First Results from Southern Hemisphere Extragalactic Observations with H.E.S.S. (mono-mode)

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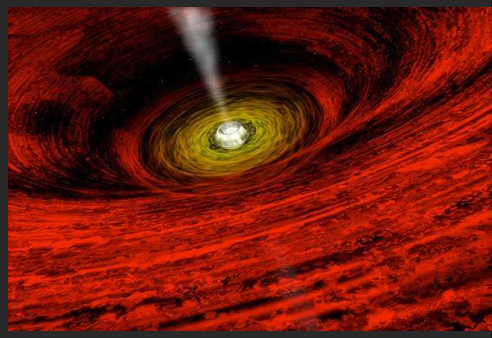
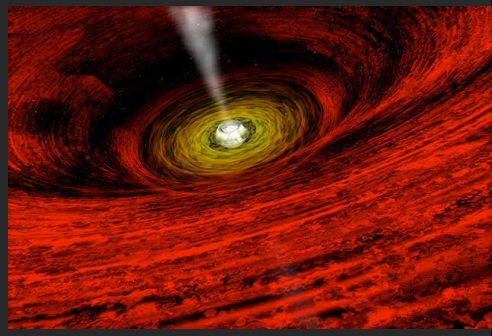
Outline

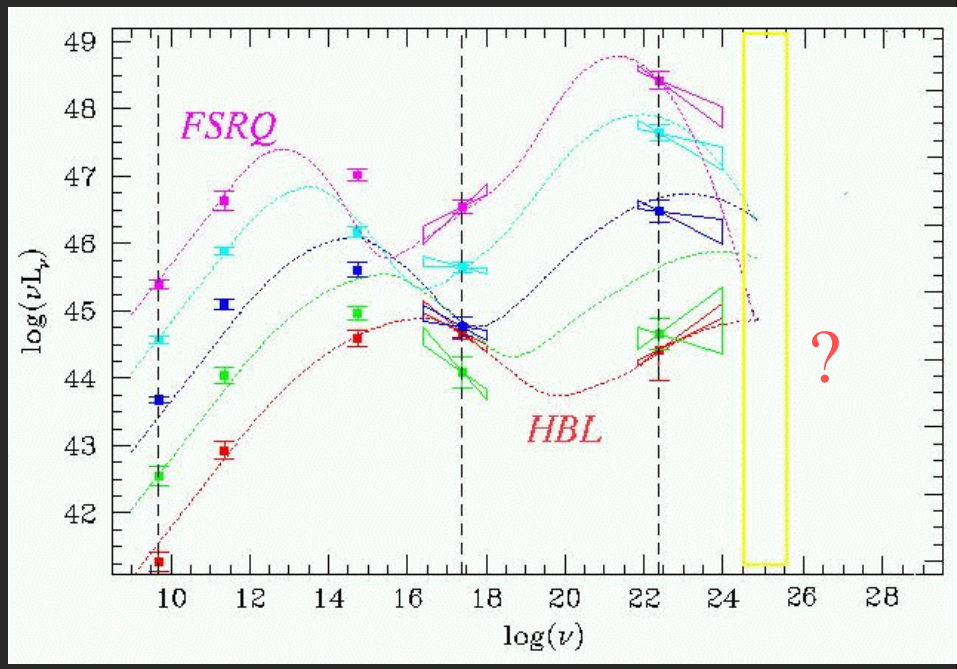
- Introduction
- Results on 3 southern hemisphere closest BL Lac objects:
  - PKS2155-304, z=0.117
  - PKS2005-489, z=0.071
  - PKS0548-322, z=0.069
- Conclusions

