



MAX-PLANCK-GESELLSCHAFT



MAGIC
Major Atmospheric
Gamma Imaging
Cerenkov Telescope

Observations of AGNs with the MAGIC telescopes

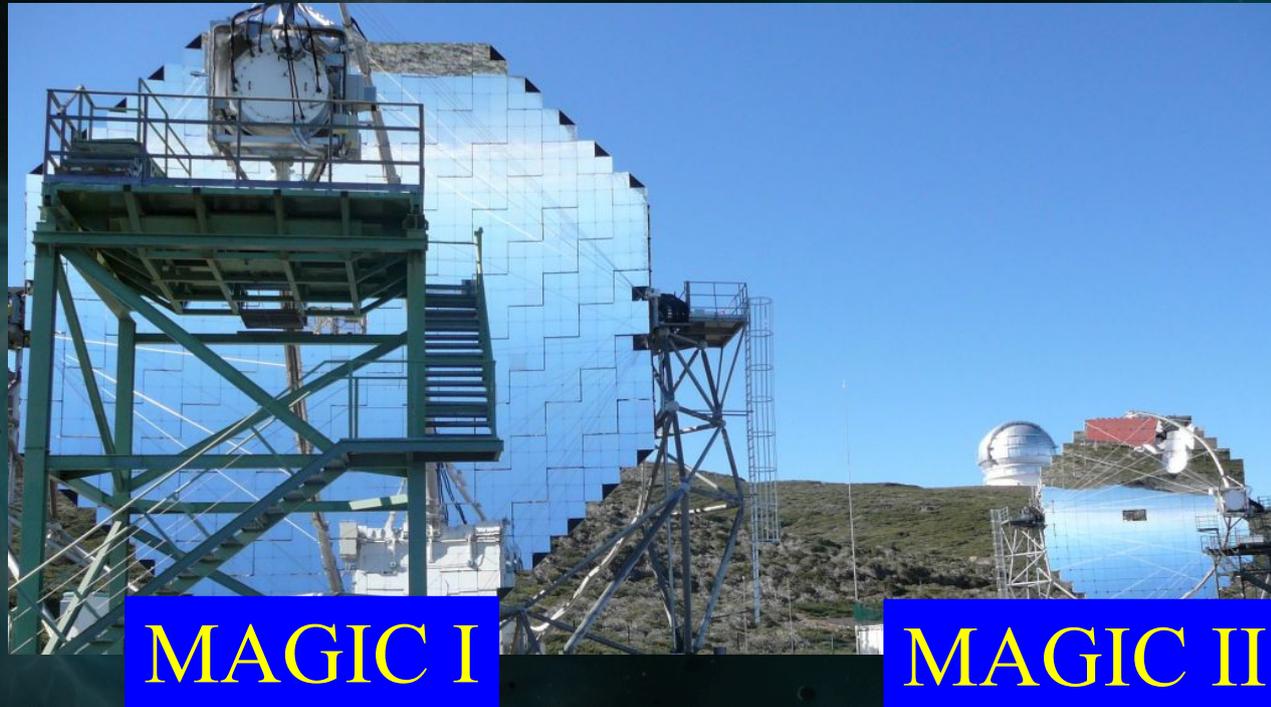
Julian Sitarek

(Max-Planck-Institut für Physik, Munich)

on behalf of the
MAGIC Collaboration

The MAGIC telescopes

- A system of two Cherenkov telescopes separated by 85m
- Located in Roque de los Muchachos observatory, (2200 m a.s.l.), Canary Island of La Palma, Spain
- MAGIC I in operation since fall 2004
- MAGIC II in operation since 2009.
- IACTs with the largest individual mirrors in operation (17 m diameter)
- Duty cycle ~10-15% (dark and moderate moonlight)



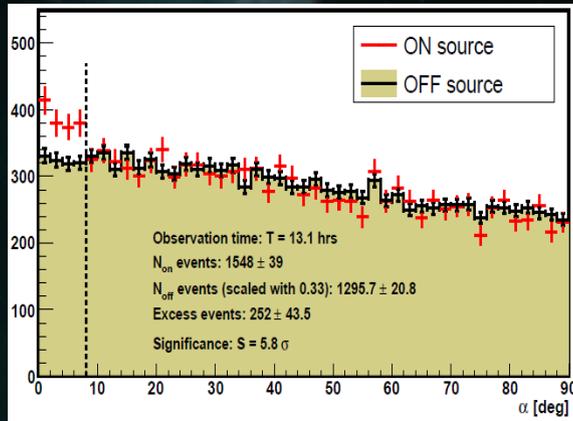
- Lowest energy threshold among all presently operating IACTs (50-60 GeV)
- Sensitivity 1.6% Crab in 50h (MAGIC I)
< 1% Crab in 50h (Stereo)

MAGIC AGN program

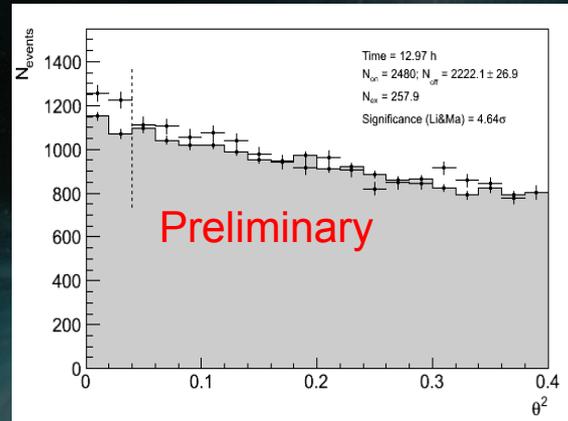
- Detection of new VHE gamma-ray sources (so far ~9 AGNs were discovered by MAGIC as new VHE gamma-ray sources)
- Monitoring of bright and/or interesting sources
- Multiwavelength campaigns for better understanding of known sources
- Studies of the EBL via VHE gamma-ray observations

