EBL Studies and DC2

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"Blazar and other AGNs" Science Group

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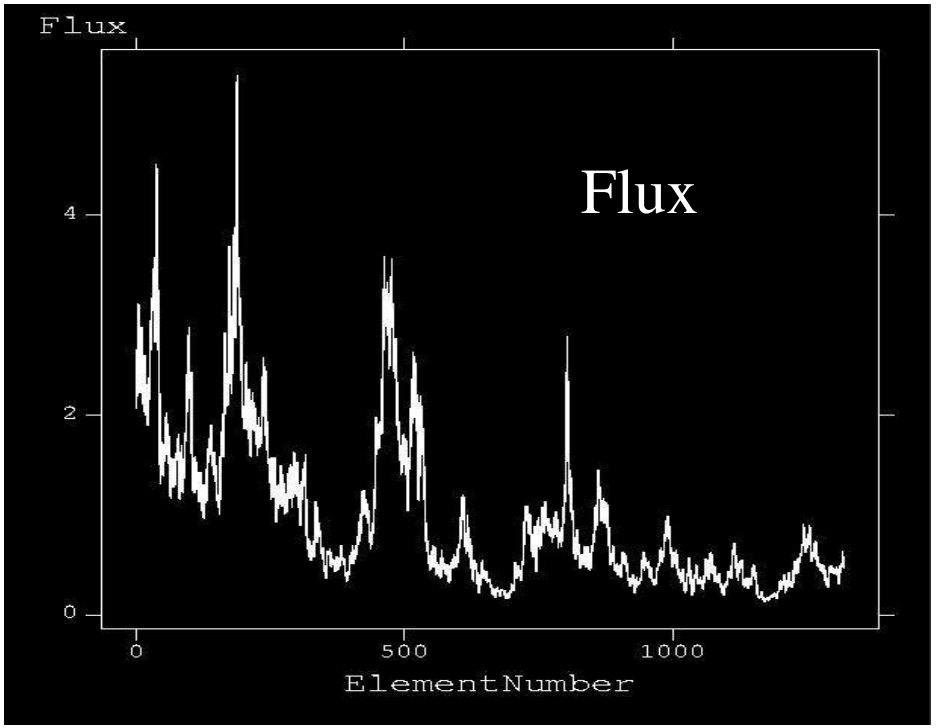
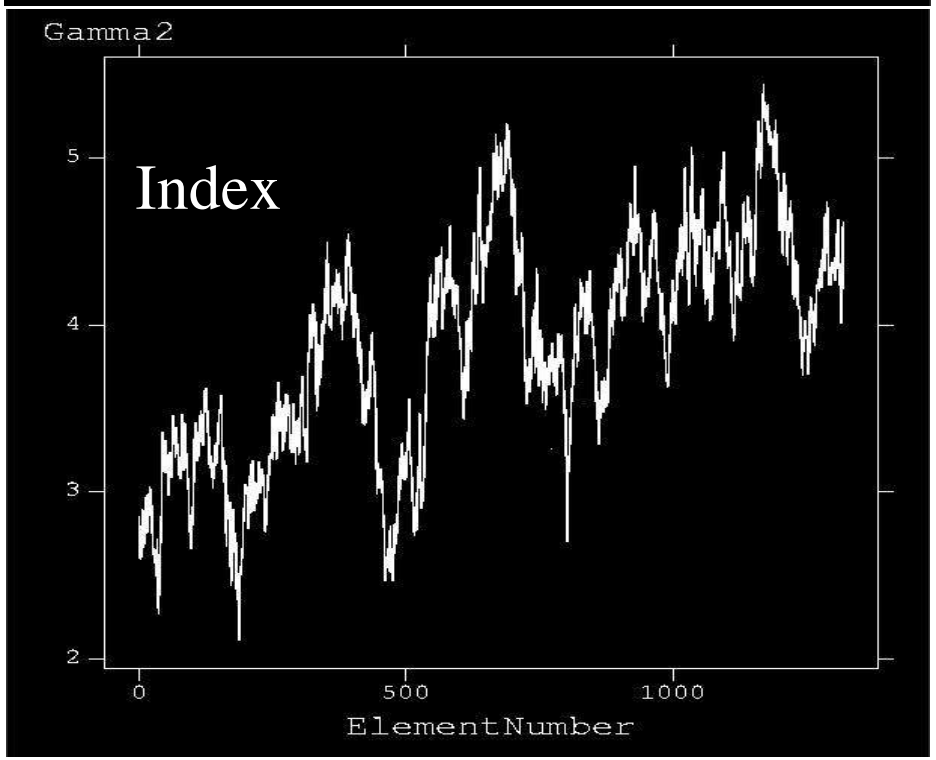
Considerations

