



Recent AGN results from H.E.S.S.

Olivier Hervet for the H.E.S.S. collaboration

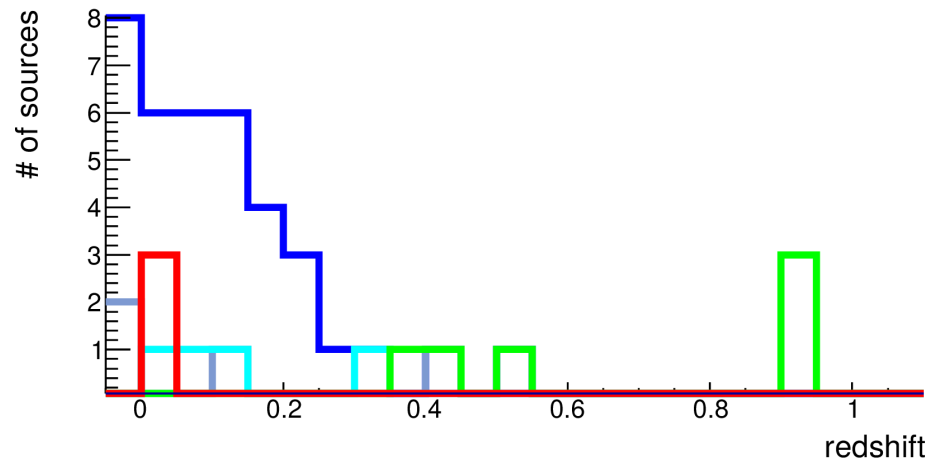
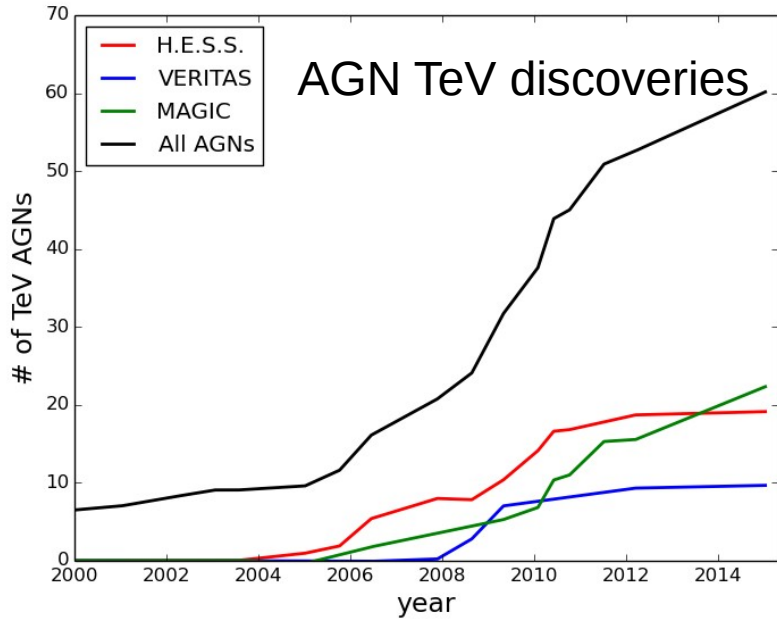
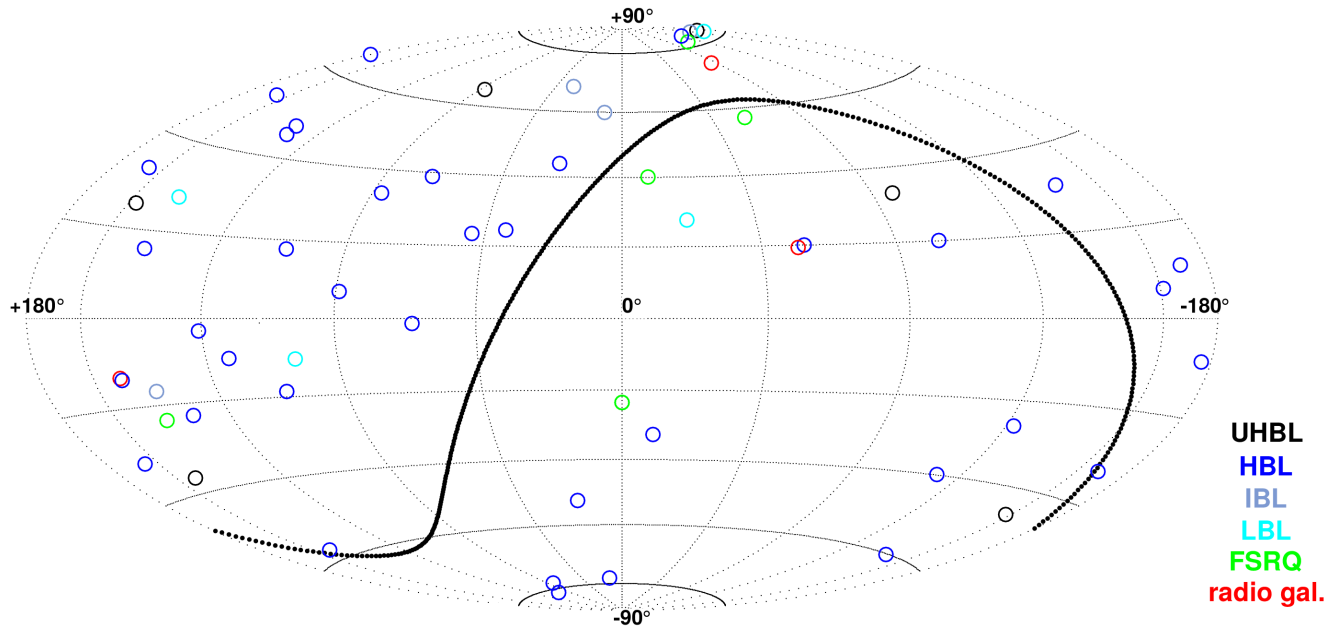
LUTH – Laboratoire Univers et ses Théories, Observatoire de Paris, France



Relativistic Jets conference
April, 23, 2015, Krakow



AGN seen at TeV



- 60 AGNs are currently detected at TeV
- Large dominance of HBLs (75%)

<http://tevcat.uchicago.edu>

Imaging Atmospheric Cherenkov Telescopes

VHE Gamma-ray

Interaction in atmosphere
generates an Air Shower
(e^+ , e^-)