Selected results of the MAGIC AGN observations

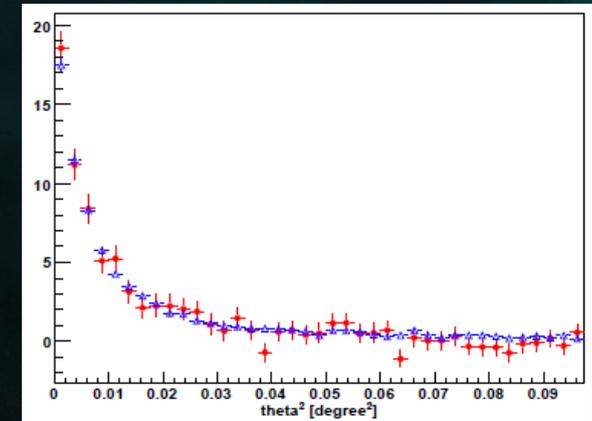
Mono



Discovery of S5 0716

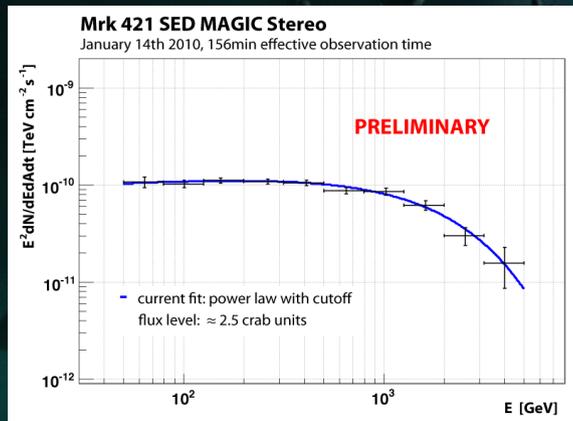


PKS 1424

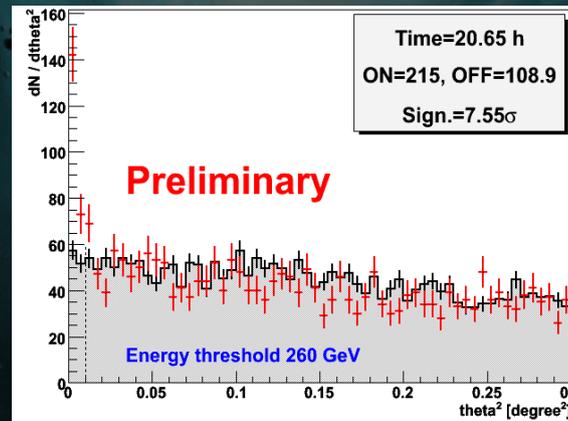


AGN halo & EGMF

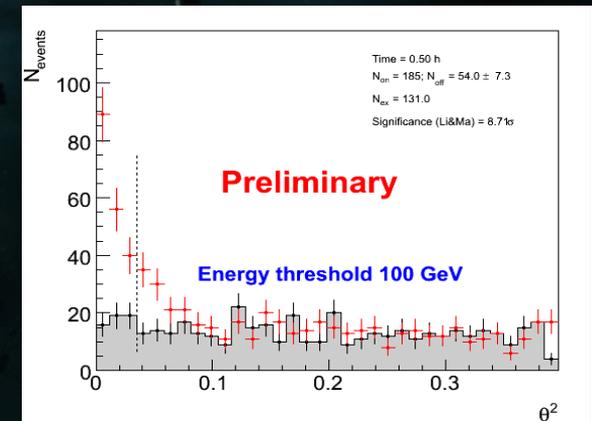
Stereo



Markarian 421 flare



Detection of IC 310



Detection of PKS 1222

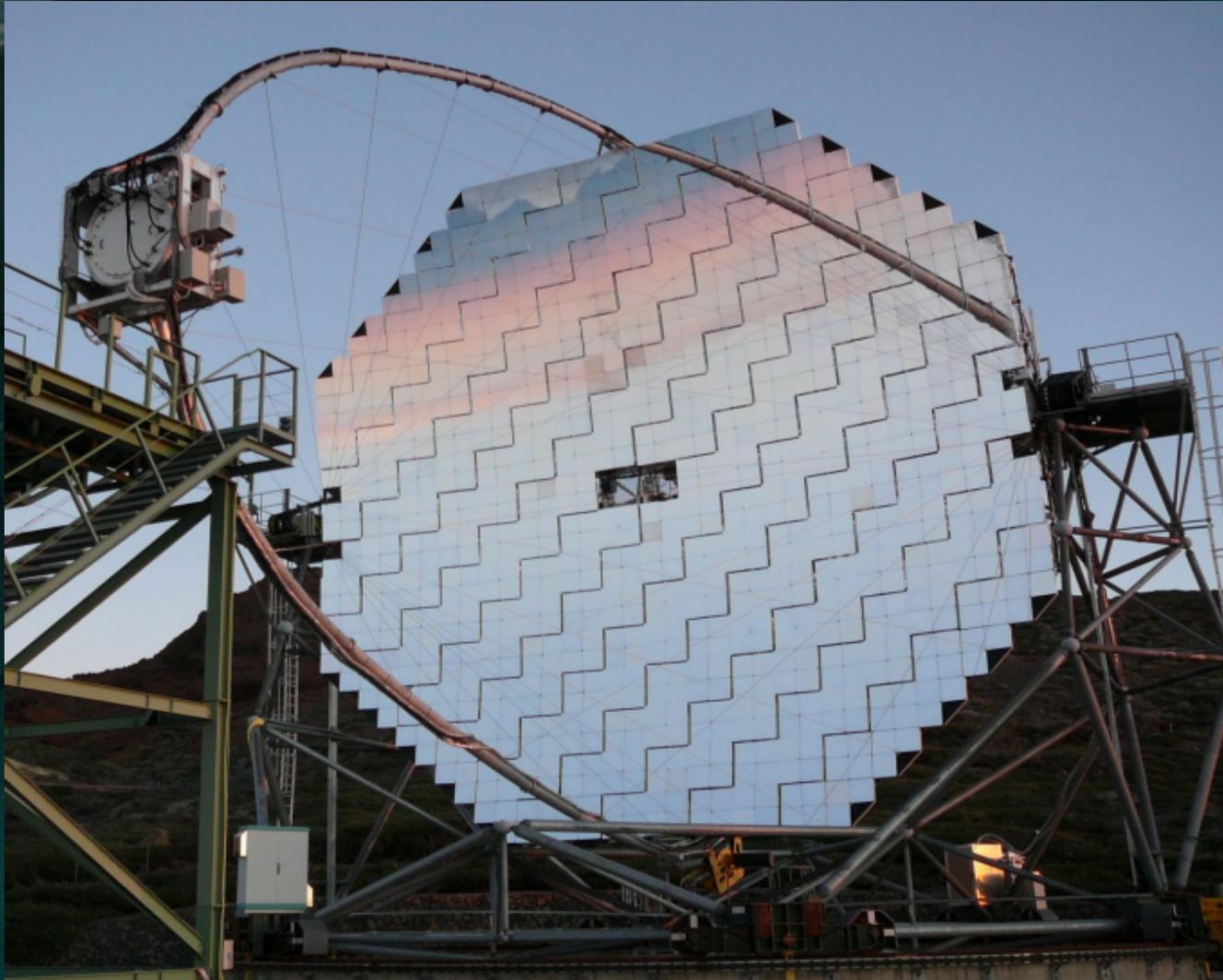
See also other MAGIC related contributions:

D. Paneque talk on Markarian 421 and 501 MWL campaign

E. Prandini poster on MAGIC long term PG 1553+113 observations

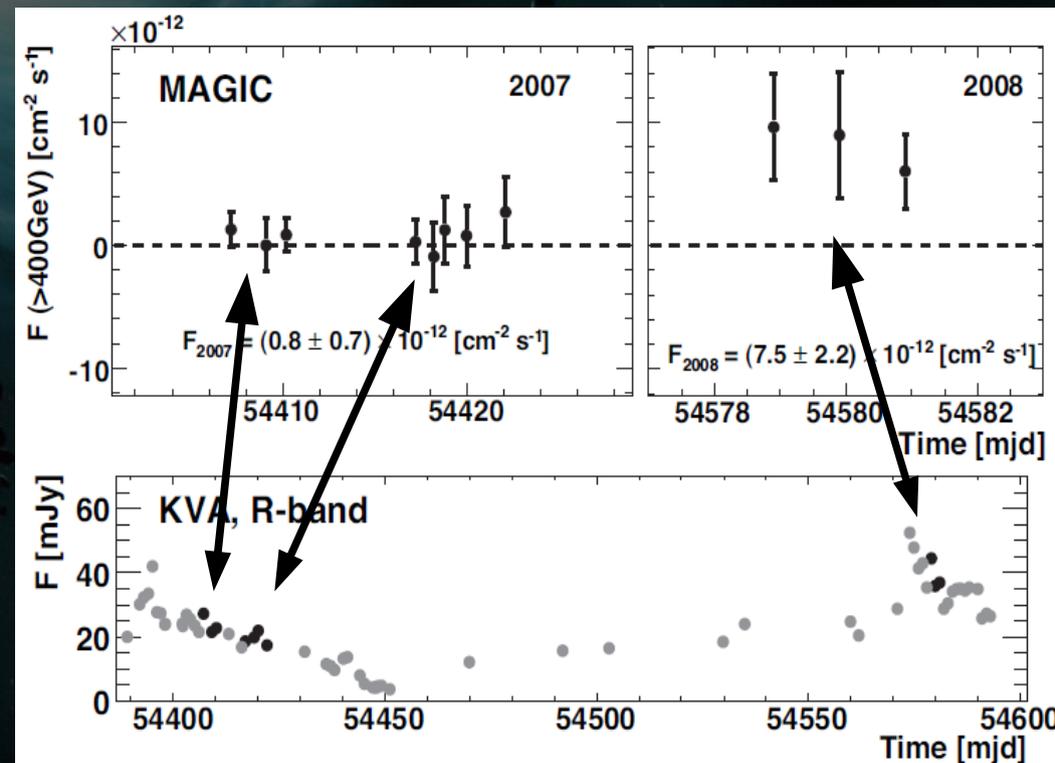
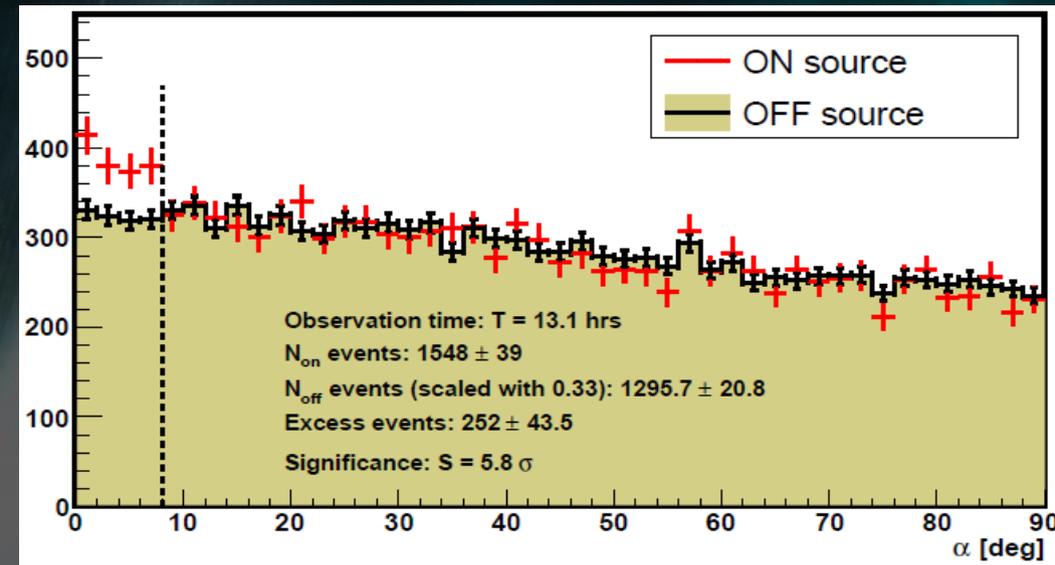
M. Raue talk on MWL observations of M87