- 1 month of data:
  - Limited number of sources
  - Even more limited number of photons with E >10 GeV

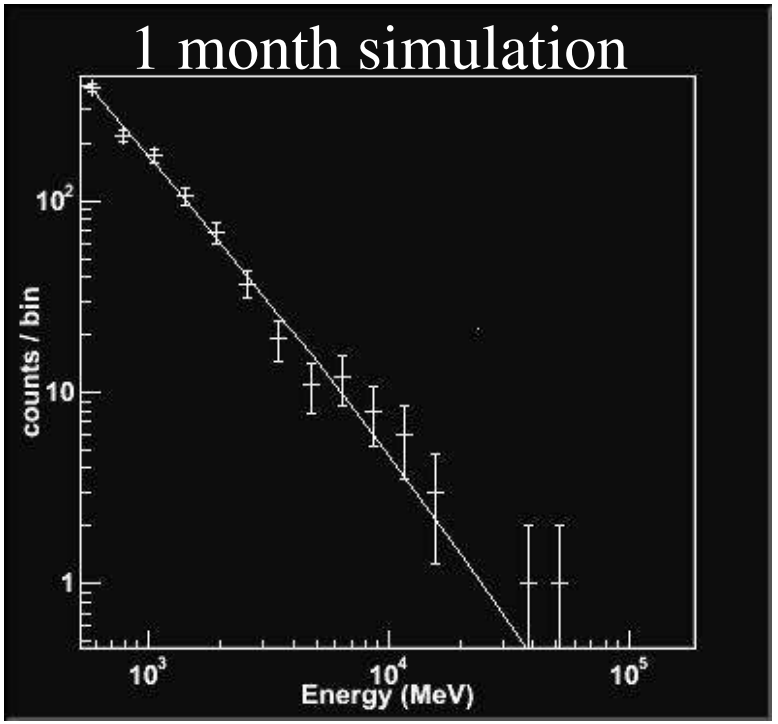
- However, it is reasonable to expect a few bright blazars with hard spectra (maybe during flaring states?). The question is: how many?