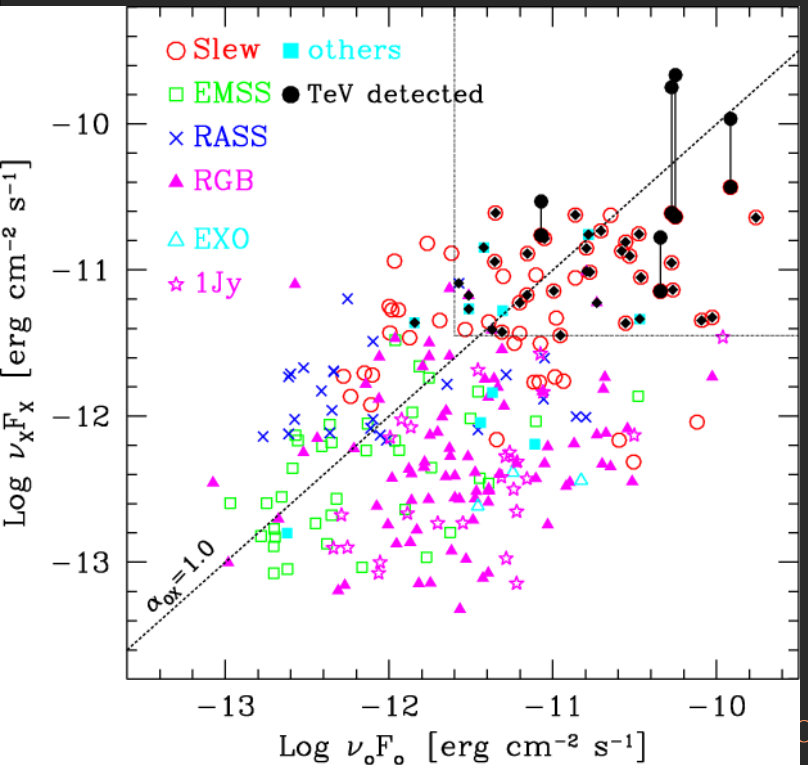




The Blazar Phenomenon

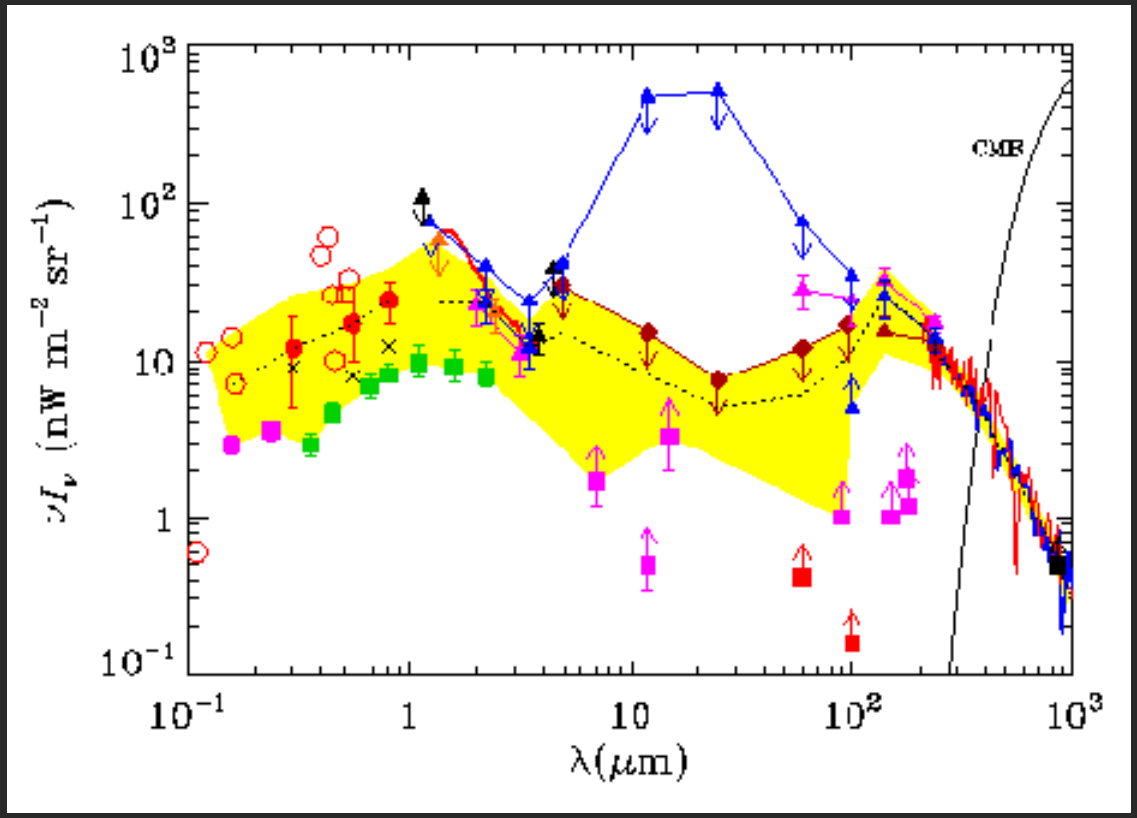
- Unified Spectral Sequence of Blazars (Fossati et al. 98):
- Phenomeological sequence according to the Luminosity:
- Correlation : ν_{sync} - ν_{IC}
- Anti-Correlation : L-ν_{sync}
- Radiative losses increase with luminosity
- Ghisellini et al. (02)





