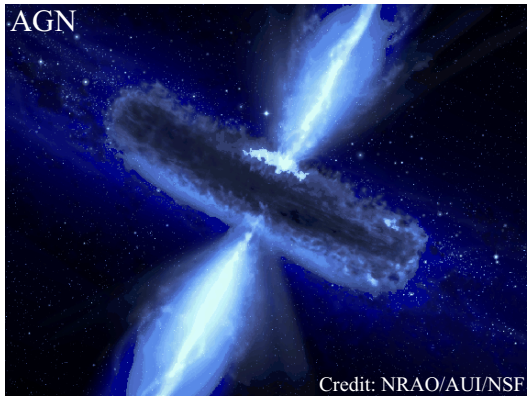
Thomas Bretz

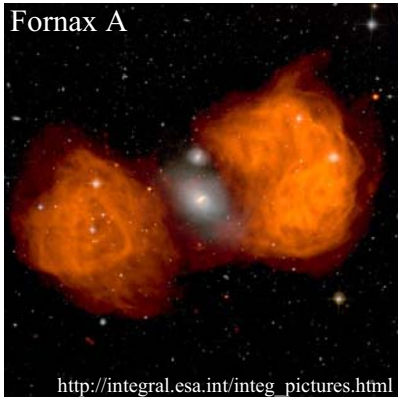
Observations of extragalactic sources above **100GeV** with the **MAGIC** telescope

Introduction

...the following talk is about AGN observed with the MAGIC telescope...

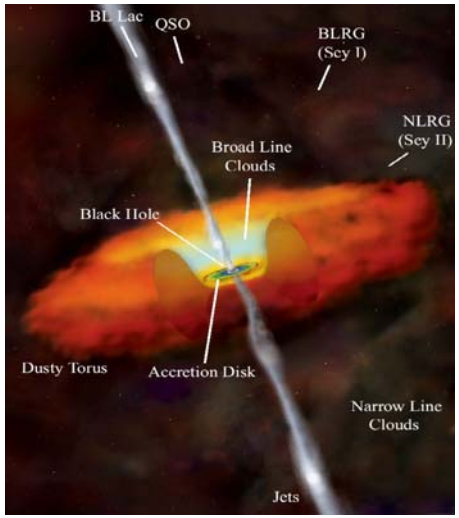


Artist view



Multiwavelengthpicture in false colors

Introduction - What is an AGN?



- ENIGMA...?

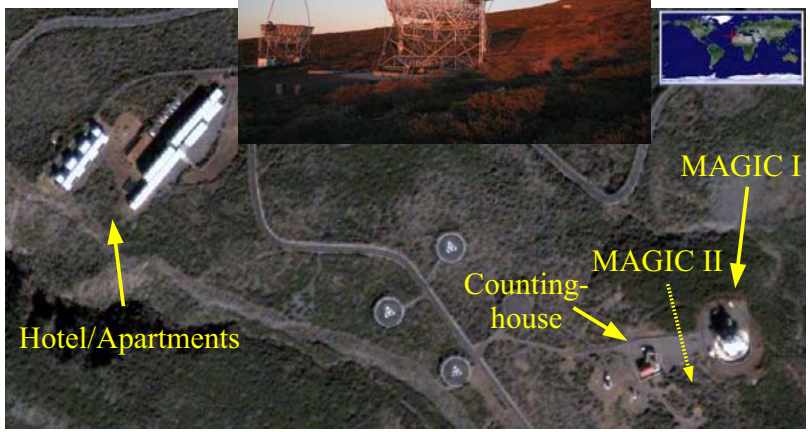
Contents

- Markarian 421 – spectrum
- Markarian 501 – lightcurve
- Markarian 180 -> Elina
- 1ES2344+514 – detection
- 1ES1959+650 – SED

- 1ES1218+304
  - detection
  - spectrum
  - intrinsic spectrum
  - spectral energy distribution