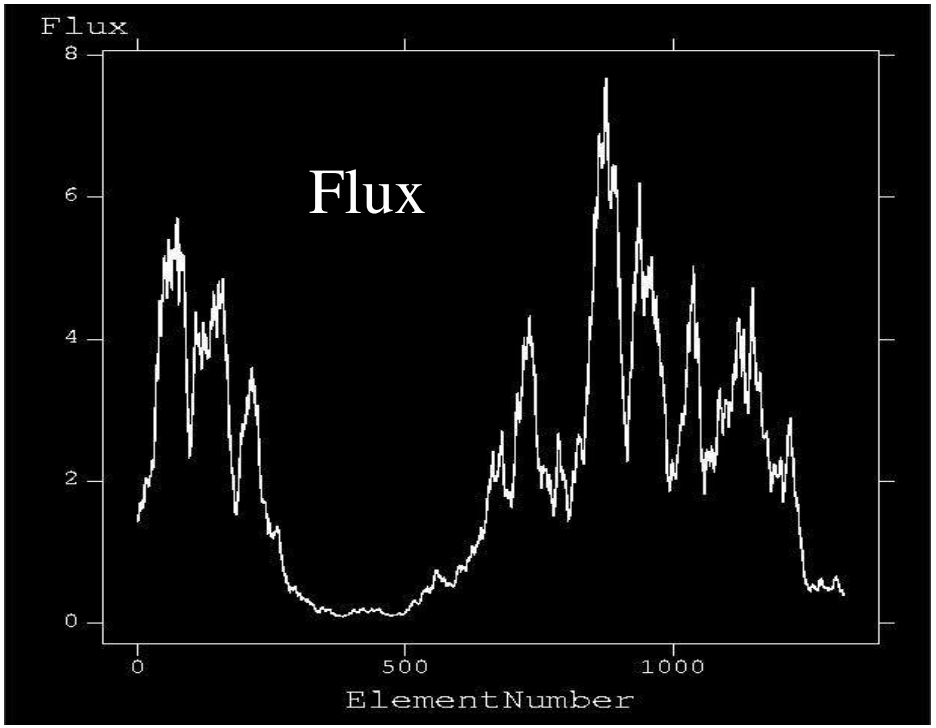


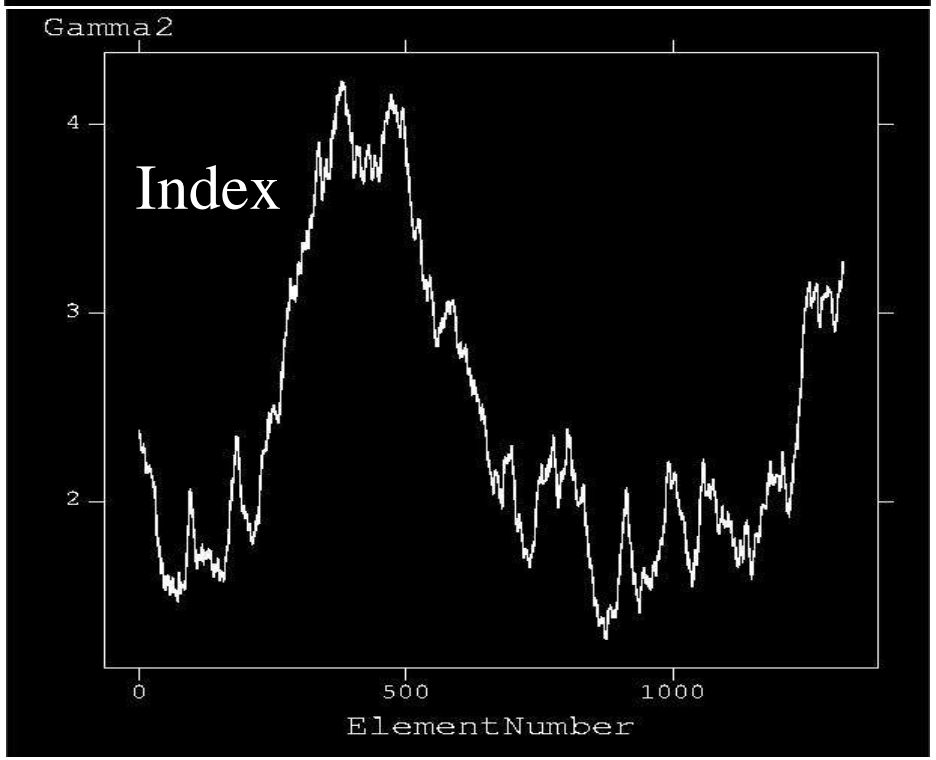


Example of an unsuitable blazar:

- Blazar J0530p1323 from checkout3
- This is the brightest blazar of checkout3 'Flux(E>20 MeV)'
- Redshift = 2.07
- Index ~ 2.5 during flares (see lightcurves on the left)
- Spectrum cannot be distinguished from simple powerlaw.