$\approx 10\text{km}$

$$\theta_c = \cos^{-1} \left(\frac{1}{\beta n} \right)$$

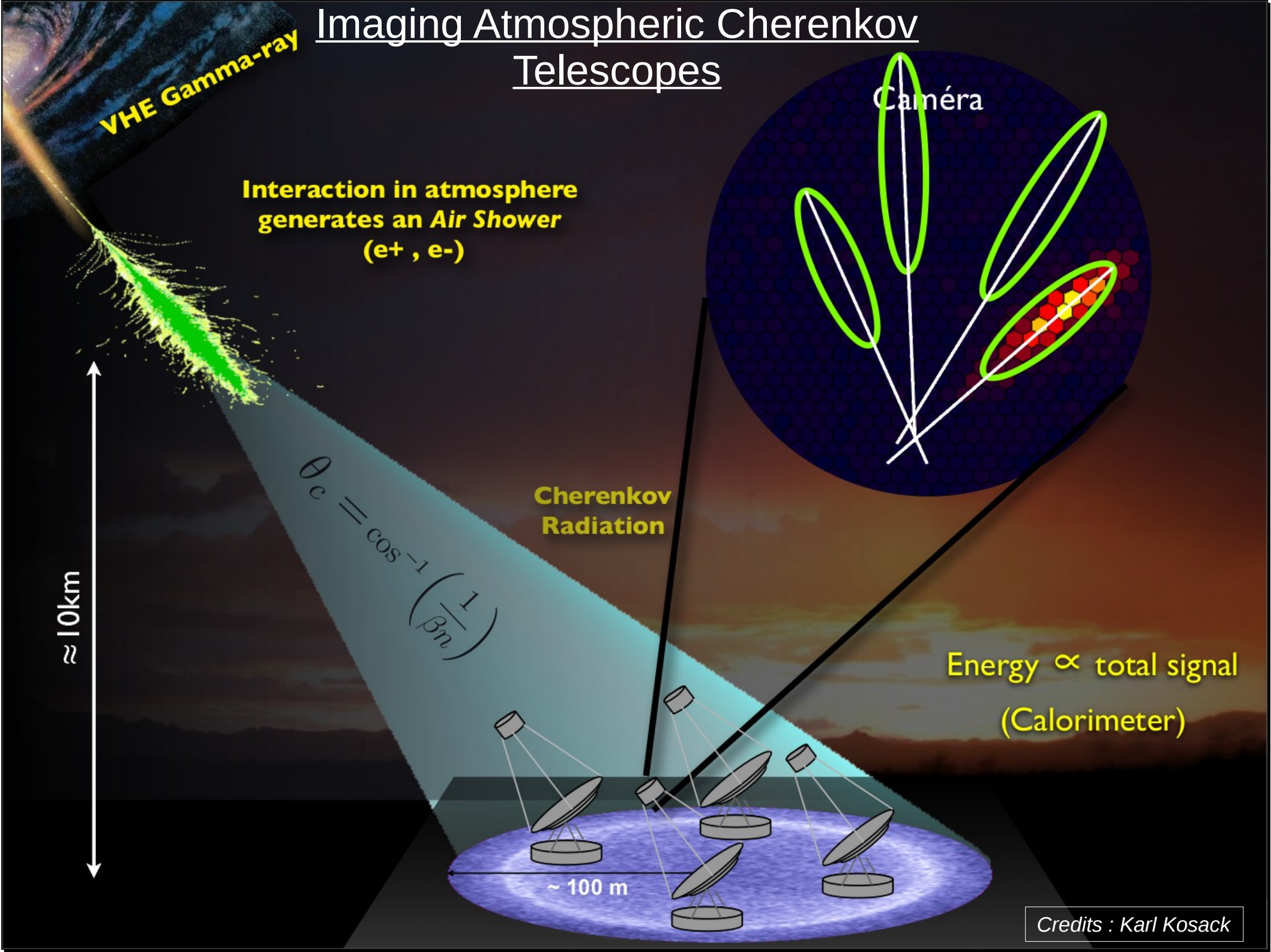
Cherenkov
Radiation

Caméra

Energy \propto total signal
(Calorimeter)

$\sim 100\text{ m}$

Credits : Karl Kosack



Interest on TeV AGN observations

Study of intrinsic properties

- Fast variability (\sim mn) constraint the size and velocity of the VHE zone
- Spectra can test non-trivial emission processes (from lepto-hadronics models, various external photon fields,...)

AGN as cosmological probes

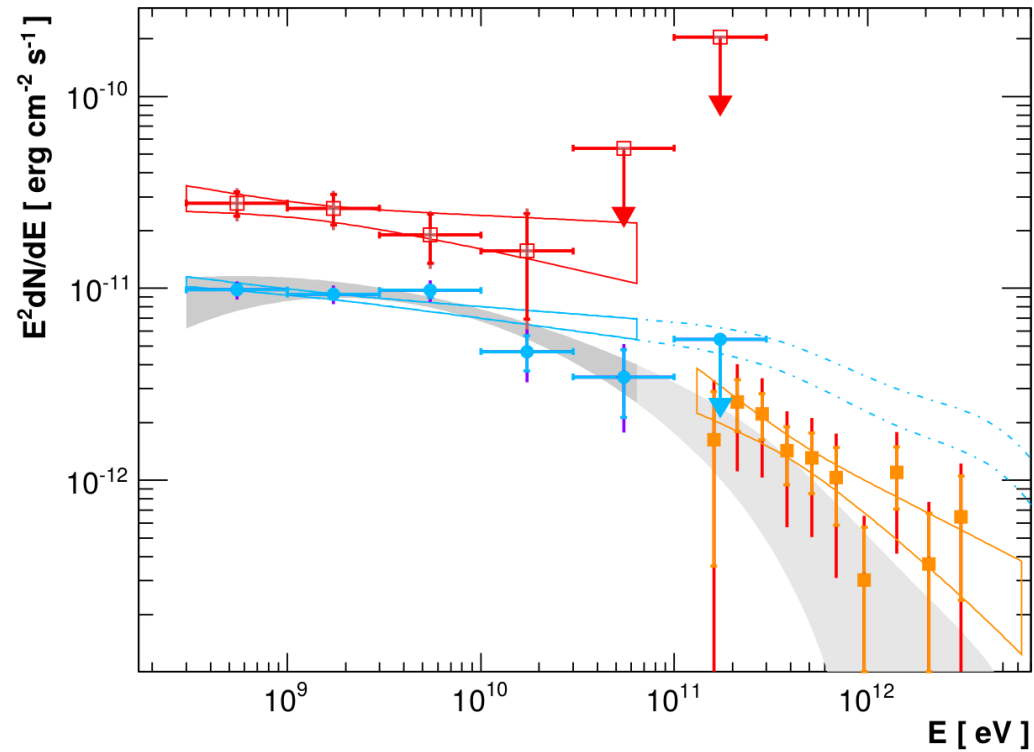
- VHE γ -rays absorbed by pair-creation on extragalactic background light (IR & visible)
 - indirect measurement of EBL and extragalactic magnetic field