- HBLs: best VHE candidates :
  - ⇒ Very high $F_{x(\sim 1\ keV)}/F_{radio(5GHz)}$
  - ⇒ High X-ray Flux (~10^{-11} erg $s^{-1}cm^{-2}$)
  - ⇒ Flat X-ray spectrum
  - ⇒ $\alpha_{rx} < 0.8$, $\alpha_{ox} < 1.2$

Probing blazars with VHE γ-rays



- Absorption features in the VHE spectrum:
  - -> can be used to constrain the Extragalactic BackGround Light field (EBL) in the poorly measured 0.5-20 μm band;
  - -> needs many objects and detailed understanding of intrinsic spectra;

HESS : Stereo Imaging Cherenkov Telescope ~100 GeV-50 TeV

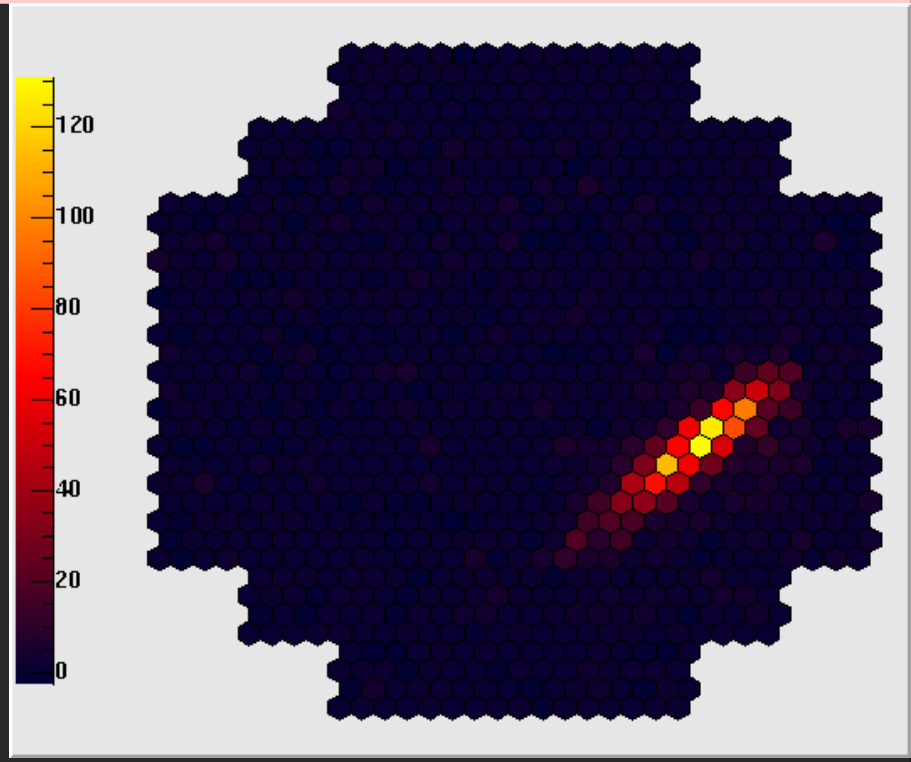
- First light: June 11 2002
- Mirror area ~107 m^2
- Diameter 13 m, focal length 15 m
- Camera: 960 pixels , 5° f.o.v