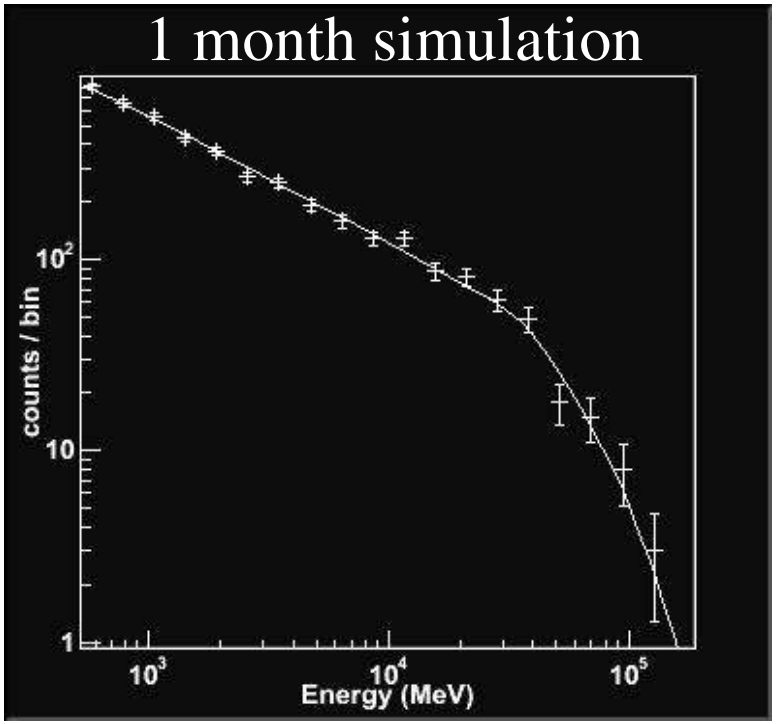






Example of a suitable blazar:

- Blazar J0210m5055 from checkout3
- This is the second brightest blazar of checkout3 'Flux(E>20 MeV)'
- Redshift = 1.00
- Index ~ 1.5 during flares (see lightcurves on the left)
- Spectrum can be used to measure opacity (likely) due to EBL



What can we do?

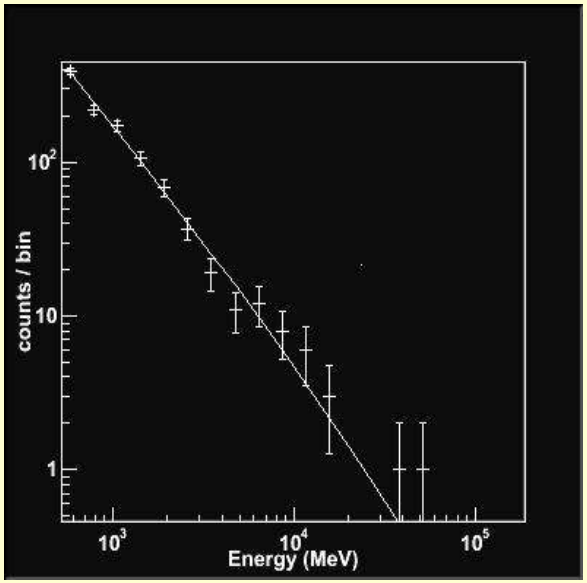
- Fit blazar candidates to a power law function with exponential cutoff:

$$F(E) \quad \alpha \quad E^{-\alpha} \qquad ; \qquad E < E_b$$

$$E^{-\alpha}\mathrm{Exp}(-(E-E_b)/P_1) \qquad ; \qquad E > E_b$$

- With the results from the fits, calculate opacity related quantities, for example at which energy is $\tau(E,z) = 1$?

$$E_{\tau=1} = E_b + P_1$$



J0530p1323

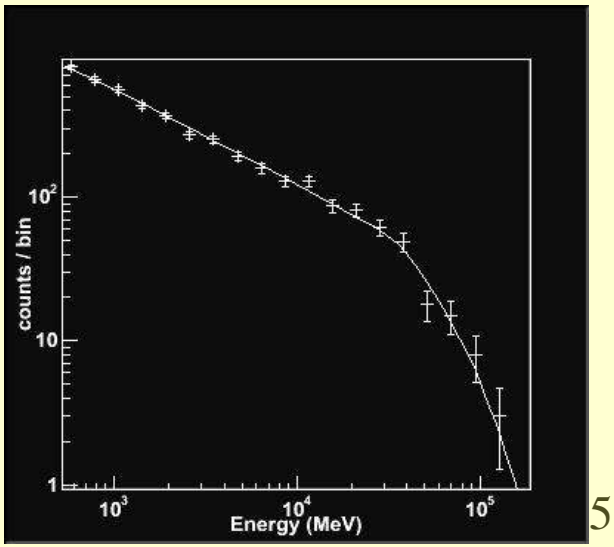
$E_{\tau=1}$ = 110.1±71.2 GeV (from fit)

E_{model} = 40.4 GeV (true value)

J0210m5055

$E_{\tau=1}$ = 75.1±7.2 GeV (from fit)

E_{model} = 75.8 GeV (true value)



