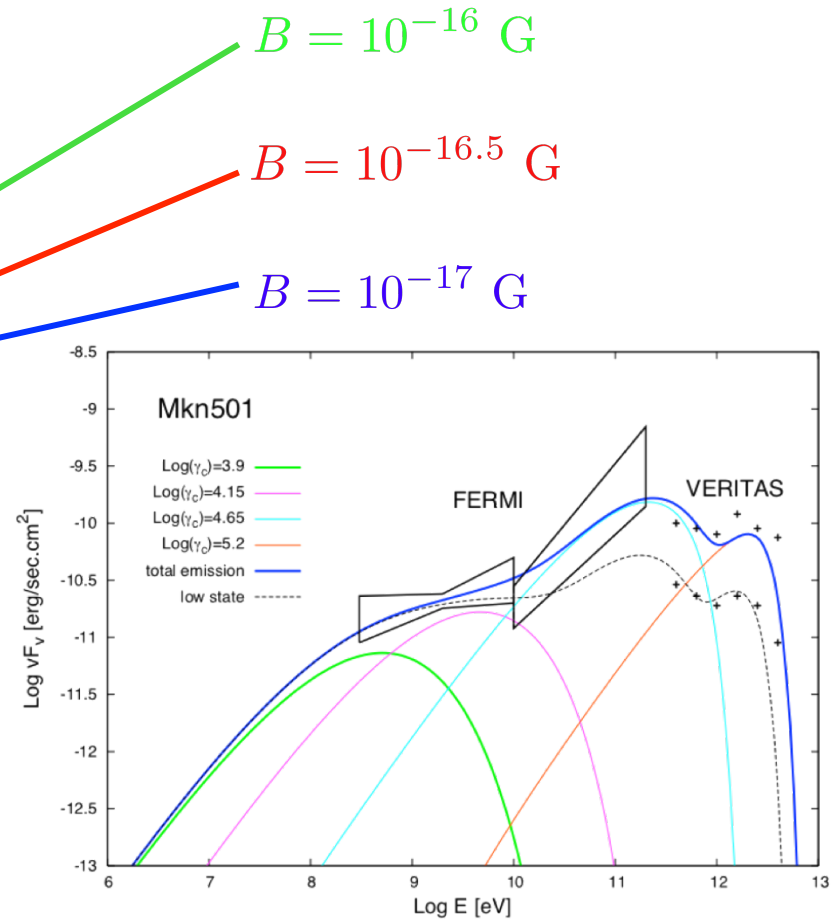
Potential Hard Spectra Issues- Mrk 501



Hard Spectra are Hard to Explain!