MAGIC I observations



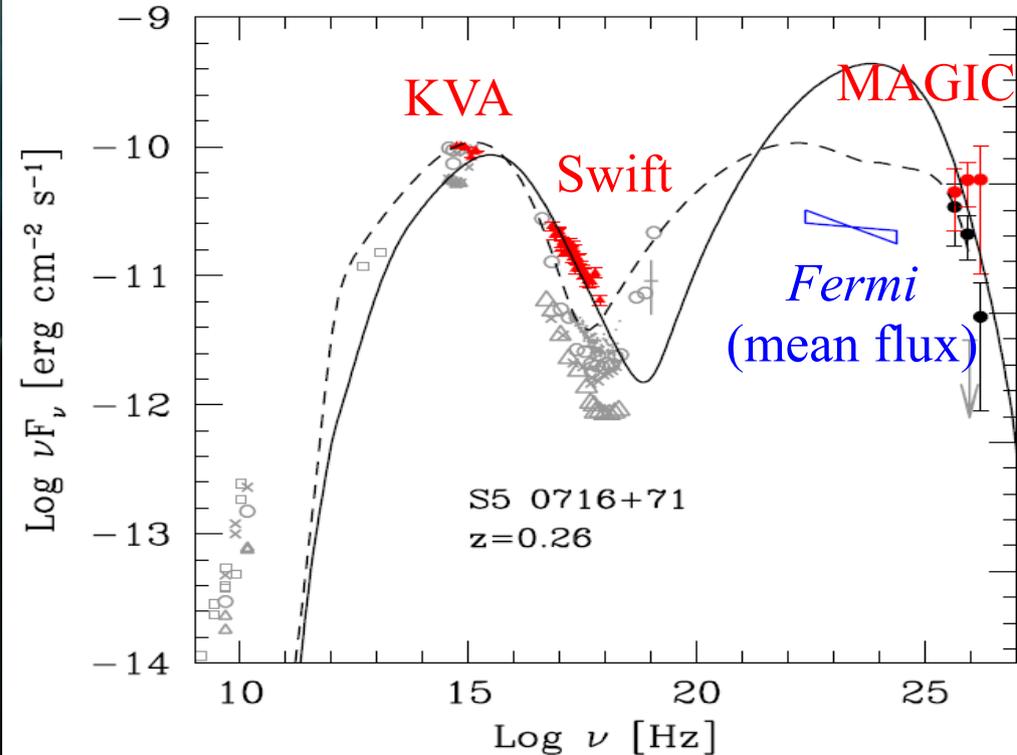
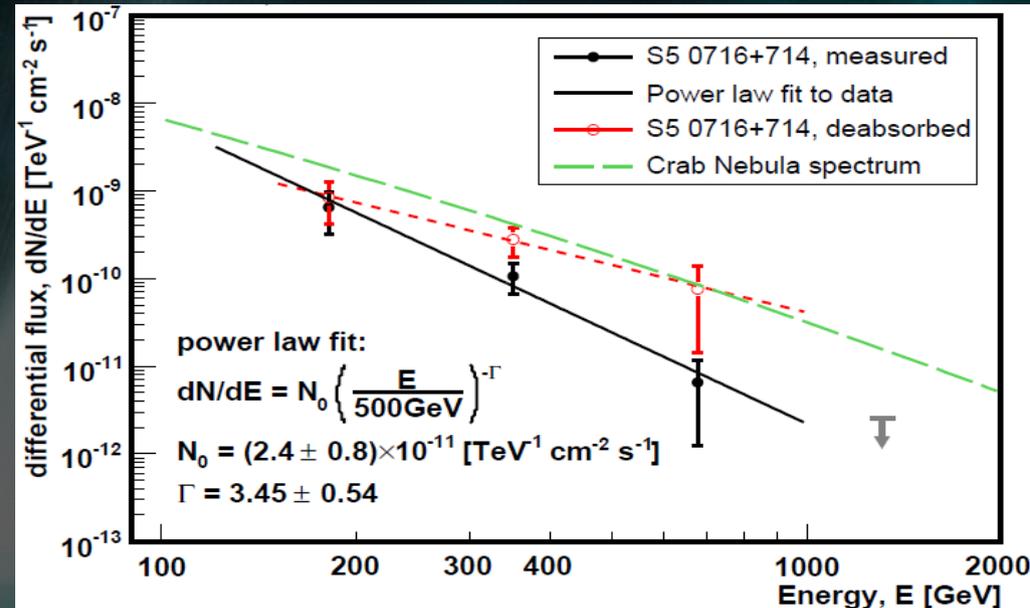
MAGIC I observations of S5 0716+714

- LBL object with estimated redshift $z \approx 0.26$
- Observed by MAGIC I in November 2007 and (following an alert of high optical activity) April 2008
- Detected with a total significance $S = 5.8\sigma$ in 13h
- VHE flux in 2008 ~ 9 times higher than in 2007
- Gamma-ray flare seen during high state of the optical emission



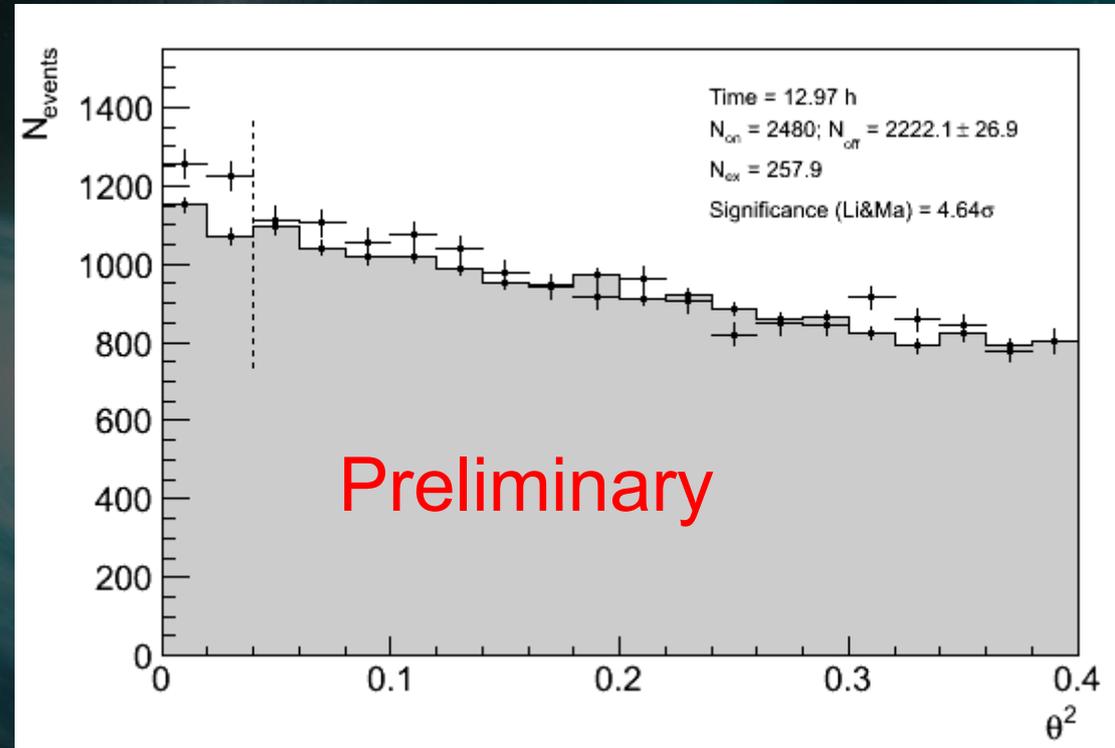
MAGIC I observations of S5 0716+714

- The measured power-law spectrum from 2008 data: $dN/dE = (2.4 \pm 0.8) \times 10^{-11} (E/500\text{GeV})^{-3.5 \pm 0.5} [\text{TeV}^{-1} \text{cm}^{-2} \text{s}^{-1}]$
- Corrected for the EBL absorption (with Franceschini et al. (2008) model): hard spectral index of -1.8 ± 0.6
- SED can be fitted with a single zone SSC model (solid) or a “spine-layer” model (dashed). A possible component from EC cannot be also excluded.
- More information:
H. Anderhub et al. (2009), ApJ, 704, L129