Redshifts and DC2

- In DC2 as in real life, redshifts for GLAST blazars are not “given”.
- The only thing we get for free is a initial list of LAT sources, with preliminary position, flux and spectrum. No redshift.
- We have to identify blazar-candidate sources (variability, spectrum), establish their position and then look them up in catalogs to get their redshift
- What we may expect from the DC2 sky:
  - High-confidence EGRET blazars -> Get redshift from 3EG catalog if known
  - Sources not in 3EG catalog(like FSRQs) -> Use NED to find counterparts
  - Sources with no counterpart in any existent catalog -> No redshift available

DC2 Goals

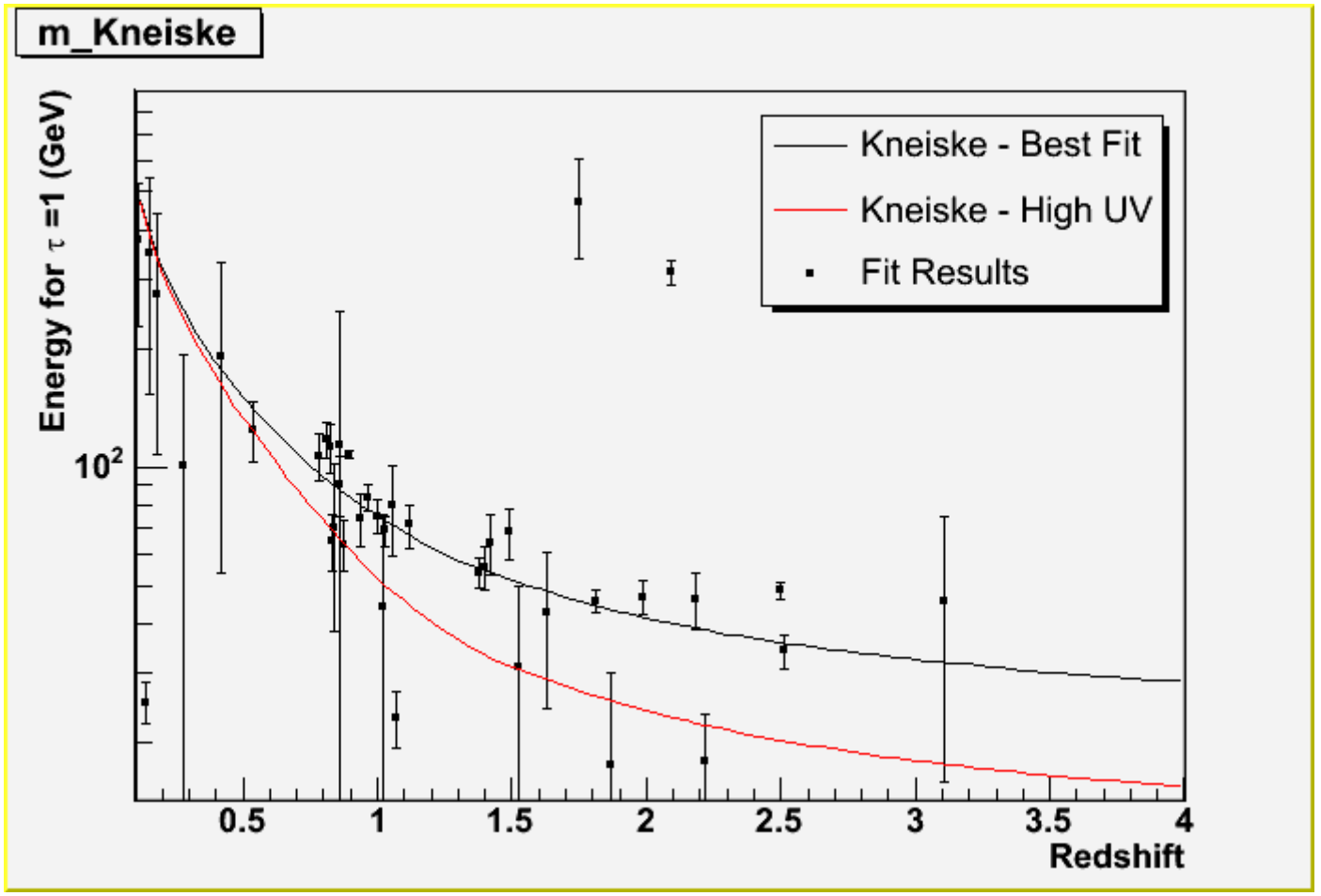
- With the blazars that have known redshift:

  - Scatter plot of $E_{\tau=1}$ vs redshift (Fazio-Stecker Relation)

  - In my opinion, getting this plot should be the primary goal for DC2 regarding EBL studies.