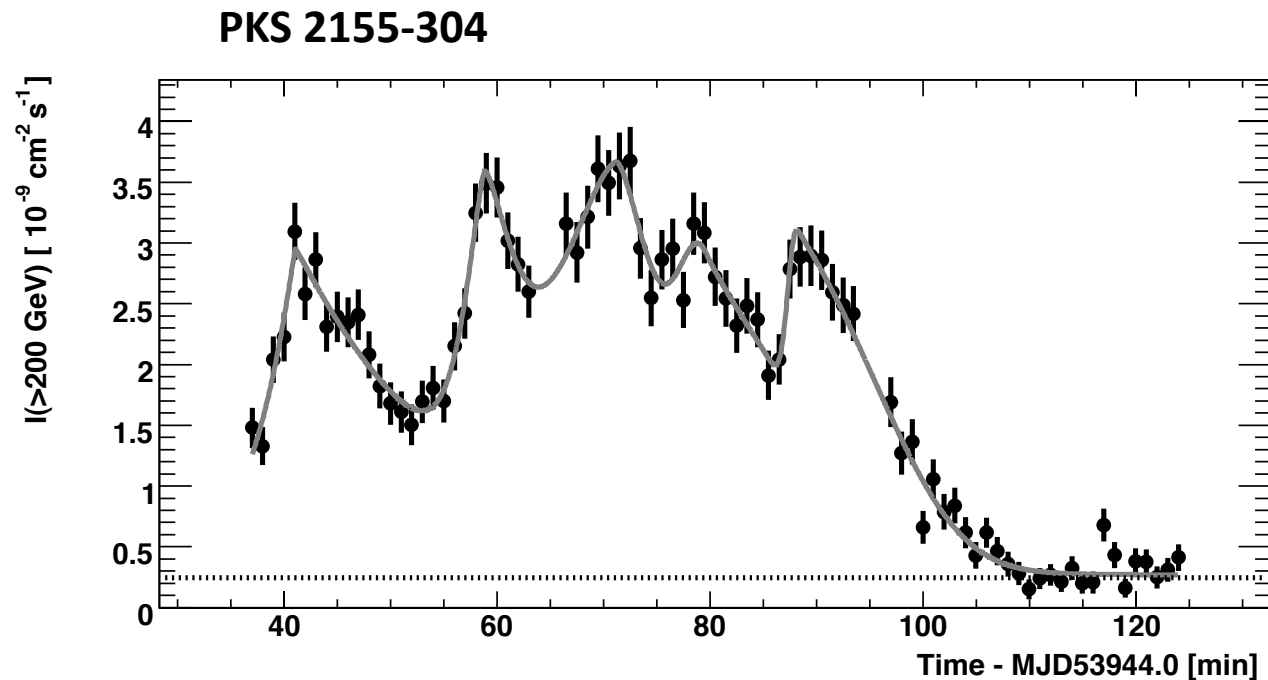
From astro-ph/1104.2801



From astro-ph/1108.4568

