GLAST answers & new questions on High-energy peaked BLLacs

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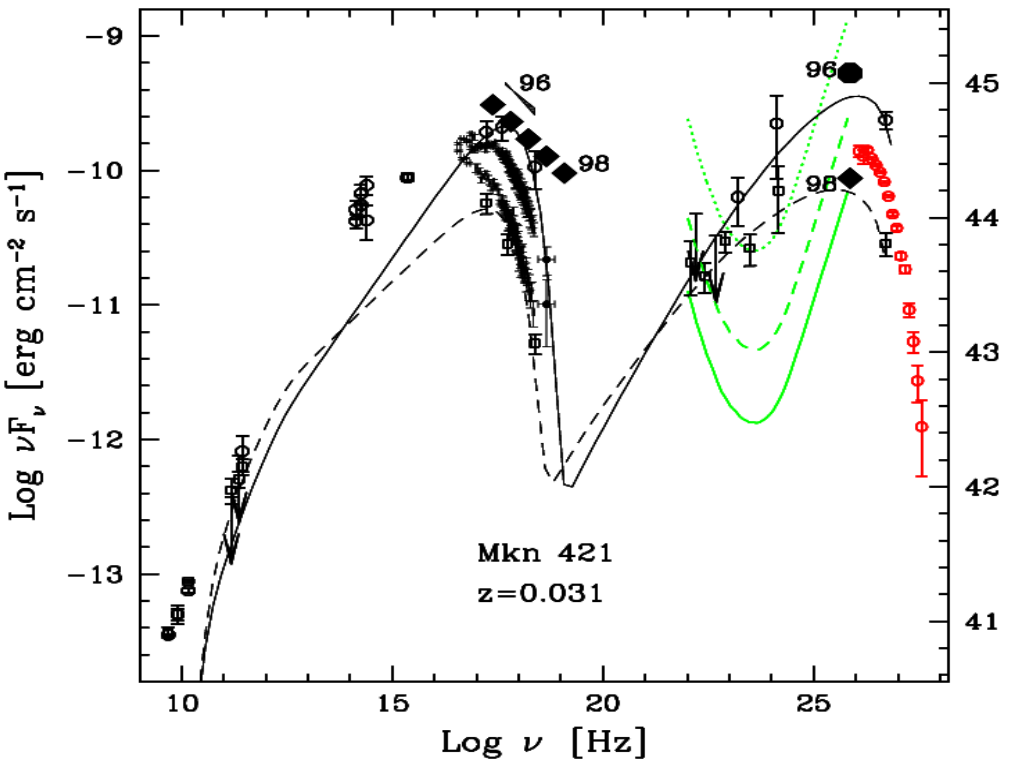
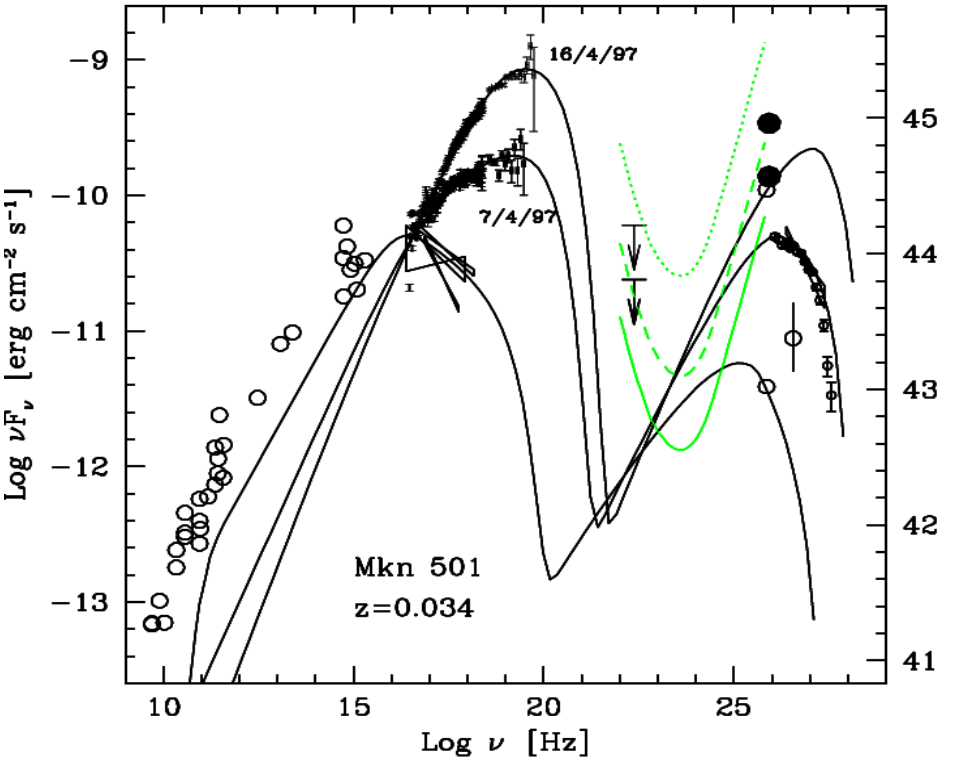
- HBL / TeV-blazars: determination of the IC peak
- Hint of surprises ? (the case of PKS 2155-304)
- MeV-synchrotron BLLacs