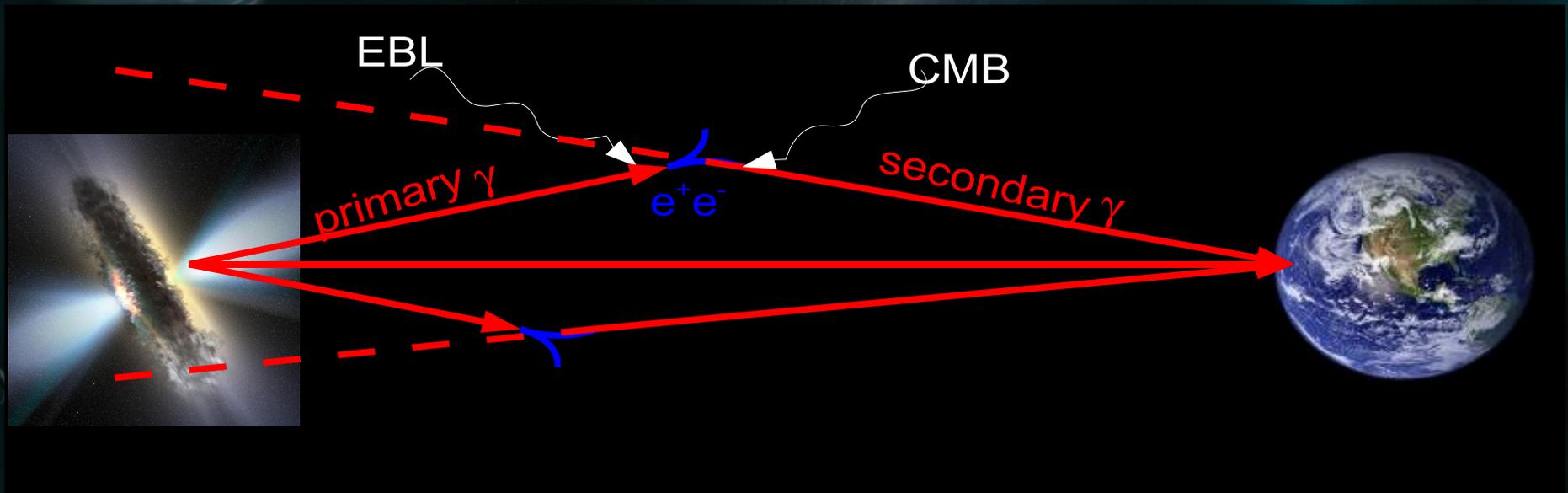


MAGIC I observations of PKS 1424

- IBL (or HBL) at an unknown redshift
- Discovered by VERITAS (AteI #2084)
- Confirmed by MAGIC after just 9 days (AteI #2098)
- 4.6σ signal in 13h of observations during an optical high state

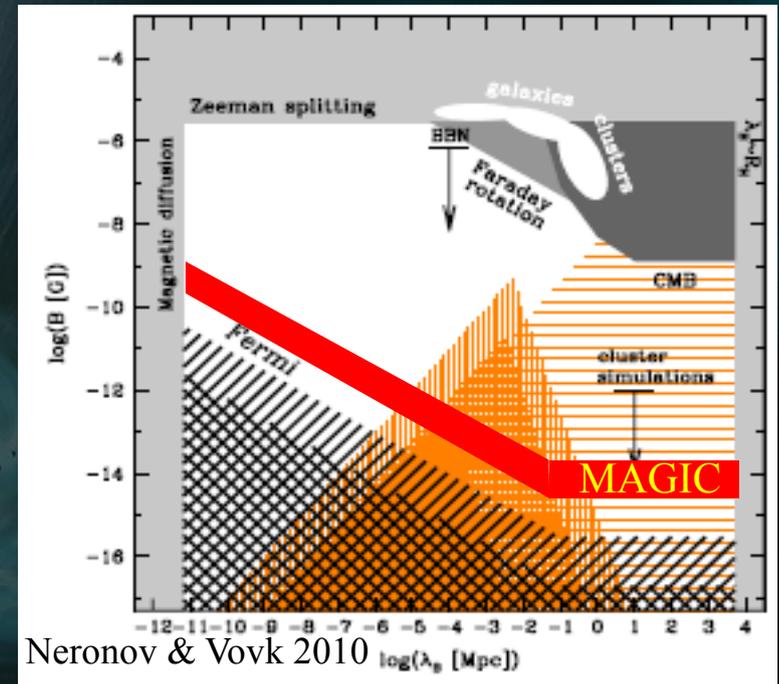
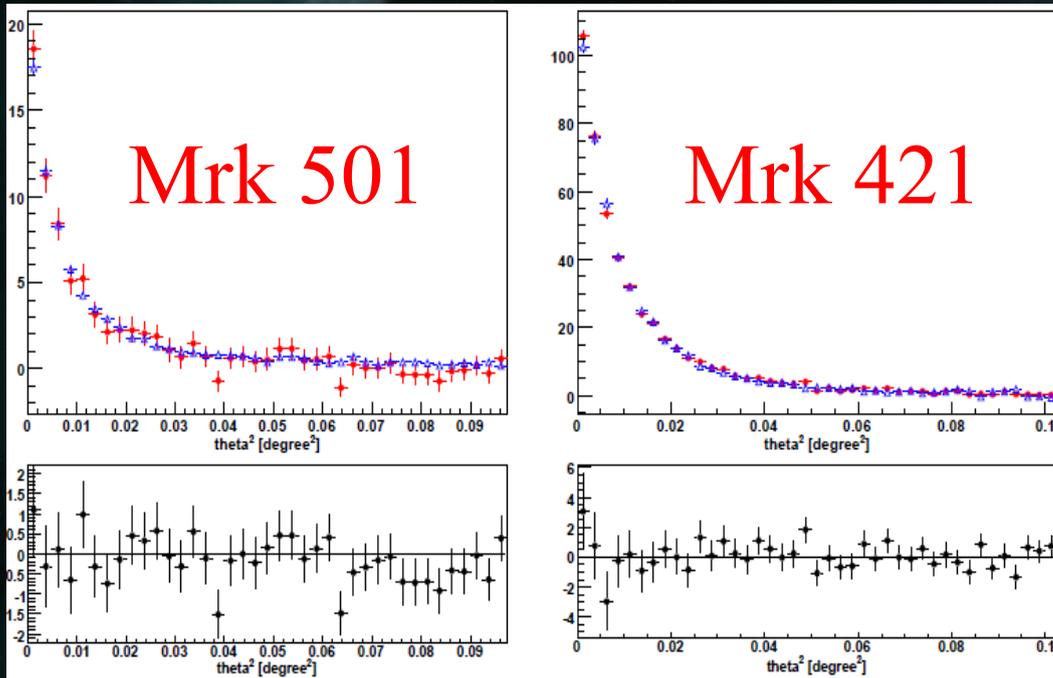