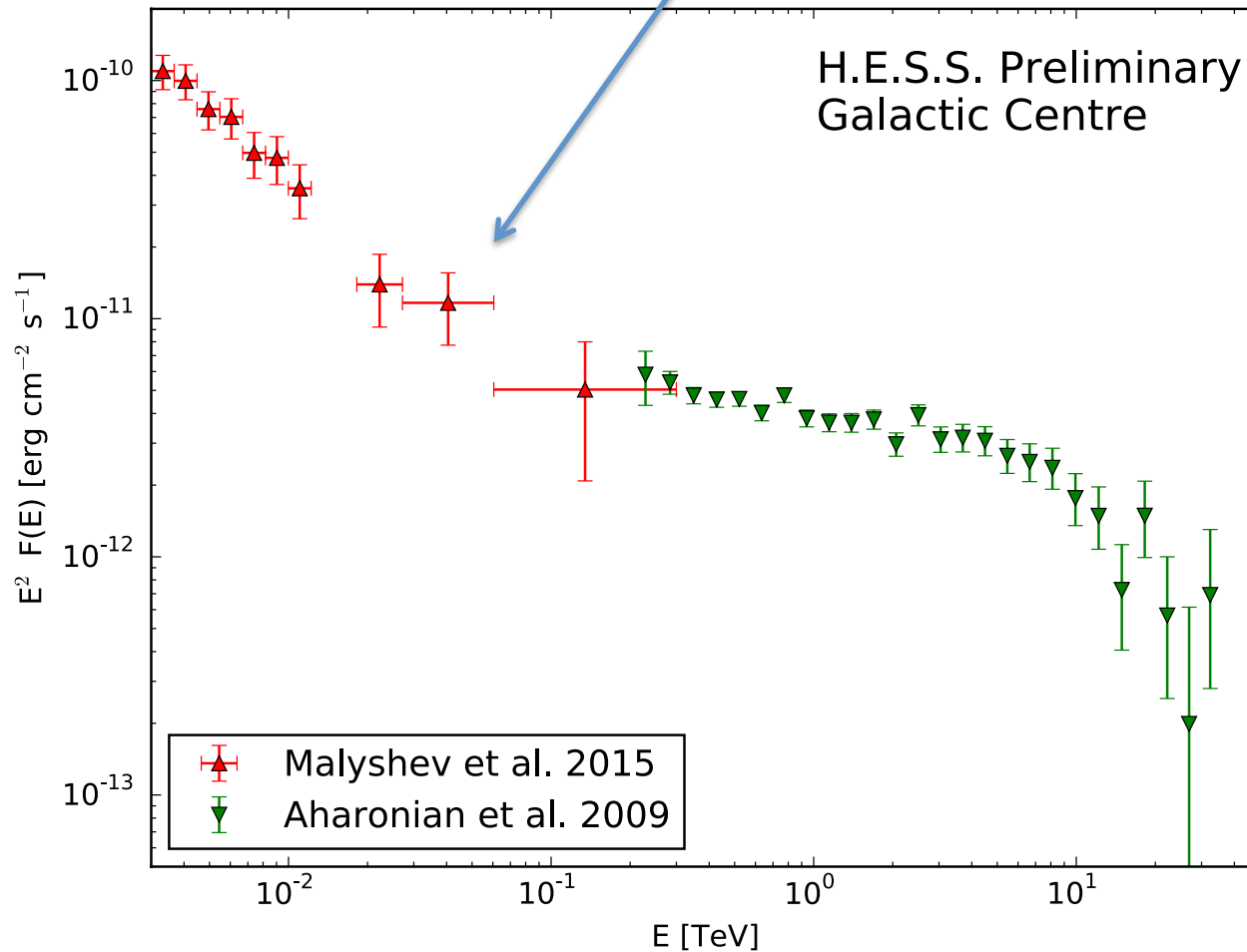
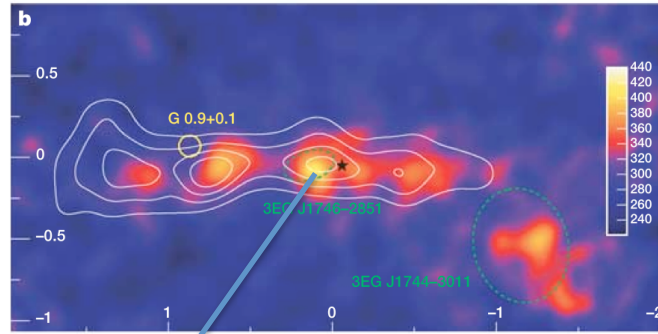