Location of the IC peak

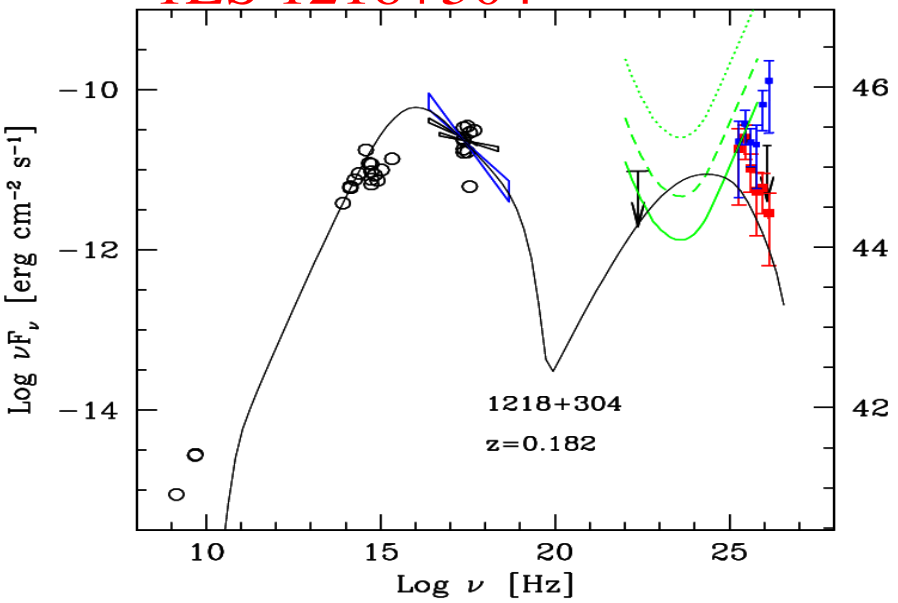
Region largely unexplored in HBLs (EGRET detected only ~3 HBL)