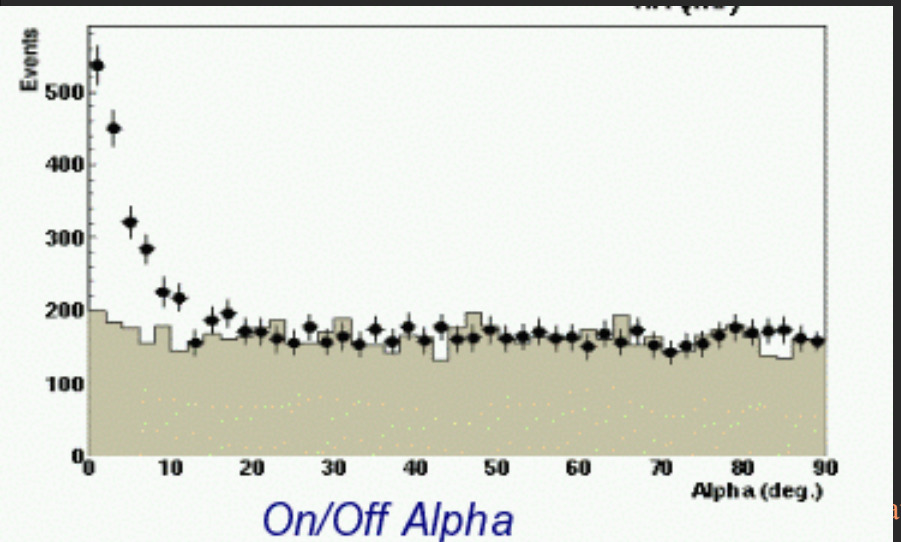
- 2/4 HESS Telescopes are complete with cameras
- 12 $\sigma/\sqrt{h}$ for a Crab-like source in mono-mode at zenith

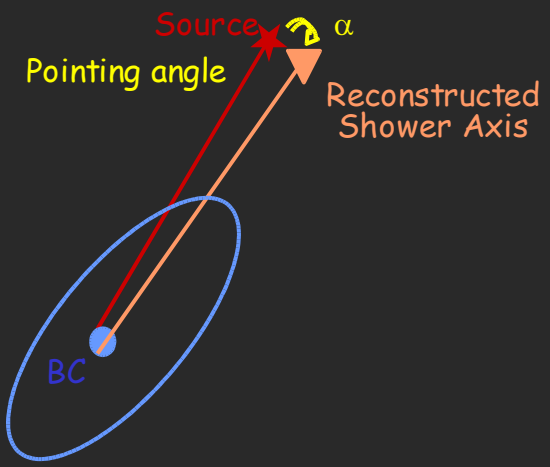
MPI Kernphysik, Heidelberg
Humboldt Univ. Berlin
Ruhr-Univ. Bochum
Univ. Hamburg
Landessternwarte Heidelberg
Univ. Kiel
Ecole Polytechnique, Palaiseau
Collège de France, Paris
Univ. Paris VI-VII
CEA Saclay
CESR Toulouse
LAOG Grenoble
Paris Observatory
Durham Univ.
Dublin Inst. for Adv. Studies
Charles Univ., Prag
Yerewan Physics Inst.
Univ. Potchefstroom
Univ. of Namibia, Windhoek

γ-ray Signal Extraction : Mono-mode

- Background CR images are isotropic
  ⇒ Cut on Pointing angle α
- And are more irregular than γ-ray Images
  ⇒ Cut on Moments
- Std Hillas + cut on Length/Size
- γ-ray signal : ON - OFF source data
- Signal obtained on Crab Nebula
  ~18 σ in 4.7 hours live-time
  C. Masterson (OG 2.2)