Laboratory of exotic and unknow physics

- Fast variability allows tests of Lorentz Invariance
- Search for gamma lines that could be associated with a dark matter particle annihilation or maybe other exotic particles

Recent AGN results

Spectrum of the uncommon LBL Ap Librae



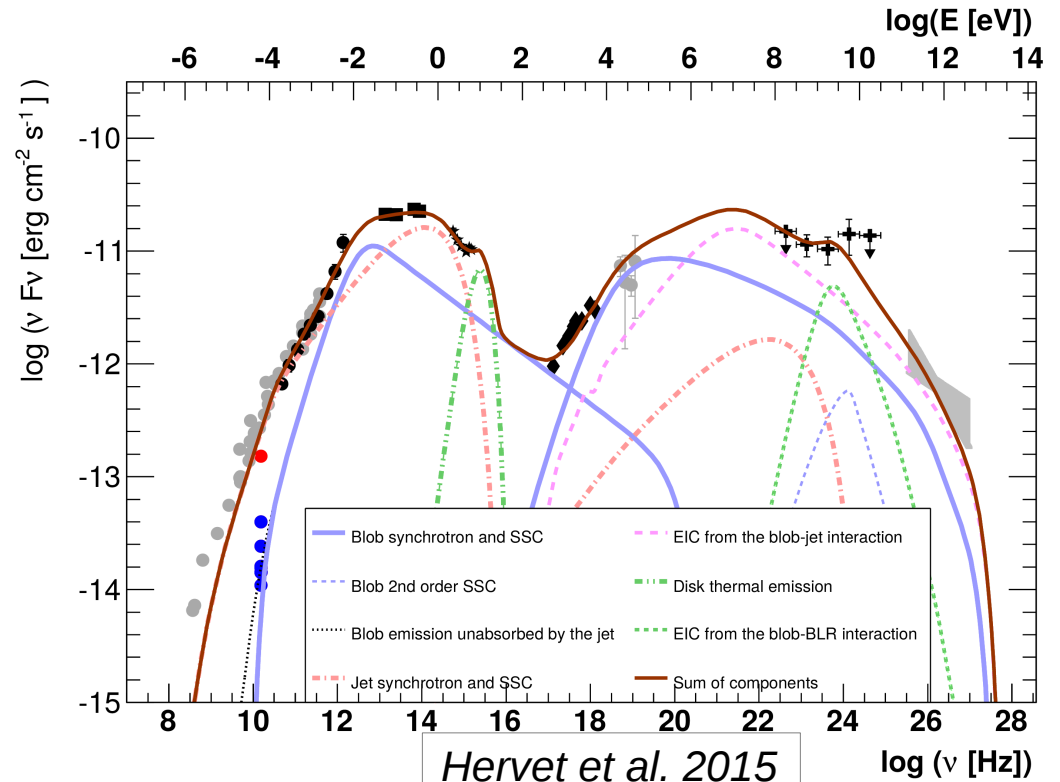
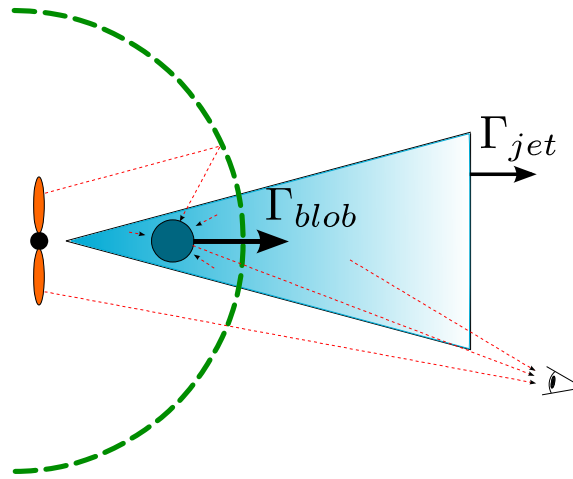
H.E.S.S. Collaboration 2015

- The strongest LBL TeV emission in quiescent state
- Unusual very broad high energy bump (maximum below the GeV range)