- PG1553+113
- GRB050713a; GRB050904

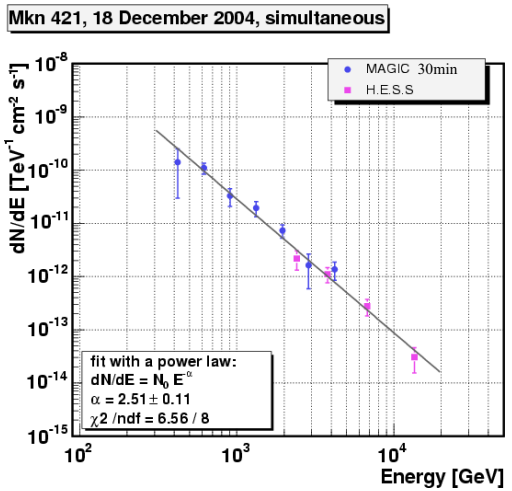
MAGIC



© Google 2006

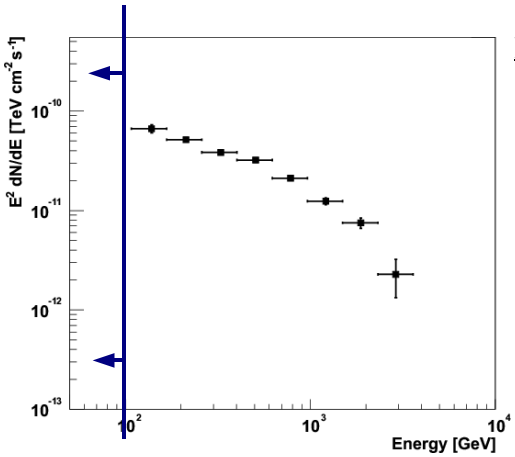
Observation Period: Since fall 2004; z.Zt. Cycle 1 (April 2005 – April 2006)

Markarian 421 (z=0.031)



- Observation period: 2004-2006
  - Significance » 40 (*Li/Ma*)
- Simult. observations (H.E.S.S.)
  - 18. December 2004
  - 1.5h
  - Significance 10.1
    - Measurements fit well
    - Spectrum over 1.5 order of magnitude

Markarian 421 (z=0.031)



Results of the observations:

- Peak-energy ≤100GeV
- Indirect measurement of the absorption due to the evolving extragalactic background light
- Correlation of X-ray and gamma-flux

ApJ 2006, submitted (astro-ph/0603478)

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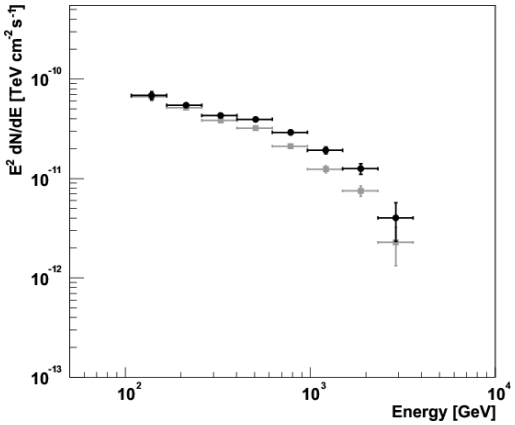

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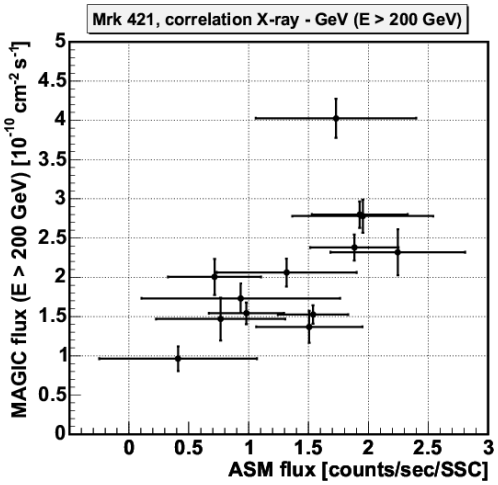