Improvement in statistics during flaring events



- temporal bins are dictated by sensitivity limits
- $\mathbf{ct}_{\text{var}} \ll \mathbf{r}_{\text{Schwarz}}$
- allows tests of a dispersion relation between different energy photons, proving LIV constraints

Exciting Features at “Low” Energies



Observations of SgrA* reveal an interesting feature in the spectrum at the transition energy between Fermi and HESS



HESSII- Mono vs. Stereo

CT5 Mono

- Low energy threshold
- Limited angular resolution
- Limited sensitivity

Best for: bright high redshift AGN + GRB



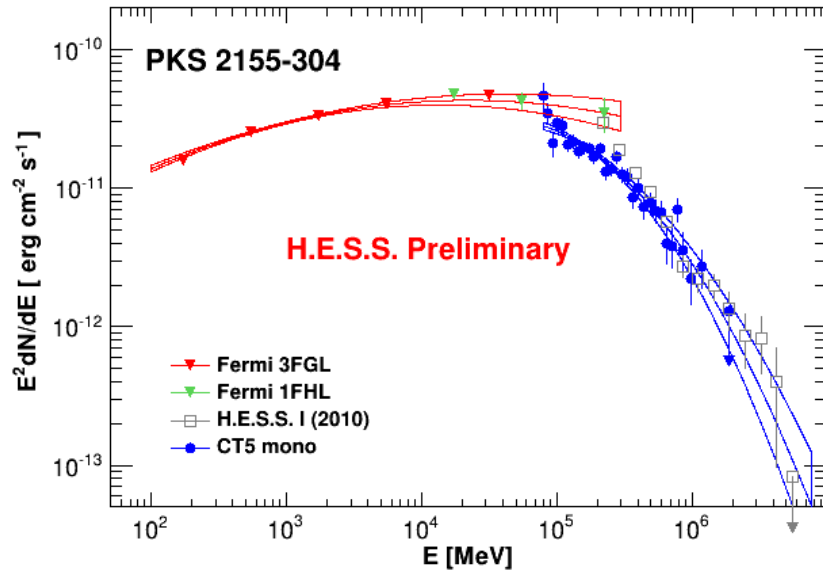
CT1-5 Stereo

- Higher energy threshold
- Excellent angular resolution
- Excellent sensitivity

Best for: weak AGN
And morphology studies

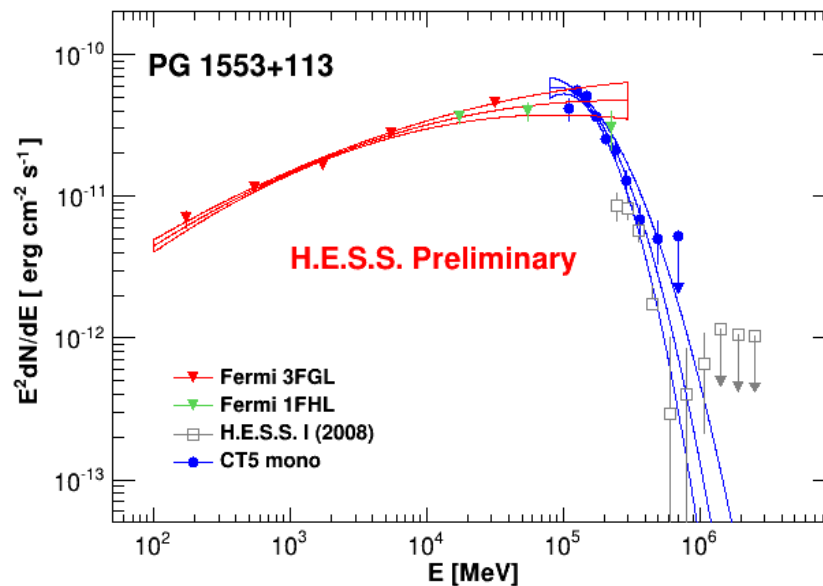


First HESS II AGN Results

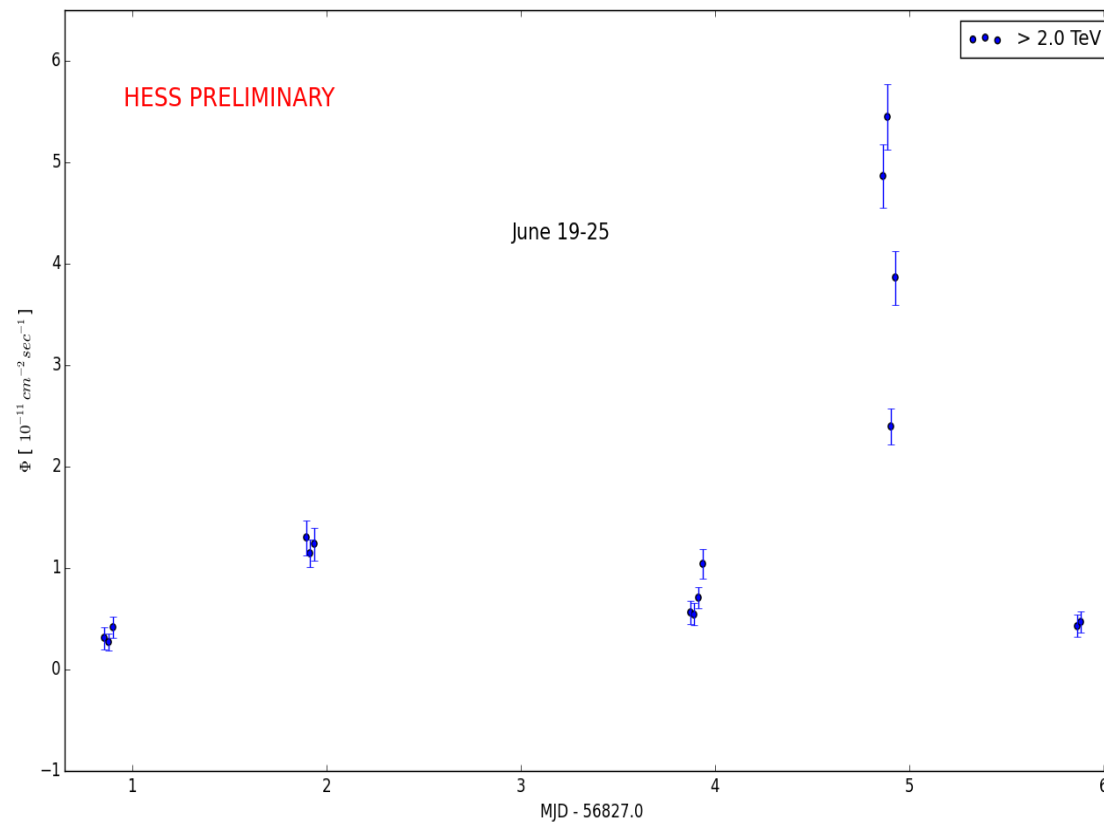


Clear evidence for curvature seen in both spectra

EBL cut-off kicks in at end of Fermi spectrum, so good overlap is crucial



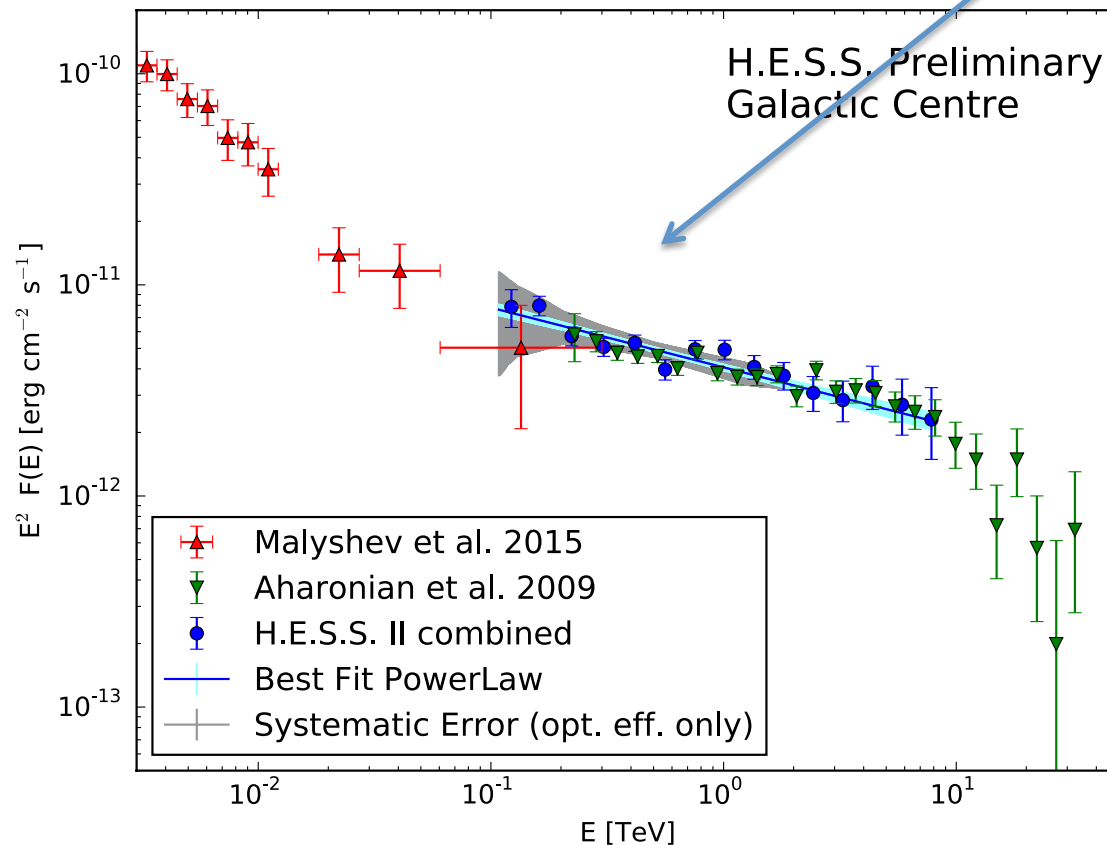
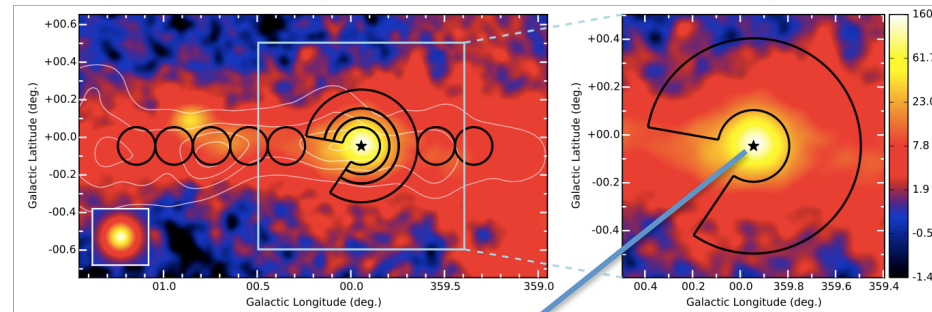
Mrk 501 Massive Flare 2014