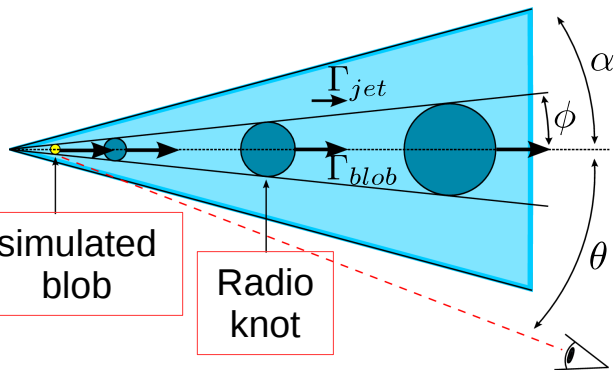
Recent AGN results

Ap Librae

Multi-component model



Two jets structure

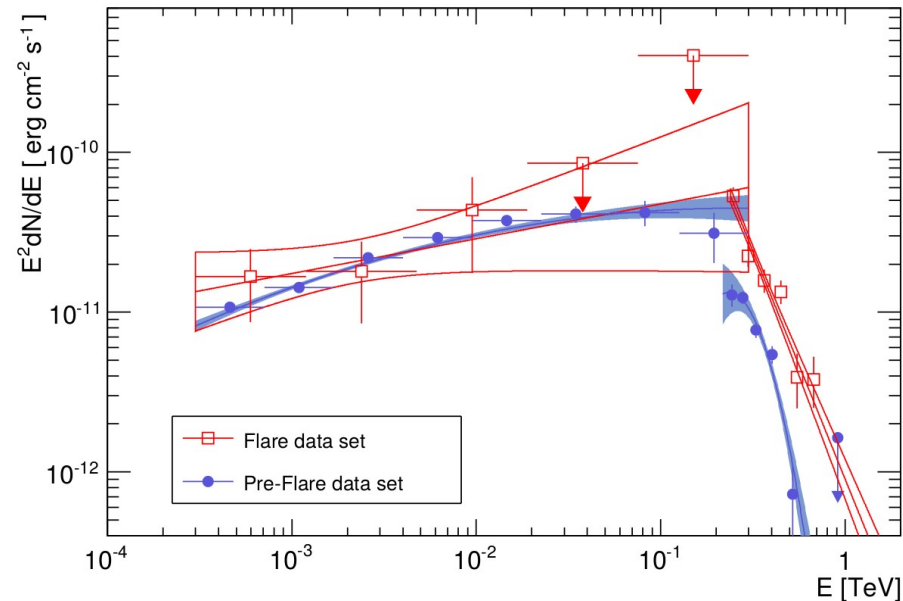


- External compton from the jet radiation is a good candidate to reach TeV energies
- Strong link between the compact SSC zone and radio knots seen in VLBI by MOJAVE

➔ **More details on my poster !**

Recent AGN results

Intra-night flare of the HBL PG 1553+113



H.E.S.S. Collaboration 2015

Redshift constraint

- Comparison between the intrinsic spectrum from Fermi extrapolated and the observed EBL-absorbed spectrum
- Most probable value of $z = 0.49 \pm 0.04$
 $z \in [0.45, 0.56]$ at 95 % of confidence

Recent AGN results

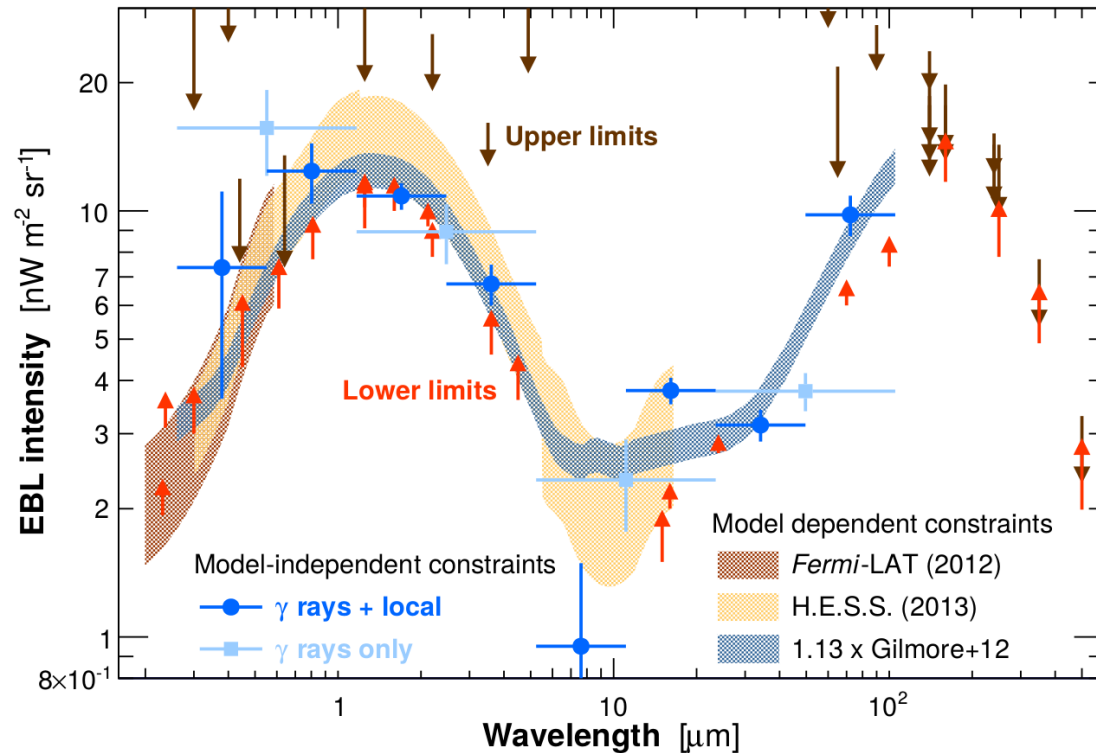
Local EBL measurements

If redshifts are known



The EBL spectrum can be deduced

EBL shape can be constrained by various intrinsic AGN TeV spectra



H.E.S.S. Collaboration, 2013

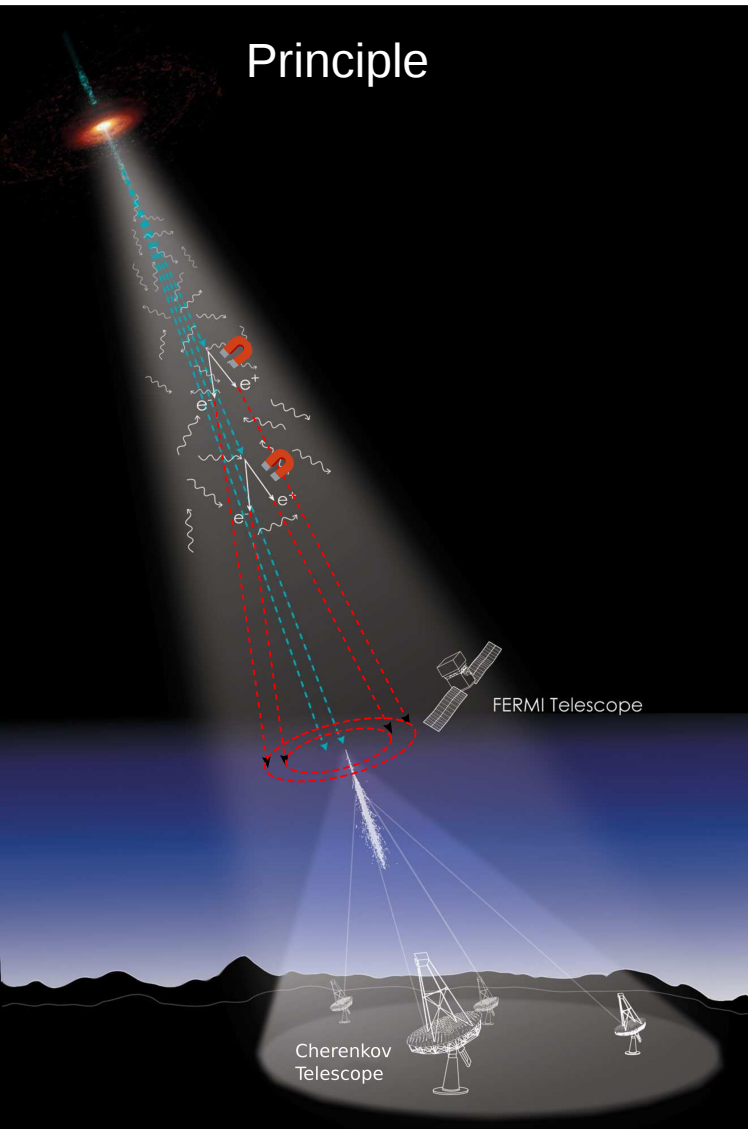
Extended by

Biteau & Williams 2015 (Submitted to Apj)

Study of 106 Intrinsic spectra from 38 TeV blazars (30 spectra from H.E.S.S.)