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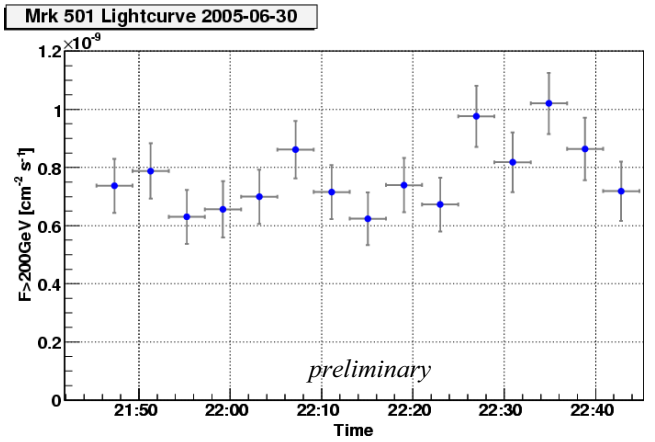
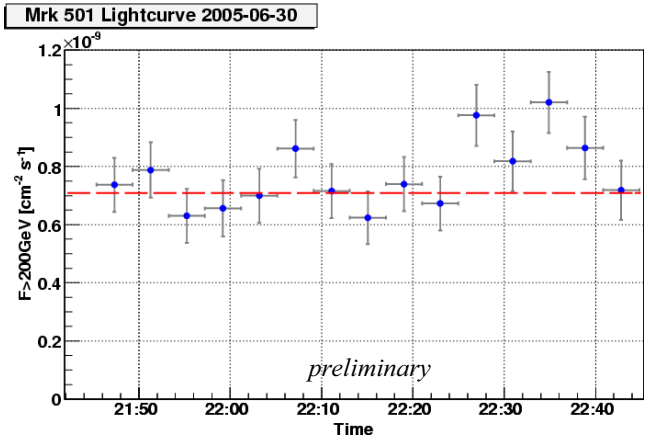
Markarian 501 (z=0.033)



- Resolution of the time-variability <5min
- Probability for the flux being consistent with a constant flux only 5%
- Flux-variations 30%-50%

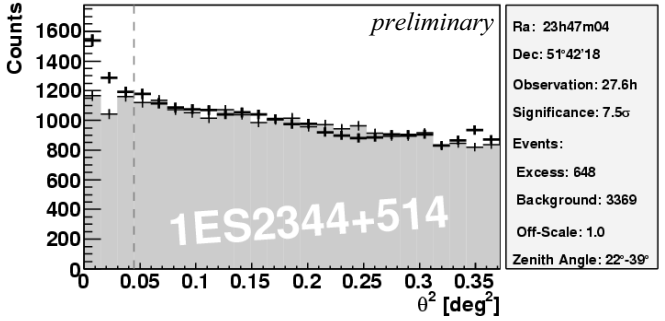
Markarian 501 (z=0.033)



- Resolution of the time-variability <5min
- Probability for the flux being consistent with a constant flux only 5%
- Flux-variations 30%-50%

see also Bednarek, Protheroe 1999 MNRAS 310, p.577ff

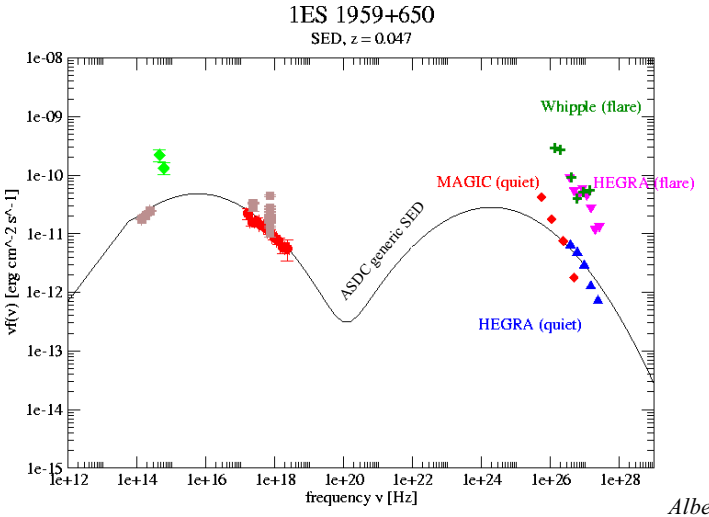
1ES 2344+514 (z=0.044)



- Known to emit at VHE (Whipple)
- 3. Aug. – 31. Dec. 2005
- Low flux state
- Extension of the VHE-spectrum below 350GeV

in preparation

1ES 1959+650 (z=0.047)