No significant delay
between the highest
and lowest energy
photons is found

Galactic Center- Sgr A*

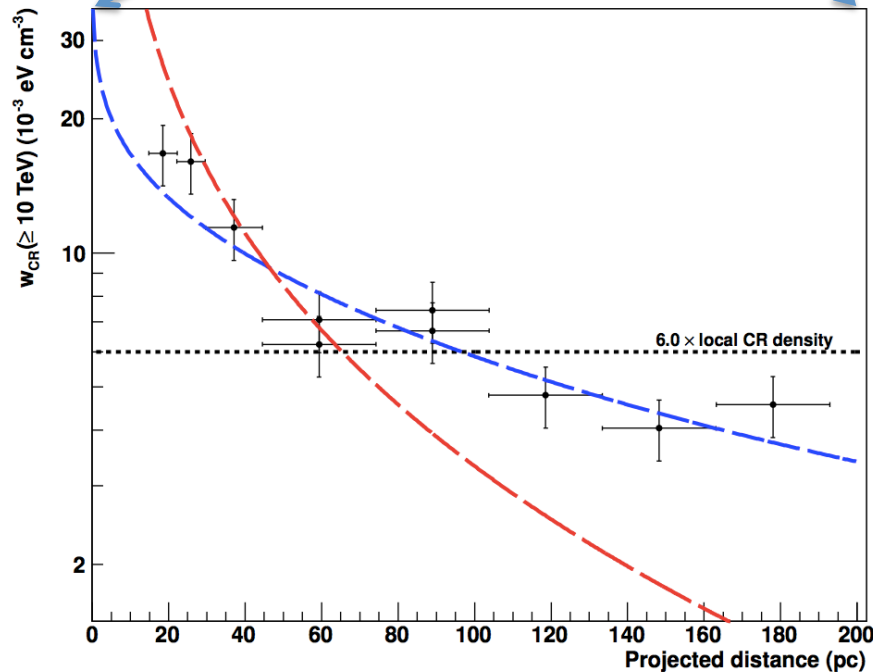
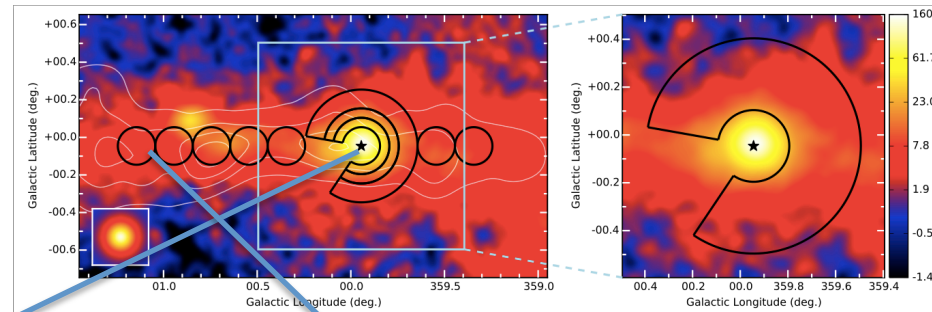
150 pcs 50 pcs