Search for an extended emission from Markarian 421 and 501 blazars



- Cascades (on the way to the observer) of VHE gamma-rays in the EBL/CMB radiation fields
- The trajectories of e^+e^- pairs are bend in the extragalactic magnetic field (EGMF) \rightarrow an additional, extended emission component is possible.

Search for an extended emission from Markarian 421 and 501 blazars



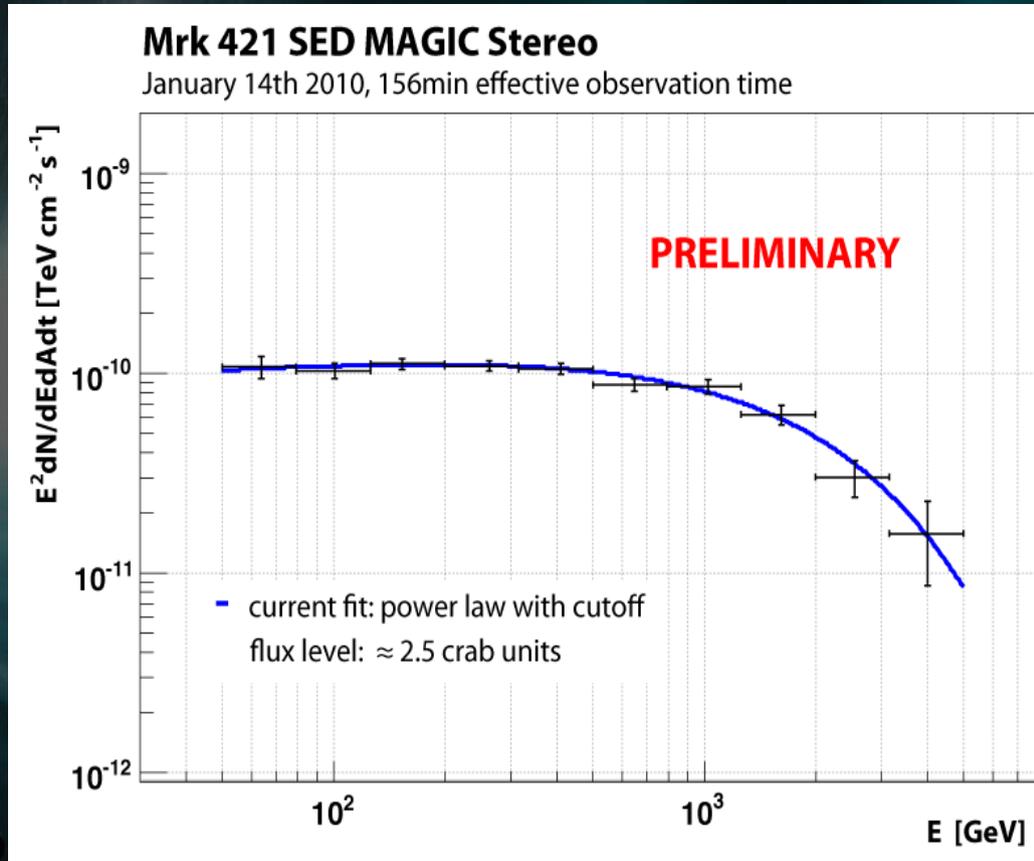
- No extended emission was found, an upper limit of $< 4\%$ of the Crab Nebula flux was obtained
- More information: Aleksić, J., et al., arXiv:1004.1093 (submitted to A&A)
- Constraints for the existence of EGMF with strengths of: $4 \cdot 10^{-15} < B < 1.3 \cdot 10^{-14} \text{ G}$ (for its correlation length $\gg 30\text{kpc}$) assuming comparable level of SED at 300 GeV and 20TeV