Recent AGN results

Search of extended **pair-halo (PH)** and **magnetically broadened cascade (MBC)** emission around blazars



$B > 1e-7$ G :

- strong synchrotron cooling
- **Not enough energy for secondary gamma-rays**

$1e-7 > B > 1e-14$ G :

- Deviation of e^+ - e^- pairs
- **Magnetically broadened cascades or pair-halos can be observed**

Recent AGN results

Search of extended **pair-halo (PH)** and **magnetically broadened cascade (MBC)** emission around blazars

Investigation

3 blazar angular profiles are studied:

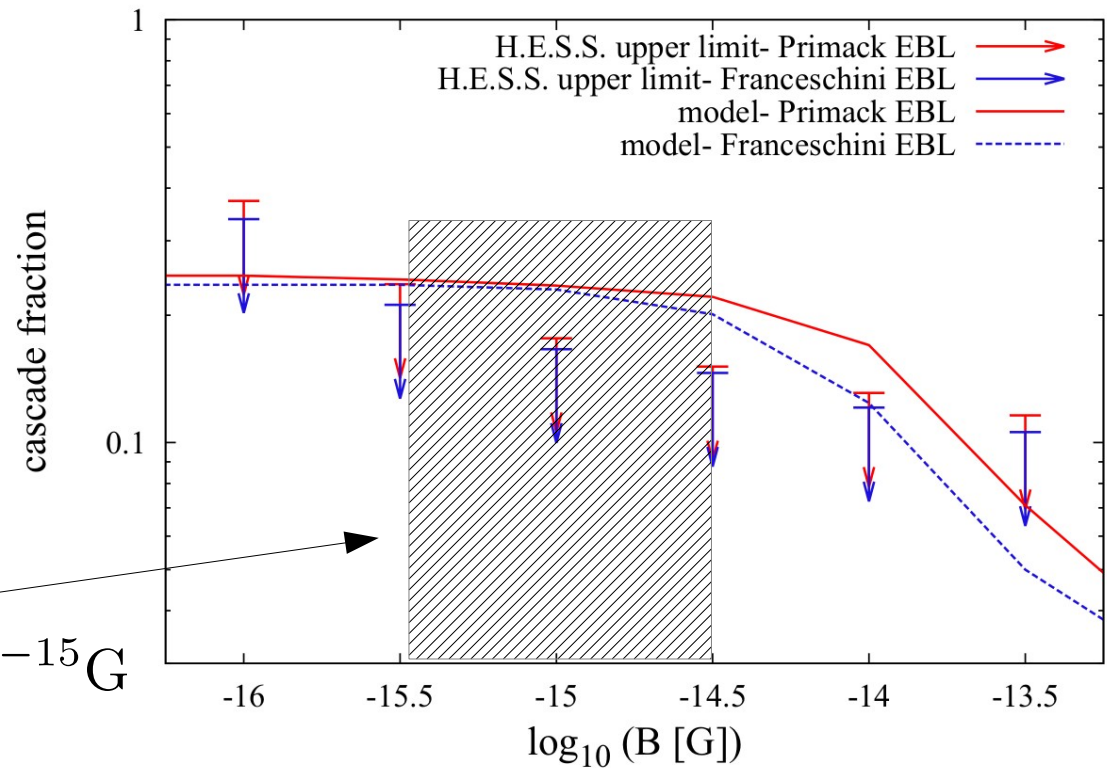
1ES 1101-232 $z = 0,186$

1ES 0229+200 $z = 0,140$

PKS 2155-304 $z = 0,117$

Excluded region :
 $\text{EGMF} \notin [0.3, 3] \times 10^{-15} \text{ G}$

Constraint on the extragalactic magnetic field (PKS2155-304)



H.E.S.S. Collaboration 2014

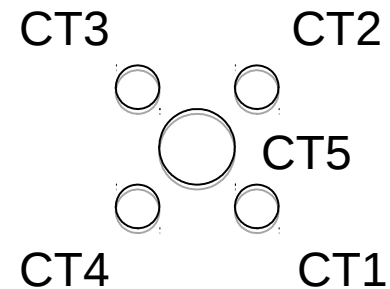
Next generation of Cherenkov telescopes should give strong constraints on the effect

H.E.S.S. phase II

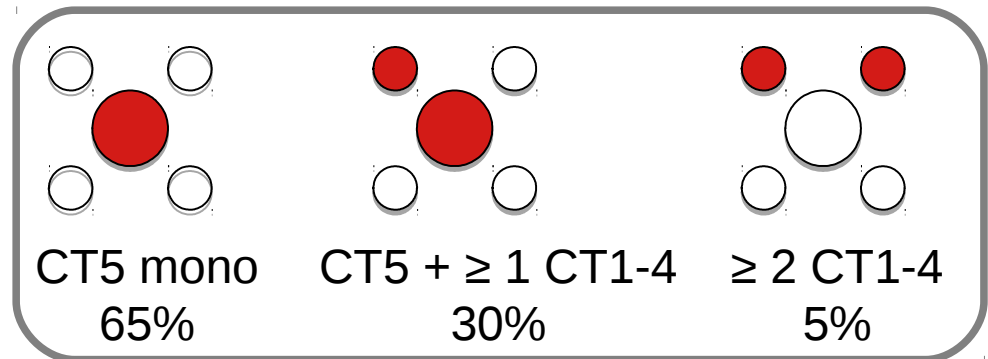


The first hybrid system of Cherenkov telescopes

- Four 12m telescopes (FoV 5 deg)
- One 28m telescope (FoV 3.5 deg)
- Energy threshold
~ 50 GeV (Fill the gap with Fermi)
- Angular resolution
from 0.4 deg to less than 0.1 deg