- Analysis of Sgr A* 'point source' at Galactic center
- Inflection evident in spectrum around 100 GeV revealing presence of new hard component



Flux in Diffuse Region Close to Galactic Center



Recall that the diffusive propagator is

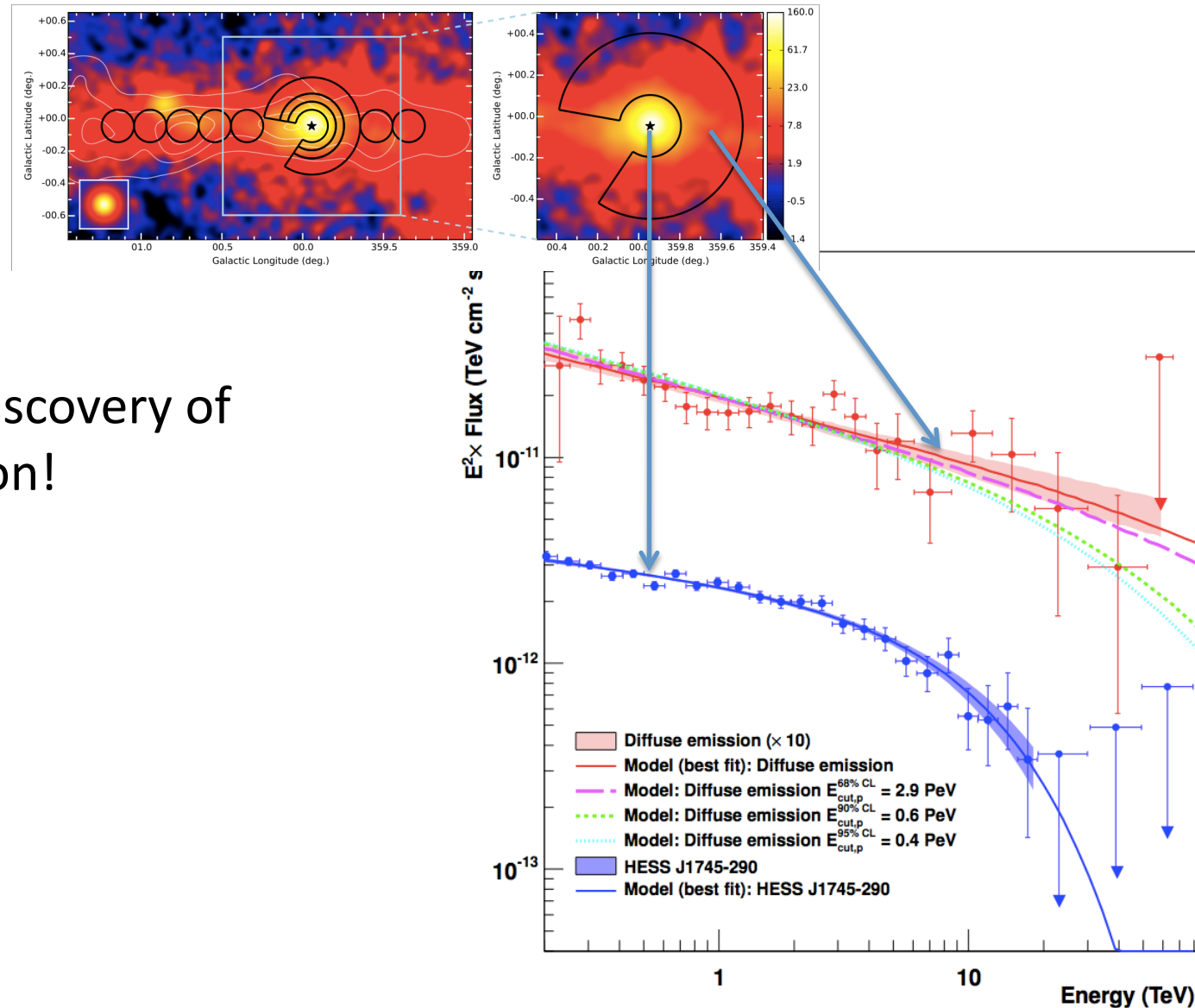
$$G(\mathbf{r}, t) \propto \frac{e^{(-r^2/(4Dt))}}{(4\pi Dt)^{3/2}}$$