Stereo observations



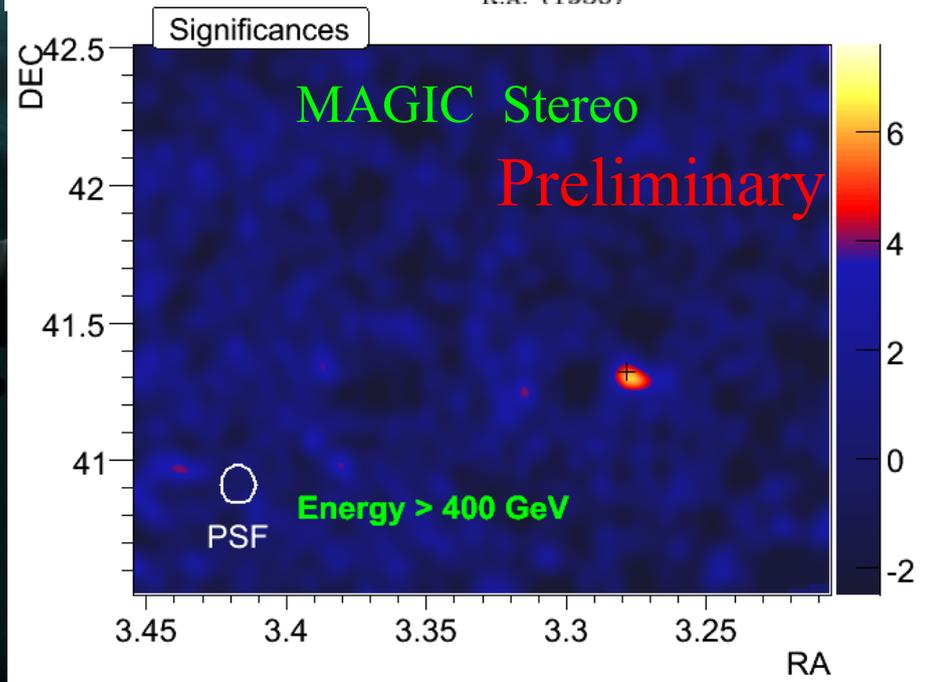
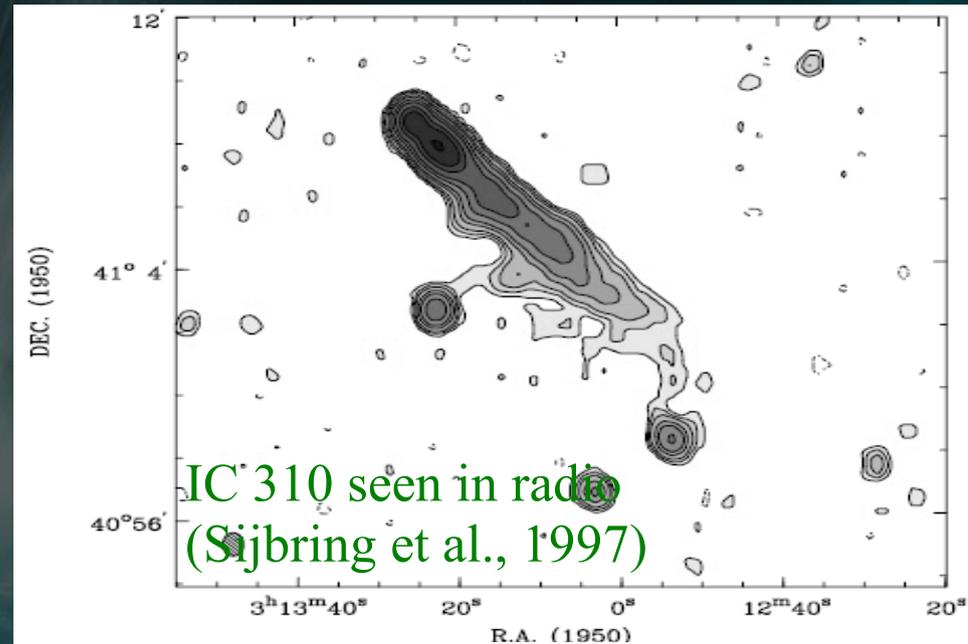
Markarian 421 flare seen with MAGIC Stereo

- A strong, ~ 2.5 C.U. flare was observed with MAGIC Stereo on 14th of January 2010
- A detailed SED spreading over 2 orders of magnitude in the energy (down to 50 GeV !) obtained in < 3 h of observations
- The energy spectrum can be well fitted by a power law with an exponential cutoff



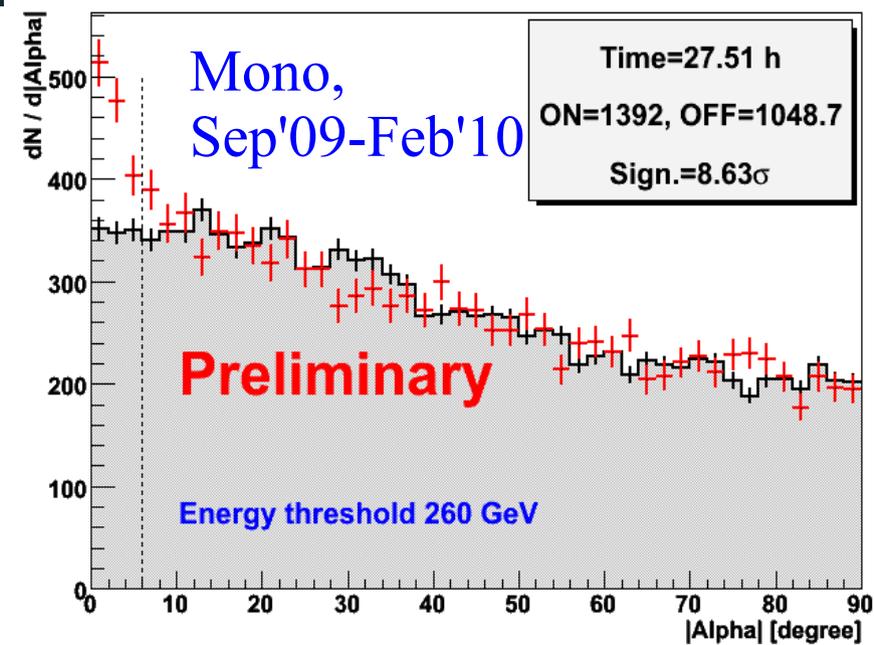
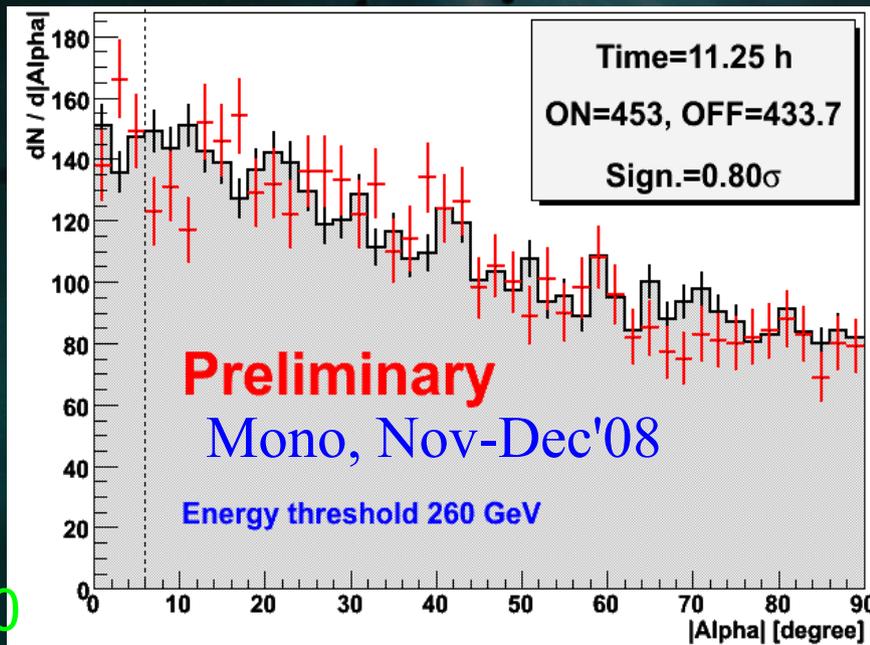
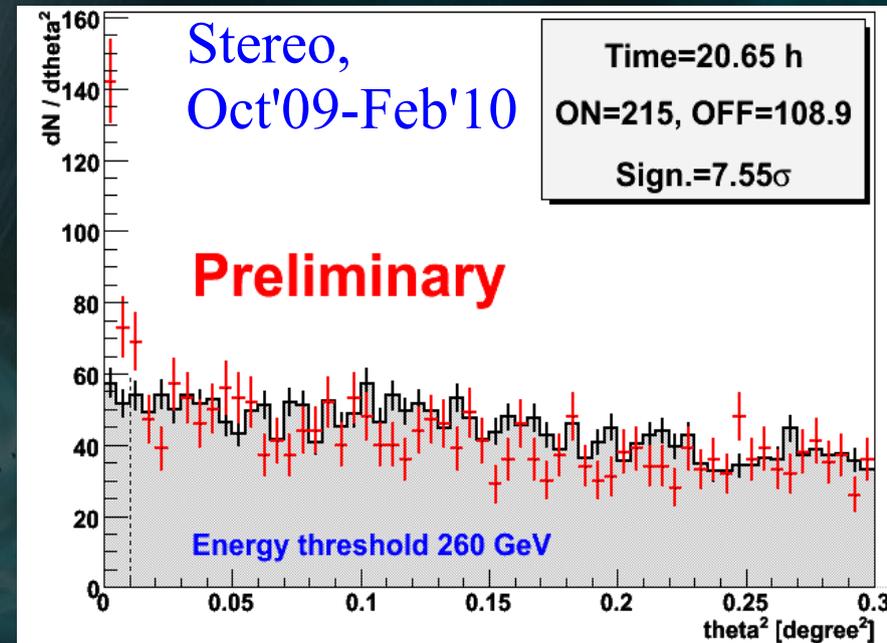
IC 310 observations with the MAGIC telescopes