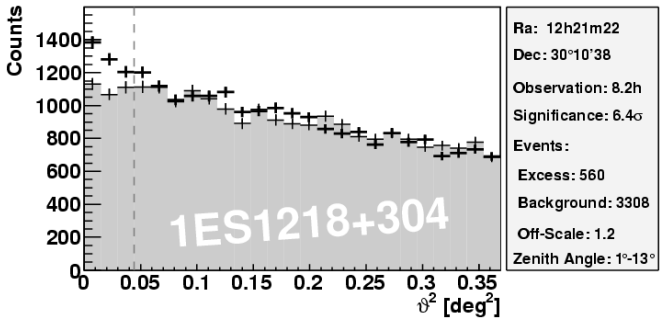
- Sept./Oct. 2004: 6.5h
- Significance 8.2

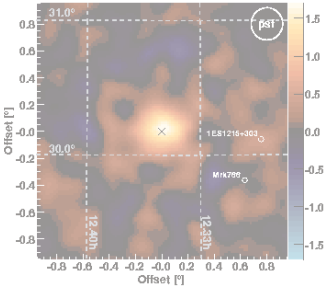
- Orphan flare (Whipple)
- Spectrum extended to lower enegies
- low flux state (quiescent state?)
- fits well with *HEGRA-quiet*
- X- and Gamma-ray luminosität similar

PhD thesis N.Tonello, 2/2006
Albert et al., ApJ 2006, 639, p.761ff

1ES 1218+304 (z=0.182)

- 9.-15. January 2005
- 6,4 sigma (Li/Ma) for the emission at the position of 1ES1218+304
- 560 excess events / 8,2h
- Signal consistent with PSF (~0.12°)





T.Bretz, PhD thesis
Albert et al., ApJ 642, 2006

Result of the data analysis

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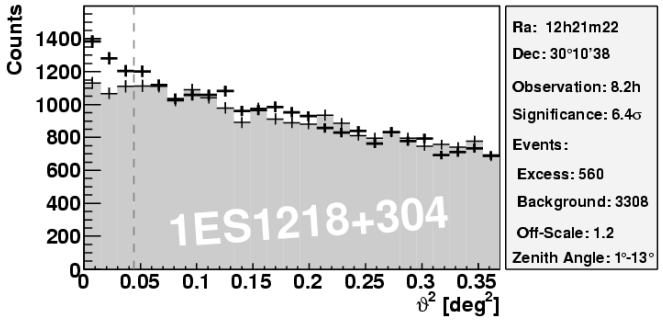

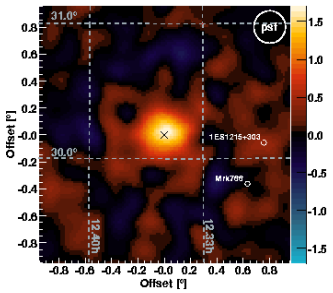

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Albert et al., ApJ 642, 2006

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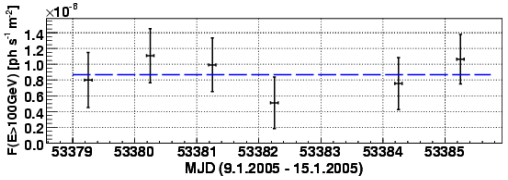
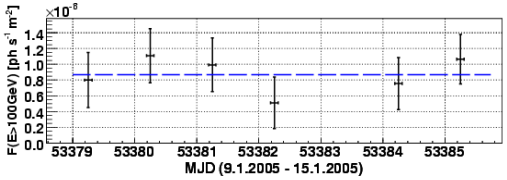


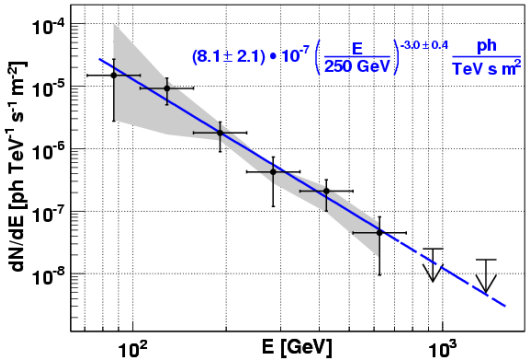
- Lightcurve consistent with constant flux