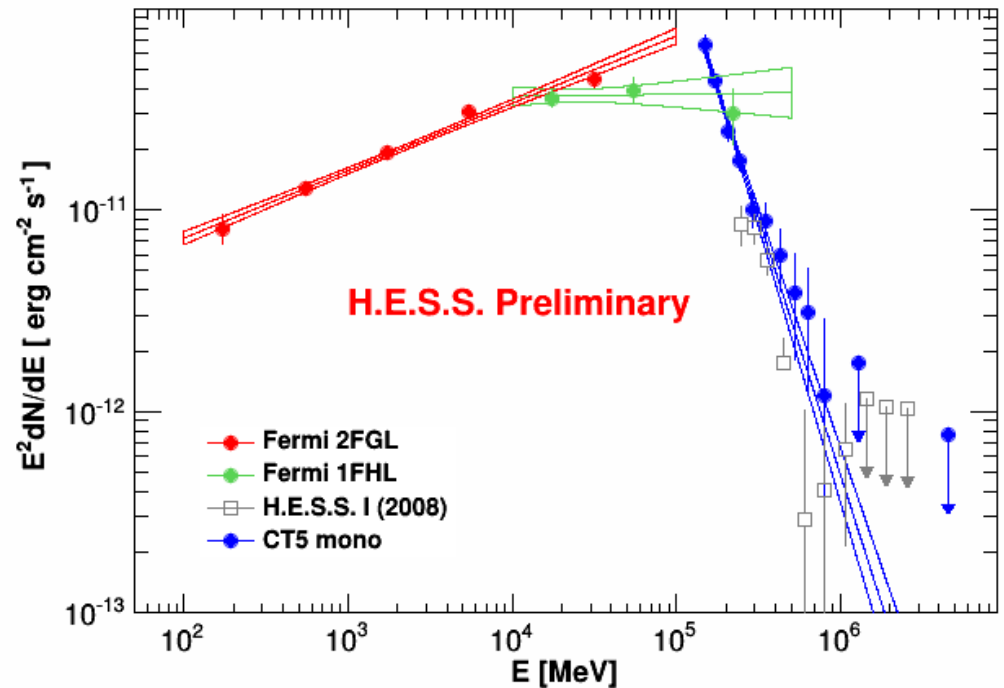
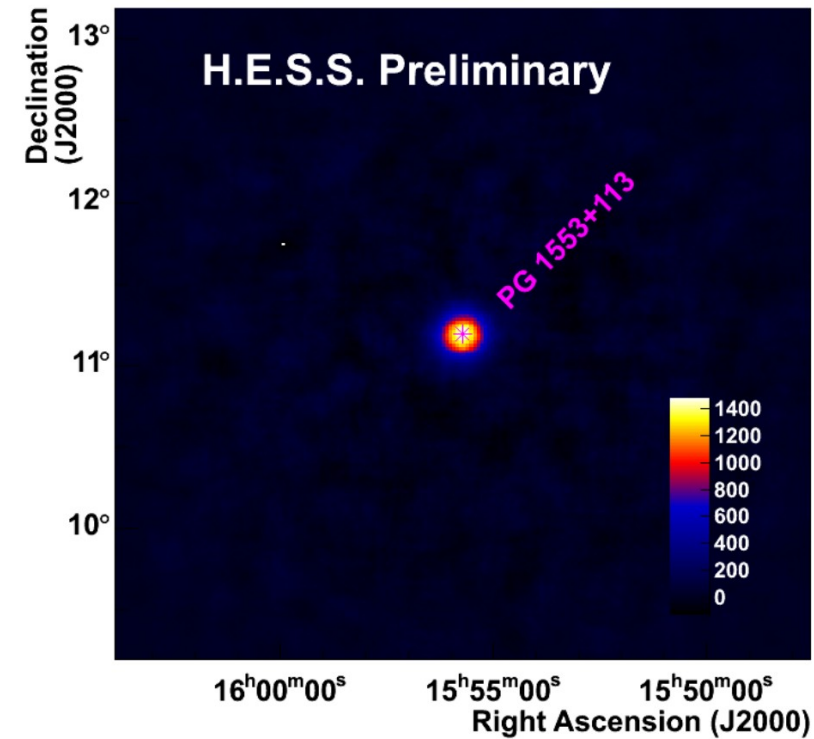