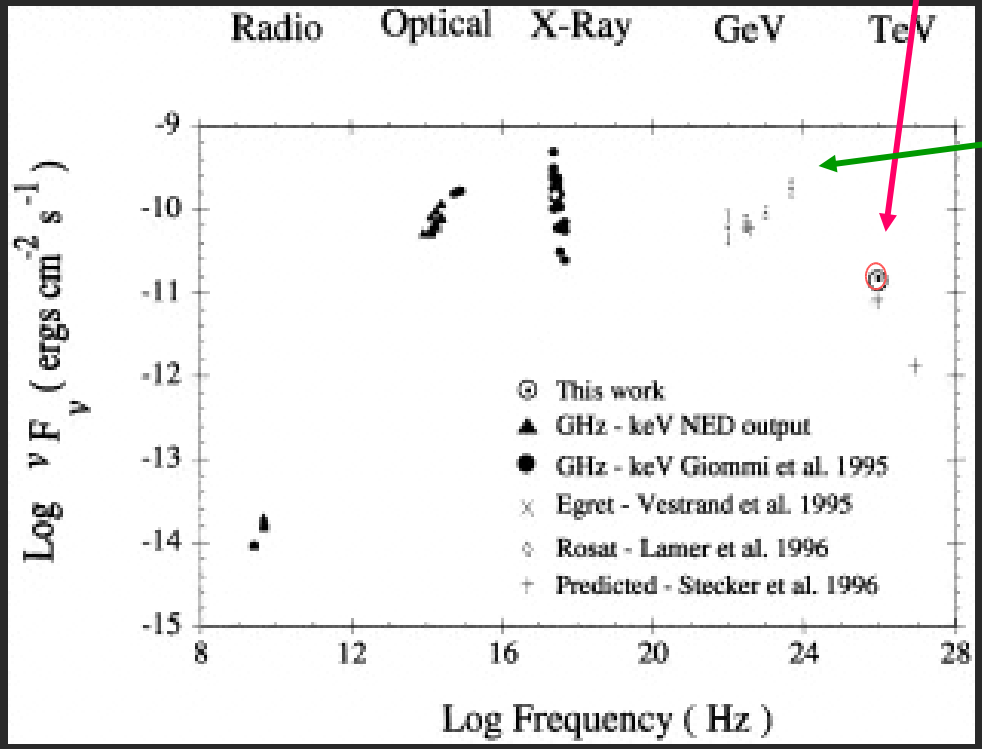






VHE emitting BL Lacs

- 4 firmly established VHE BL Lacs in Northern Hemisphere: (Whipple, Hegra, TA & CAT)
  Mkn 421, Mkn 501 (z~0.03), 1ES1959+650 (z=0.047), 1ES1426+428 (z=0.129)
- 1 BL Lac object in Southern Hemisphere detected only by Durham Mark 6 telescope:
  PKS2155-304 (z=0.116) @ E>300 GeV during 96-97 (Chadwick et al. 99)



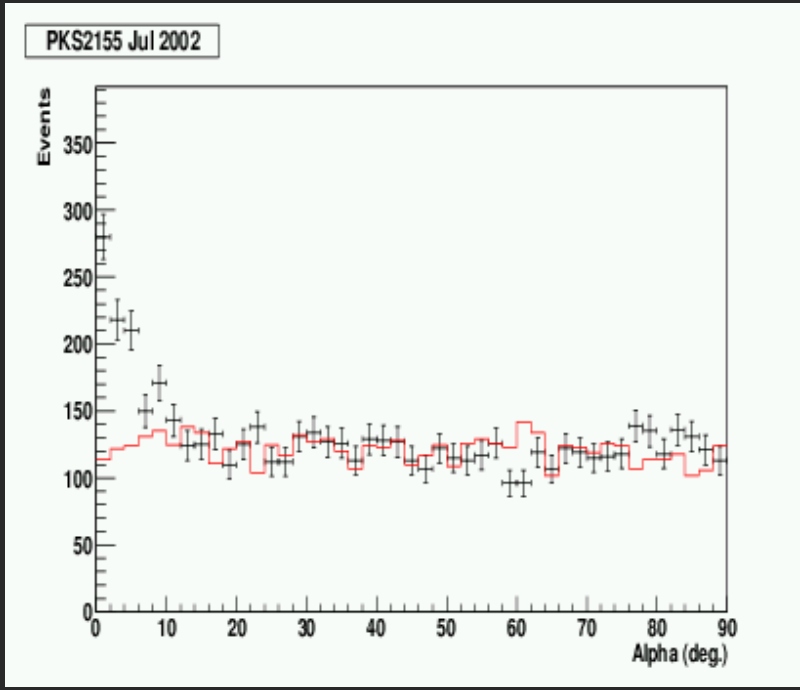
- 3rd closest BL Lac in S. hemisphere
- One of the brightest BL Lacs in X-rays
- Also detected by EGRET in the GeV range (Nov 94;Vestrand et al. 95)
  Hard spectrum with diff. index n=1.7
- Not detected by Cangaroo during 1997 observations (Roberts et al. 99)
- "Mark 6" flux 09/96-11/97 in 32.5 hr:

$\Phi(>300\mathrm{GeV}) = 4.2_{\pm 0.75} \times 10^{-11}\ \mathrm{cm}^{-2}\ \mathrm{s}^{-1}$