- MAGIC observed the Perseus cluster in the Wobble mode during Nov'08 and Sep'09- Feb'10
- Since middle of Oct'09 data were taken also with the second telescope allowing for the Stereo analysis
- A head-tail radio galaxy IC 310 was in the FOV: 0.25° and 1° away from the Wobble pointing positions.
- Seen also by the Fermi-LAT



IC 310 observations with the MAGIC telescopes

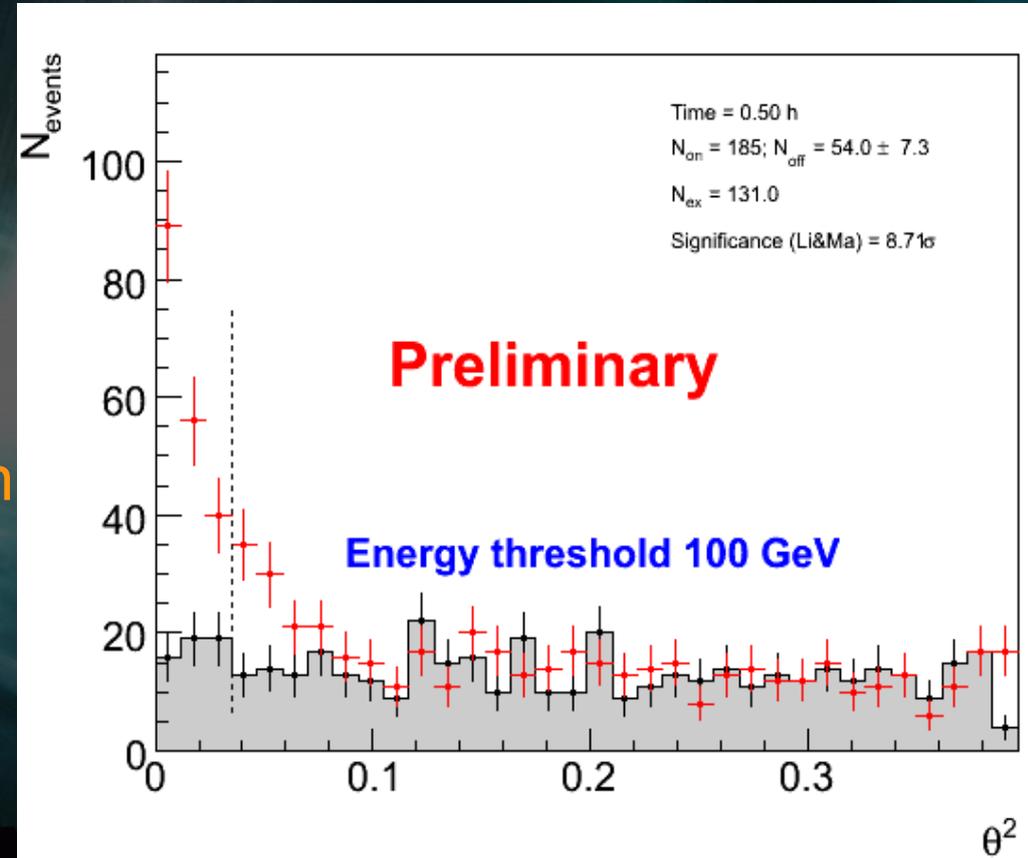
- Only the closer Wobble position was used for the analysis (higher collection area).
- 7.6σ signal from 20.6h of Stereo data
- 8.6σ signal from 27.5h of MAGIC I, mono data
- No signal in 11.2h of older, mono data, long term variability ?



- See also:
[ATel #2510](#)

Stereo observations of PKS 1222 with the MAGIC telescopes

- PKS 1222+21 (a.k.a. 4C +21.35) is a high redshift ($z=0.43$) FSRQ
- Observations triggered by a high state reported by Fermi
- A strong signal of 8.7σ in just 0.5h of data !
- Preliminary analysis show a flux $\geq 30\%$ of the Crab Nebula flux
- Also detected by Fermi in 100-300 GeV energy range.
- Can be used for the EBL studies.
- See also:
[ATel #2684](#)



Summary

- S5 0716+714 detected by MAGIC I in a high state of the optical activity
- Confirmation of the PKS 1424 detection
- Limits on the extended component of the VHE gamma-ray emission from blazars and EGMF
- High quality Markarian 421 spectrum down to 50 GeV just with < 3h of MAGIC Stereo data
- Detection of a head-tail radio galaxy IC 310, opening a new sub-class of the VHE sources
- Detection of PKS 1222 (8.7σ in 0.5h), a FSRQ with a redshift $z=0.43$, with the MAGIC Stereo observations → will constrain the EBL