Steady State Spectrum Flux from Source is

$$n \propto 1/Dr$$



Flux in Diffuse Region Close to Galactic Center



Conclusions

- AGN at “high” redshift allow EBL evolution to be probed
- Good overlap in energy with Fermi satellite observations is crucial
- Improvement in statistics during flaring events allows temporal evolution to be probed (relevant for both AGN + GRB)
- Exciting new features at these energies for particular objects (eg. Sgr A*) hinted at



Extra Slides

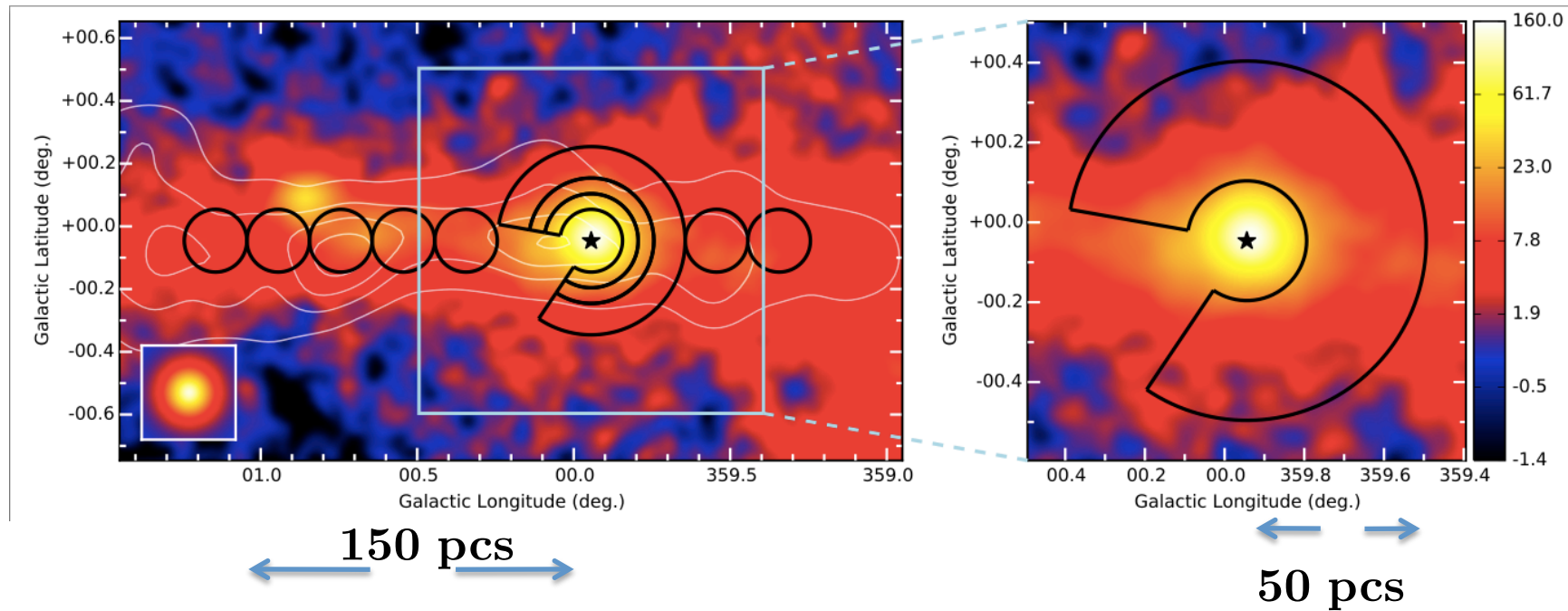


HESS II

- HESS Phase I (2002-2012) consisted of 4 Cherenkov telescopes of 12m diameter (CT1-4)
- A fifth 28m telescope (CT5) was installed in 2012 -> HESS Phase II
- Mono analysis (CT5 only) is discussed here



Diffuse Emission Around Galactic Center



Galactic Center Emission Around SgrA*