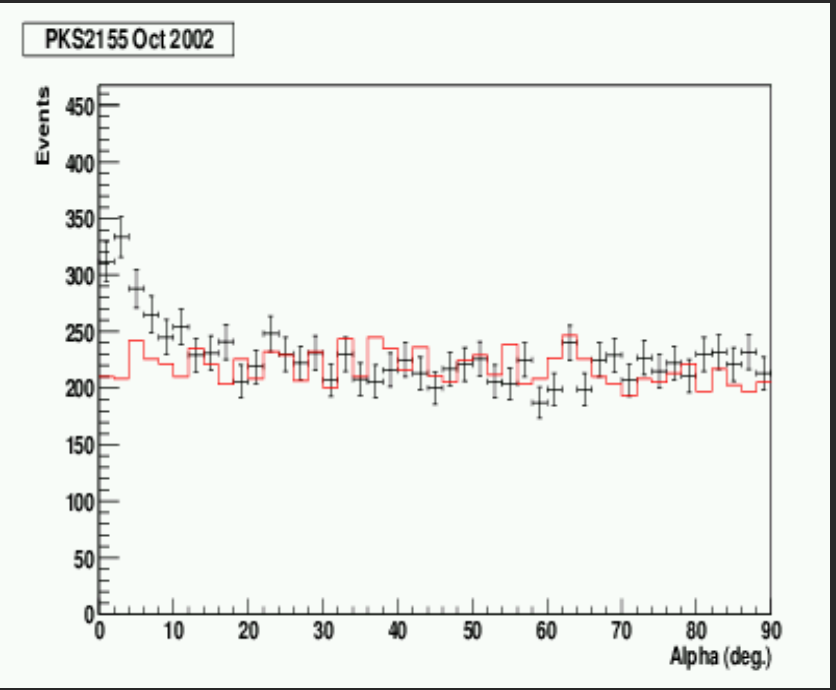
H.E.S.S. Results : PKS2155-304, z=0.117

Signal in two observation periods (alpha plots):

JULY 2002



OCT 2002

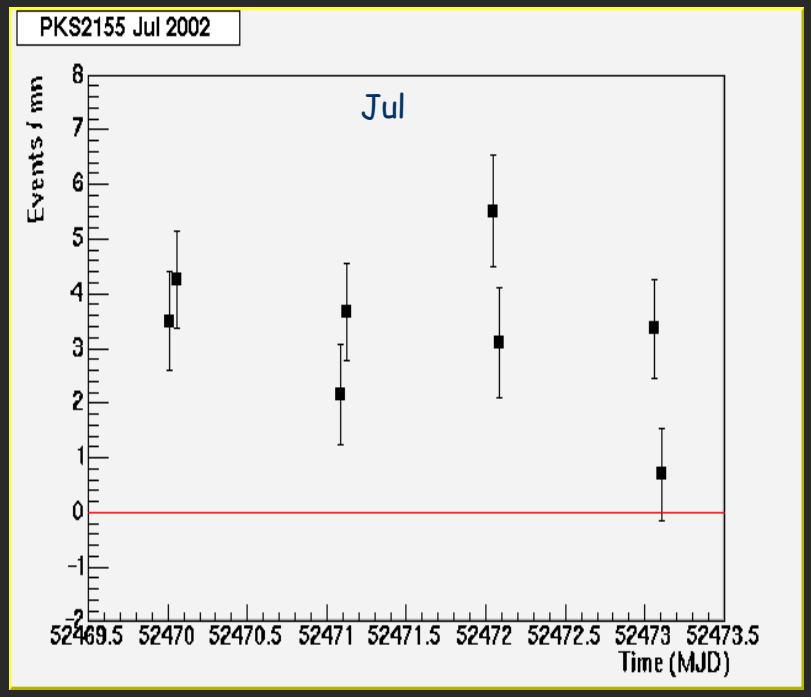


PKS2155	T_{live} (h)	Non	Noff	Excess	γ/min	Significance
Jul 2002	**2.2 h**	**1029**	**625**	**404**	**3.1**	**9.9 σ**
Oct 2002	4.7	1444	1107	337	1.2	6.6 σ