$$(8{,}7 \pm 1{,}4) \cdot 10^{-7}\, s^{-1} \cdot m^{-2}$$

T.Bretz, PhD thesis
Albert et al., ApJ 642, 2006

Result of the data analysis



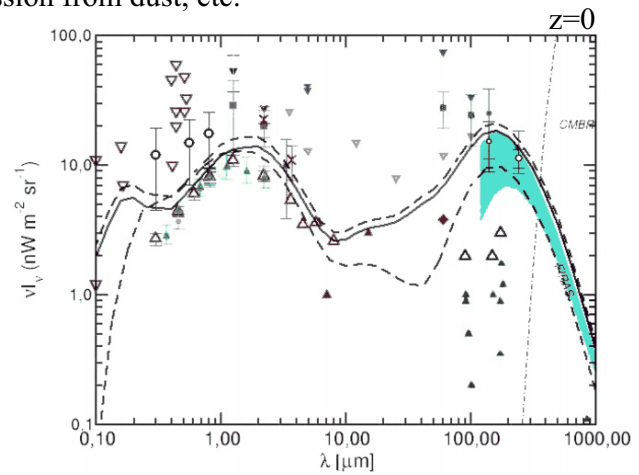


- Lightcurve consistent with constant flux
  $(8{,}7 \pm 1{,}4) \cdot 10^{-7} s^{-1} \cdot m^{-2}$
- Statistical error
- Systematic error from analysis (gray area)
- Differential spectrum consistent with apower law:
  $(8{,}1 \pm 2{,}1) \cdot 10^{-7} (E/250\,GeV)^{3{,}0 \pm 0{,}4} s^{-1} m^{-2} TeV^{-1}$
  - first new AGN emitting at 100GeV-300GeV (peak energy ~120GeV)

T.Bretz, PhD thesis
Albert et al., ApJ 642, 2006

Correction for absorption due to the metagalactic radiation field

- Pair production of gammas with diffuse metagalactic photons
  - eg. star light, reemission from dust, etc.



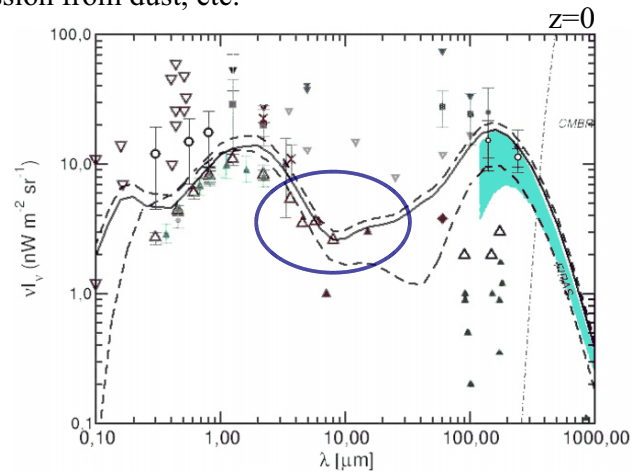
(Kneiske et al., A&A 386, 2002)

Correction for absorption due to the metagalactic radiation field

- Pair production of gammas with diffuse metagalactic photons
  - eg. star light, reemission from dust, etc.

Pair production condition:

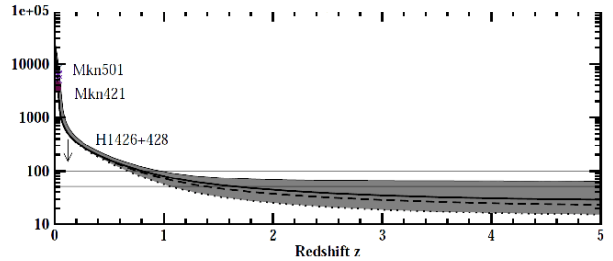
$$E_{LE} \cdot E_{HE} > 2 \cdot (m_e c^2)^2$$



(Kneiske et al., A&A 386, 2002)

Correction for absorption due to the metagalactic radiation field

- *Fazio-Stecker-Relation*:
  - Gamma-horizont (Attenuation by 1/e)