Trigger events



First AGN seen by H.E.S.S. II Mono

PG 1553+113

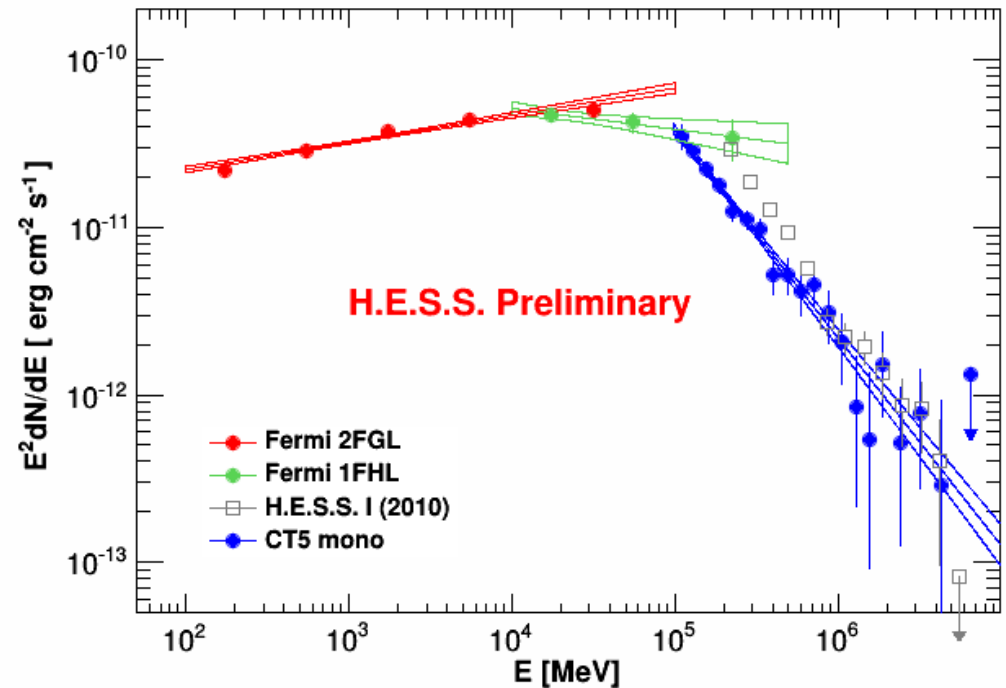
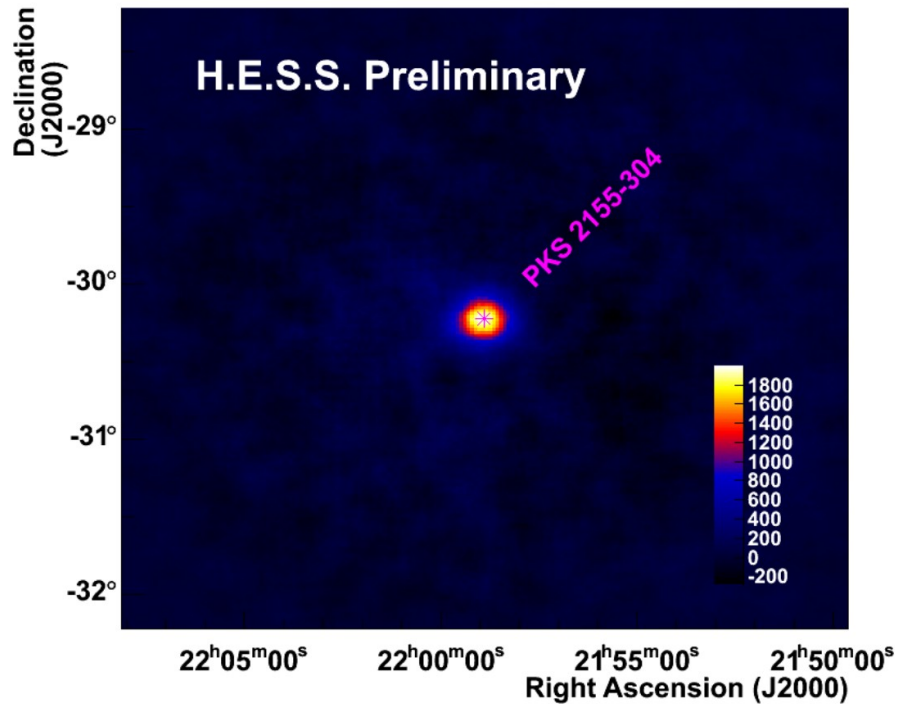


Live time : 15,1 h
Excess : 2508 γ
Significance : 26,6 σ
Zenith angle : $\sim 35^\circ$
Rate : $2,77 \pm 0,11$ γ /min

- One of the steepest TeV spectrum
- Ideal for a low energy threshold

First AGN seen by H.E.S.S. II Mono

PKS 2155-304



Live time : 42,5 h
Excess : 4442 γ
Significance : 29,7 σ
Zenith angle : $\sim 21^\circ$
Rate : $1,72 \pm 0,06$ γ /min

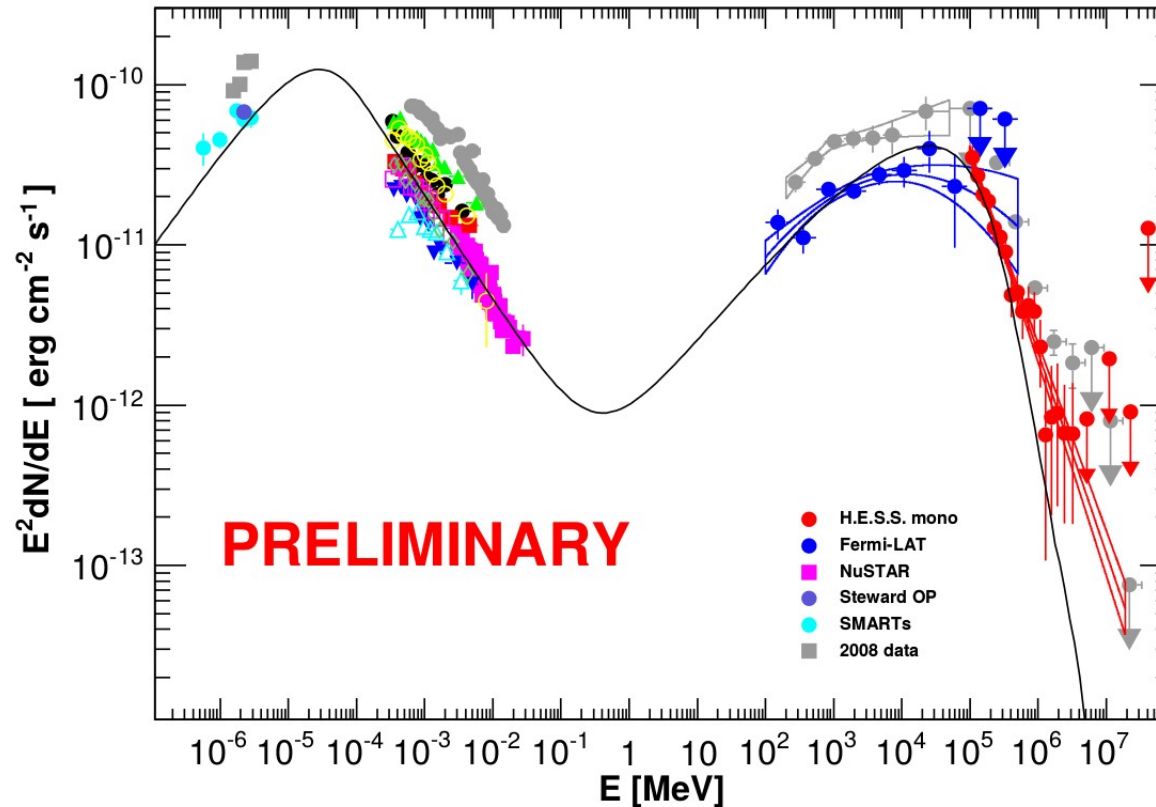
- One of the brightest TeV AGN
- Ideal for H.E.S.S. I / II comparisons

First AGN seen by H.E.S.S. II Mono

PKS 2155-304

2013 MWL Campaign of *NuSTAR*, *Fermi*, and H.E.S.S.

- Best simultaneous coverage on PKS 2155-304
- Good fit provided by a one-zone SSC modelling