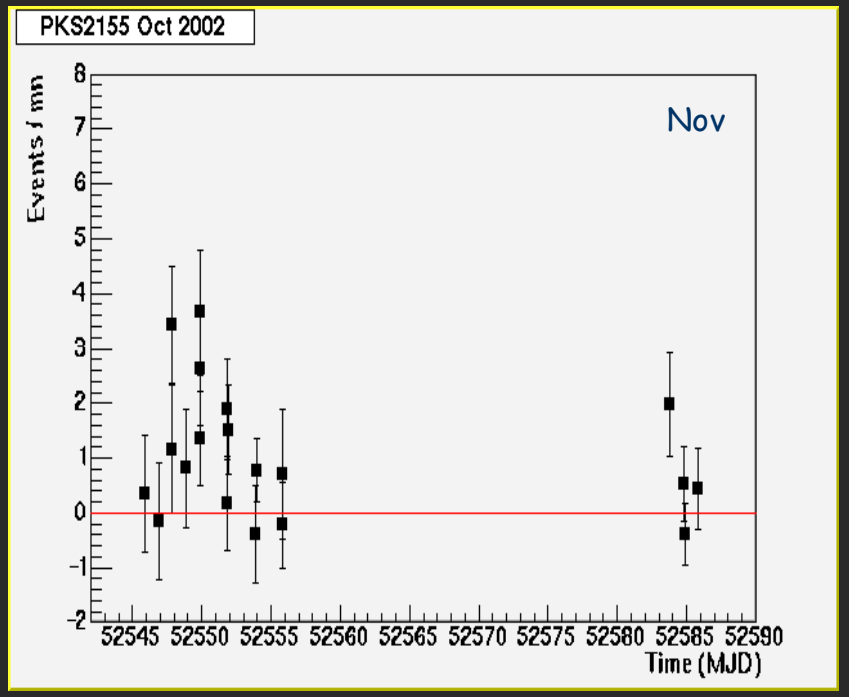
PKS2155-304 (continued)

Light-curves in two observation periods (excess per observing run):

JULY 2002



OCT 2002

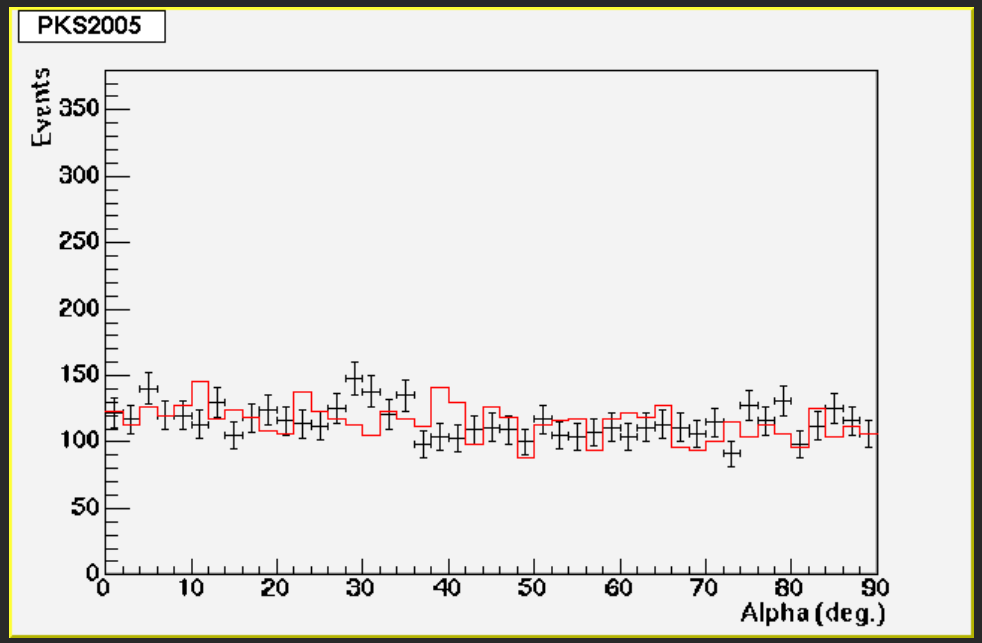


- PKS2155-304 dimmed in Oct 2002:
  the average rate decreased from 3.1 to 1.2 γ/min