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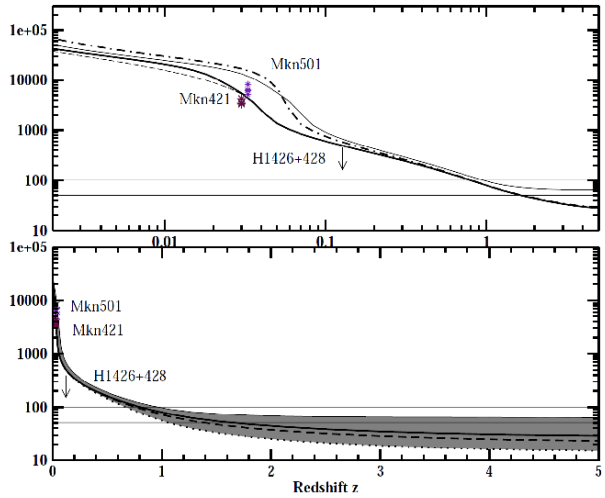
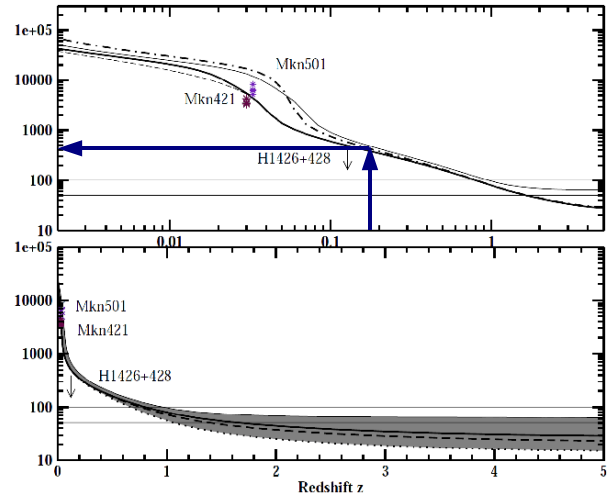


Correction for absorption due to the metagalactic radiation field

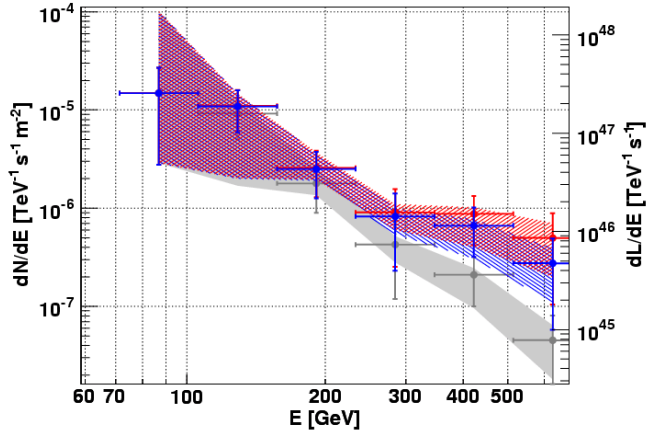
- *Fazio-Stecker-Relation*:
  - Gamma-horizont (Attenuation by 1/e)
- For **z=0.182** we get a cut-off at ~400GeV



(Kneiske, Bretz, A&A 413, 2004)

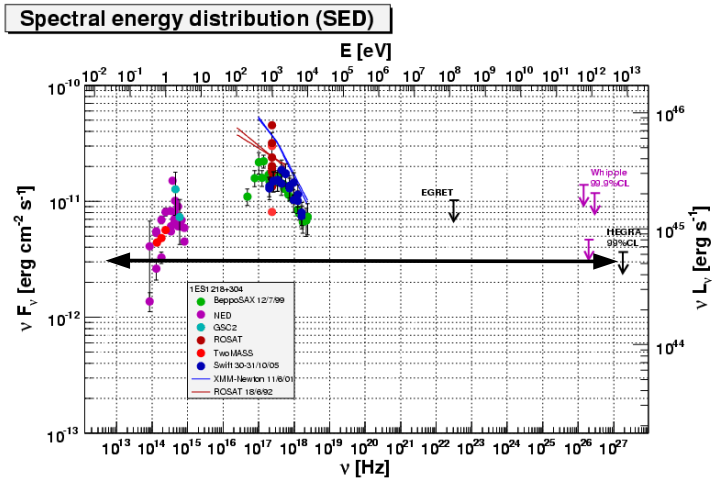
Correction for absorption due to the metagalactic radiation field

- *Fazio-Stecker-Relation*:
  - Gamma-horizont (Attenuation by 1/e)
- For **z=0.182** we get a cut-off at ~400GeV
  - Correction of the spectrum for the attenuation