*Proceeding by Sanchez et al., 2015
5th Fermi Symposium*

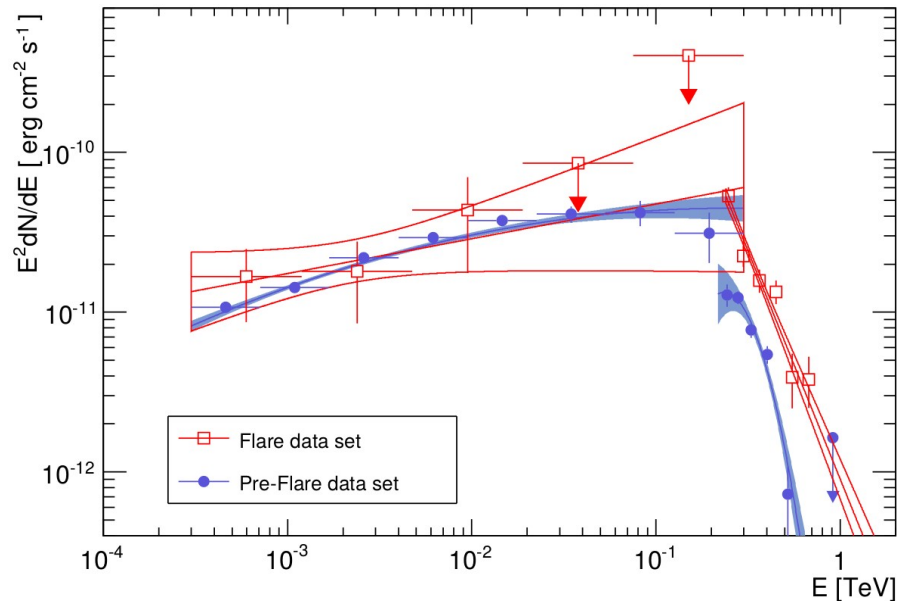
Soon H.E.S.S. II releases at the next ICRC



Thanks for your attention !

Backup

Flare of the HBL PG 1553+113



H.E.S.S. Collaboration 2015

Redshift constraint

- Comparison between the intrinsic spectrum from Fermi extrapolated and the observed EBL-absorbed spectrum
- Bayesian analysis to determine the most probable value : **$z = 0.49 \pm 0.04$**

Intra-night variability puts limits on the Lorentz invariance violation

- Linear LIV effects :

$$E_{QG,1} > 4.10 \times 10^{17} \text{ GeV}$$

- Quadratic LIV effects :

$$E_{QG,2} > 2.10 \times 10^{10} \text{ GeV}$$

Less constraining than the flare of the blazar PKS 2155-304

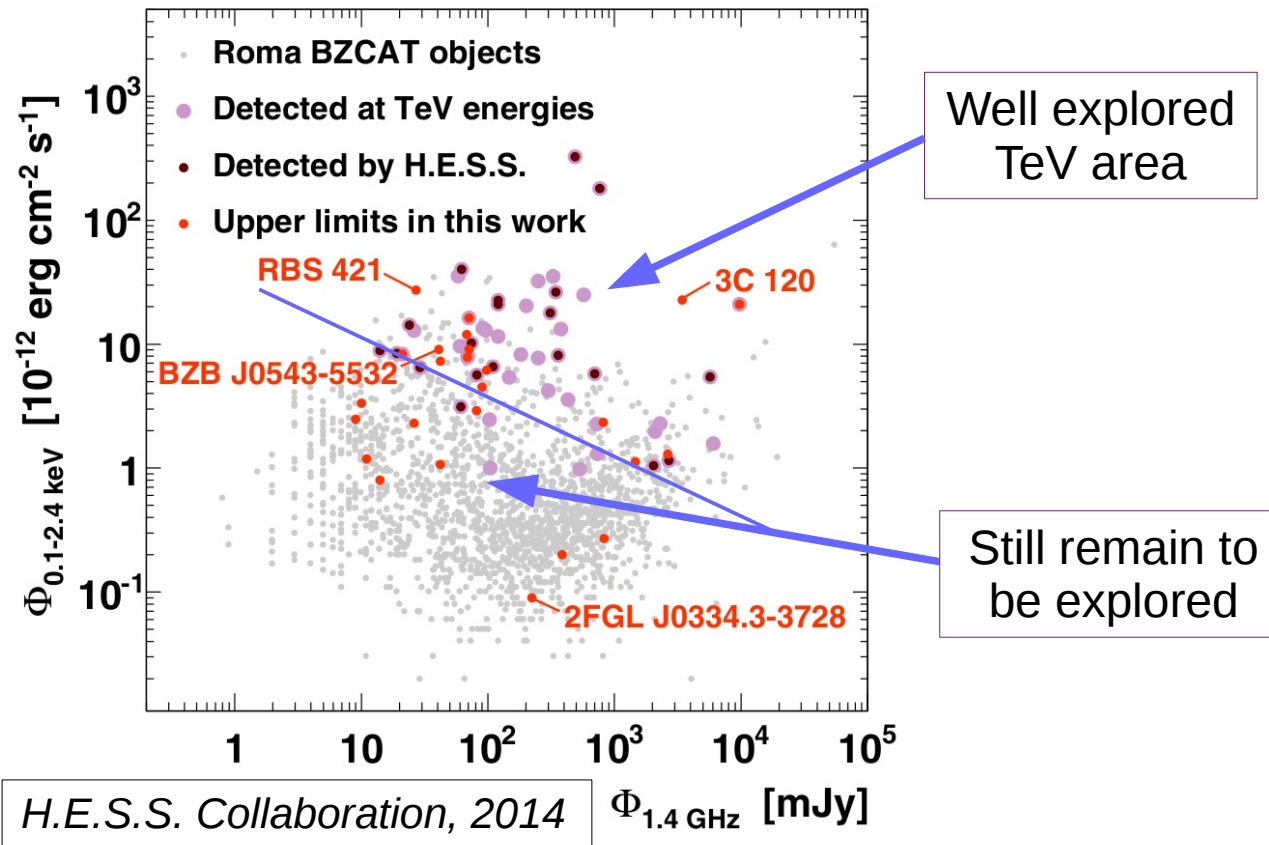
$$E_{QG,1} > 2.1 \times 10^{18} \text{ GeV}$$

$$E_{QG,2} > 6.4 \times 10^{10} \text{ GeV}$$

H.E.S.S. Collaboration 2011

Backup

47 H.E.S.S. I Upper limits on AGN



- H.E.S.S. I reach its limits to discover new sources in low state
- A new domain of AGN is open for further detections