- Spectrum analysis is ongoing, already indication of a very steep spectrum

PKS2005-489, z=0.071

Jul-Oct 2002



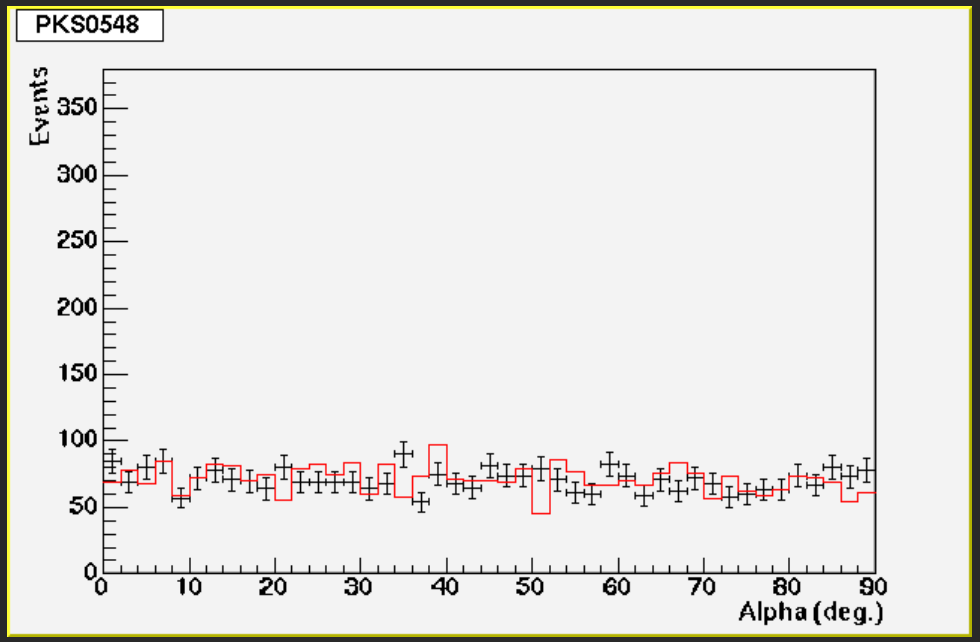
- 2nd closest BL Lac in S. hemisphere
- Only reported in the 1st EGRET catalogue
  > 5σ (Fichtel et al. 94);
  hard spectrum with diff. index=2.2
- Marginal GeV Source 4.1 σ
  (Lamb & Macomb 97)
- Not detected by
  Cangaroo (Roberts et al. 99)
  nor "Mark 6" (Chadwick 00)
- "Mark 6" 3σ upper limit
  70 hours 06/97-10/99 :

$\Phi(>400\mathrm{GeV}) < 0.79 \times 10^{-11}\ \mathrm{cm}^{-2}\ \mathrm{s}^{-1}$

PKS2005	T_{live} (h)	Non	Noff	Excess	γ/min	Significance
Jul-Oct 02	2.2 h	499	481	17.5	0.13±.08	0.6 σ

PKS0548-322, z=0.069

Nov-Dec 2002



- The closest BL Lac in S. hemisphere
- Not detected by EGRET
- Not detected by
  Cangaroo (Roberts et al. 99)
  nor "Mark 6" (Chadwick 00)
- "Mark 6" 3σ upper limit
  21.25 hours 02/96-10/99 :

$\Phi(>300GeV) < 2.4 \times 10^{-11}$ cm^{-2} s^{-1}

PKS2005	T_{live} (h)	Non	Noff	Excess	γ/min	Significance
Jul-Oct 02	1.2 h	319	299.2	19.8	0.28±0.34	0.8 σ

Summary & Conclusions

Source	z	T_live (hours)	Excess	Significance
PKS2155-302	0.117	2.2	741	11.9
PKS2005-489	0.071	2.2	17.5	0.6
PKS0548-322	0.069	1.2	19.8	0.8

- Observations with the first H.E.S.S. telescope (mono-mode)
- PKS2155-304 is confirmed as a new TeV source:
  a clear signal at an average rate of 3 γ/min
  with a significance level of 9.9σ
  is detected in 2.2 hrs during July 2002.
- PKS2155-304 dimmed in Oct 2002. Average rate: 1.2 γ/min
- Spectrum analysis is ongoing, already indication of a very steep spectrum
- No signal detected from PKS0548-322 and PKS2005-489 yet:
  Observations are ongoing on those sources and
- Other AGNs and extragalactic objects e.g. the starburst galaxy NGC253

STAY TUNED...