T.Bretz, PhD thesis

Including of the new data points into the known spectral energy distribution

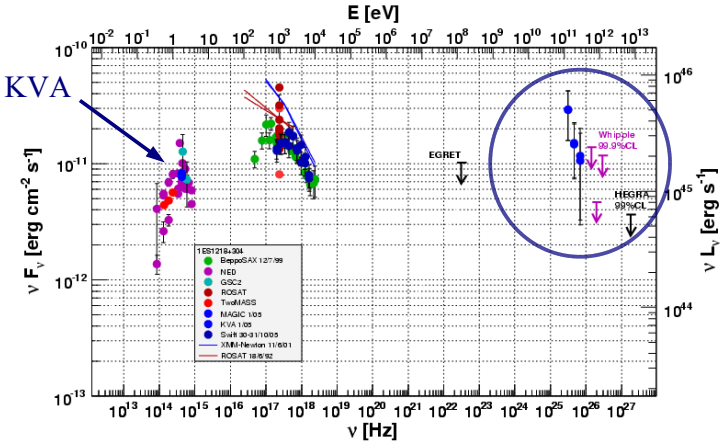


Radio optical X-ray γ-ray (VHE)

T.Bretz, PhD thesis

Including of the new data points into the known spectral energy distribution

Spectral energy distribution (SED)



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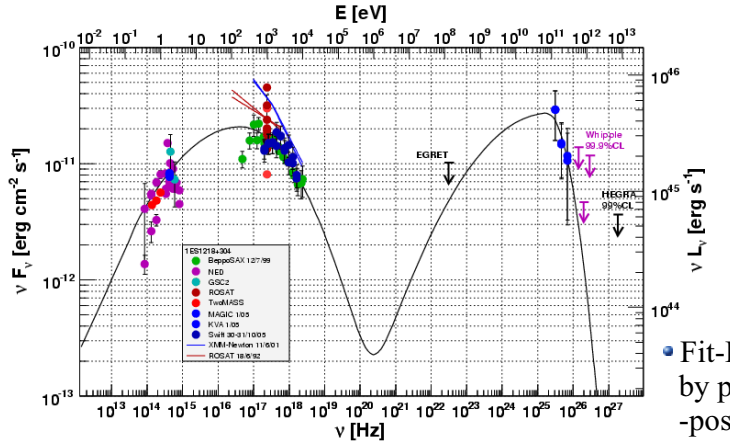
SSC-model fit

Spectral energy distribution (SED)



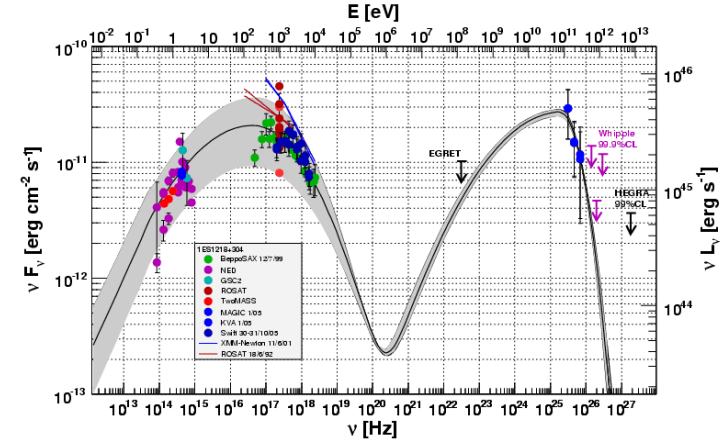
- Fit-Parameter restricted by peak-height and -position

(Model: Ghisellini, Maraschi, Dondi, A&AS 120, 1996)

(Tavecchio, ApJ 509, 1998)

SSC-model fit

Spectral energy distribution (SED)



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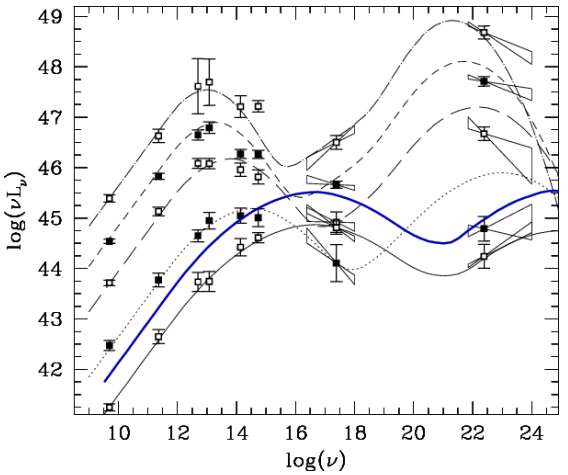
Comparison with blazar sequence