- Secondary goals if enough blazars:
  - Find which EBL model agrees better with the data
  - For the blazars without known redshift, obtain redshift (upper) limits. Something like: if $z > z_{max}$, then blazar has "unphysical" spectrum. *too optimistic...*

A glimpse of 1 month worth of Data (Preliminary)



Simulation:

- 30 days
- Checkout 3 blazars with Gino's light curves
- No diffuse

- Data points are obtained from the fits of simulated blazars
- Solid lines are obtained directly from the models

- From 105 blazars, we are left with 40 blazars after applying the following cut:

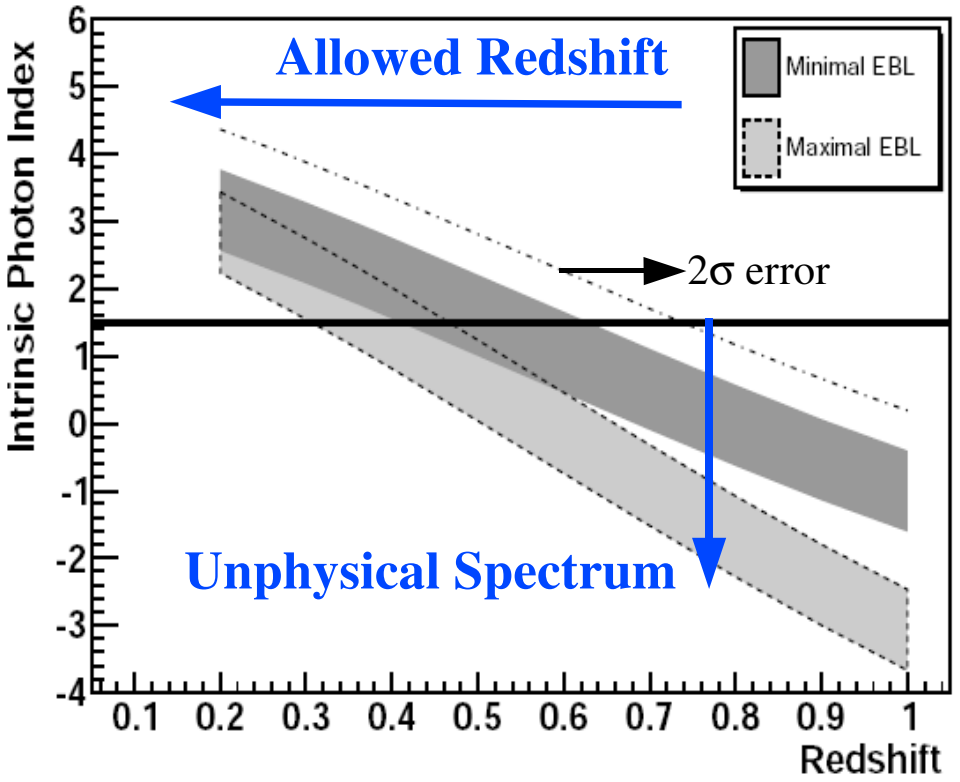
  FitQuality = 3 && Redshift > 0.1 && Index > -2.1

- In reality, the diffuse background and source confusion will make things more difficult and results less significant.

Bonus Feature: a new HESS paper on EBL
astro-ph 0601545

Facts:

- HESS observed BL LAC PG1553+113 with flux(E>200GeV) = 4.8 x 10^{-12} cm^{-2} s^{-1}
- Redshift is unknown. However, photometric observations with Hubble telescope suggest that z > 0.25 and possibly z > 0.78



Why is this interesting?

- PG1553+113 is possibly the most distant BL Lac object detected at VHE energies.
- If HESS detects a similar source with a redshift in the suggested range, the constraints on EBL models will be very strong.
- The HESS collaboration presents in the paper a method to calculate upper limits to the redshift of blazars. The method is (EBL) model dependent and requires to define a limit of when the spectrum of a blazar is "unphysical"