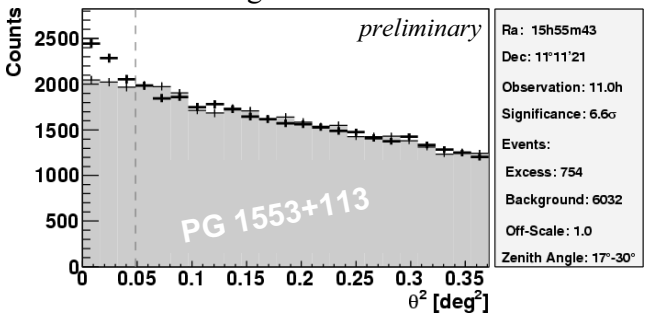


- The spectrum of 1ES1218+304 fits into the sequence
- But it is on the upper edge of the bin
- A similar source with a slightly higher luminosity would violate the sequence.

T.Bretz, PhD thesis

PG 1553+113 (z>0.09)

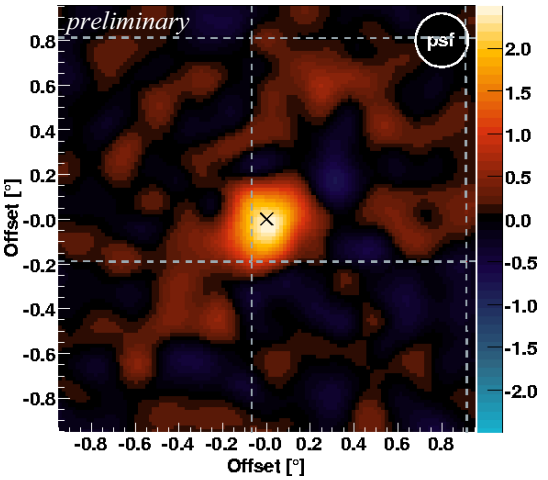
Combined signal 2005/2006

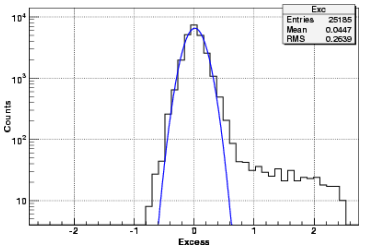


Observations:

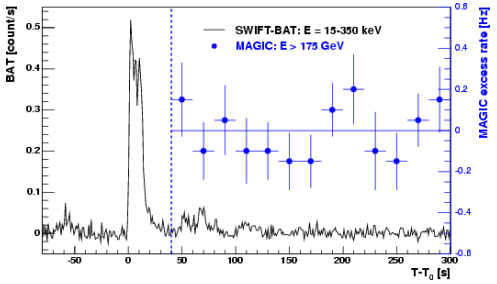
- 3.-13. May 2005 (~some days before H.E.S.S.)
  - Significance > 3
- Follow-up observations: 29. Jan. – 9. March 2006
  - Significance > 5

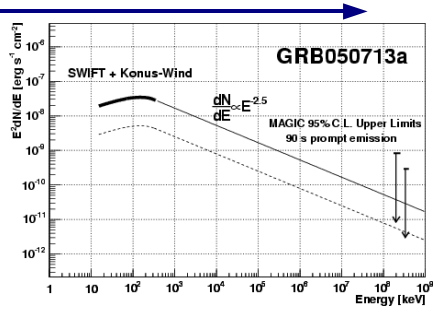
PG 1553+113 (z>0.09)





Gamma-ray Bursts (z>1?)





- 12 GRB observed since April 2005 (10x Afterglow-, 2x Prompt-emission)
- Typical repositioning time <25 seconds
- Prompt emission (050713a; 050904)
  - Time for repositioning <10 seconds (!)
  - No significant signal

ApJ 2006, accepted (astro-ph/0602231)

Conclusion

- Talking about AGN you should not forget the TeV part of the spectrum
- There are now more and more sources known to emit at TeV energies
- MAGIC is able to measure down to 100GeV at best conditions
  - **TeV spectra should be included in MWL discussions**