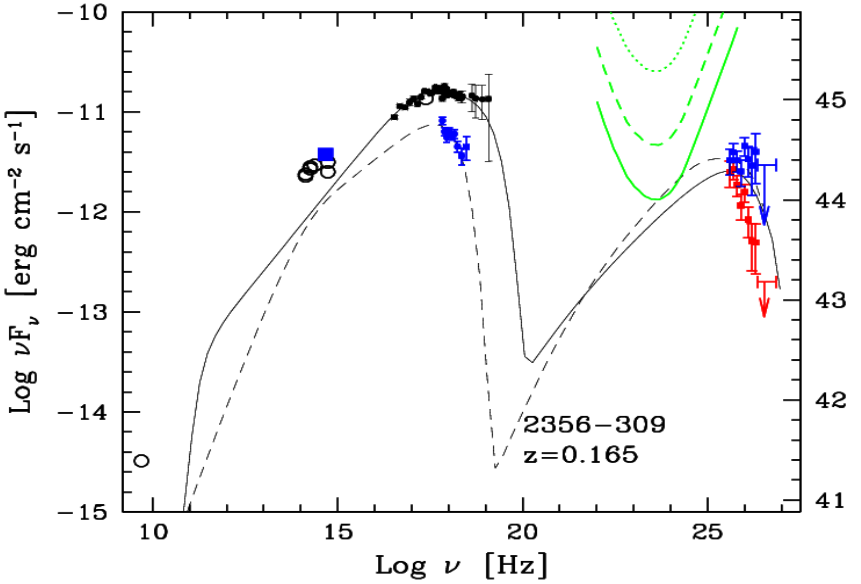


GLAST LAT sensitivity: 1day, 1 month, 1 year

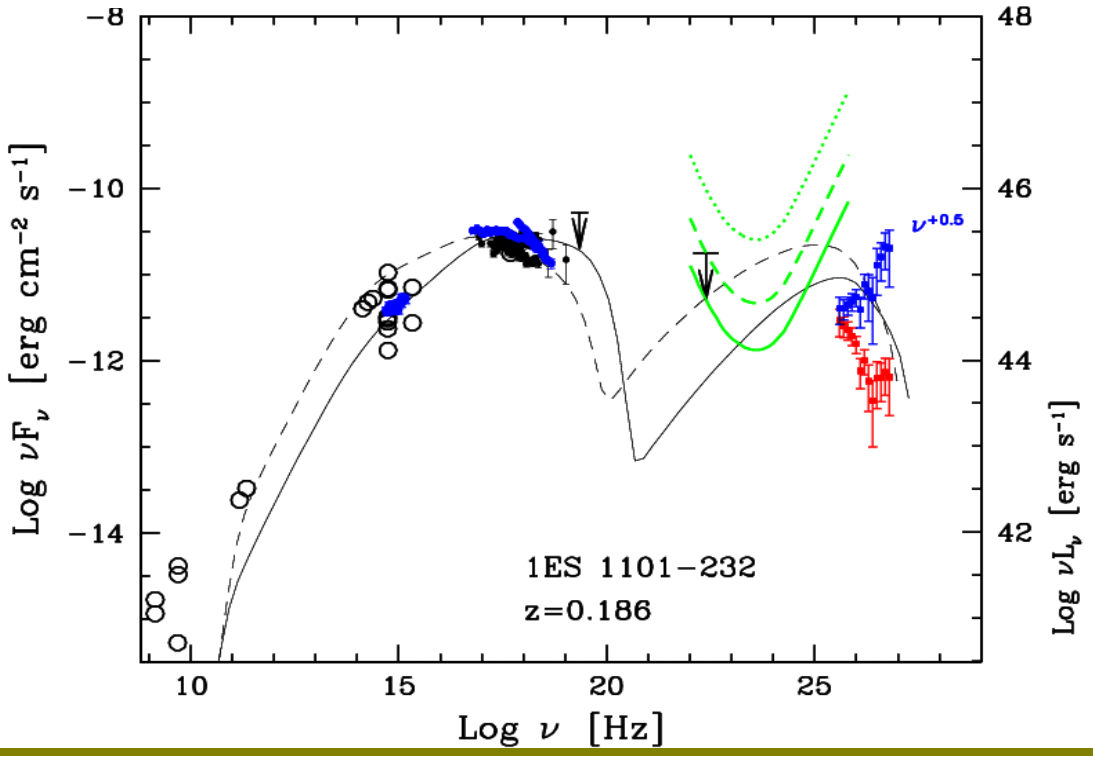
1ES 1218+304



H 2356-309

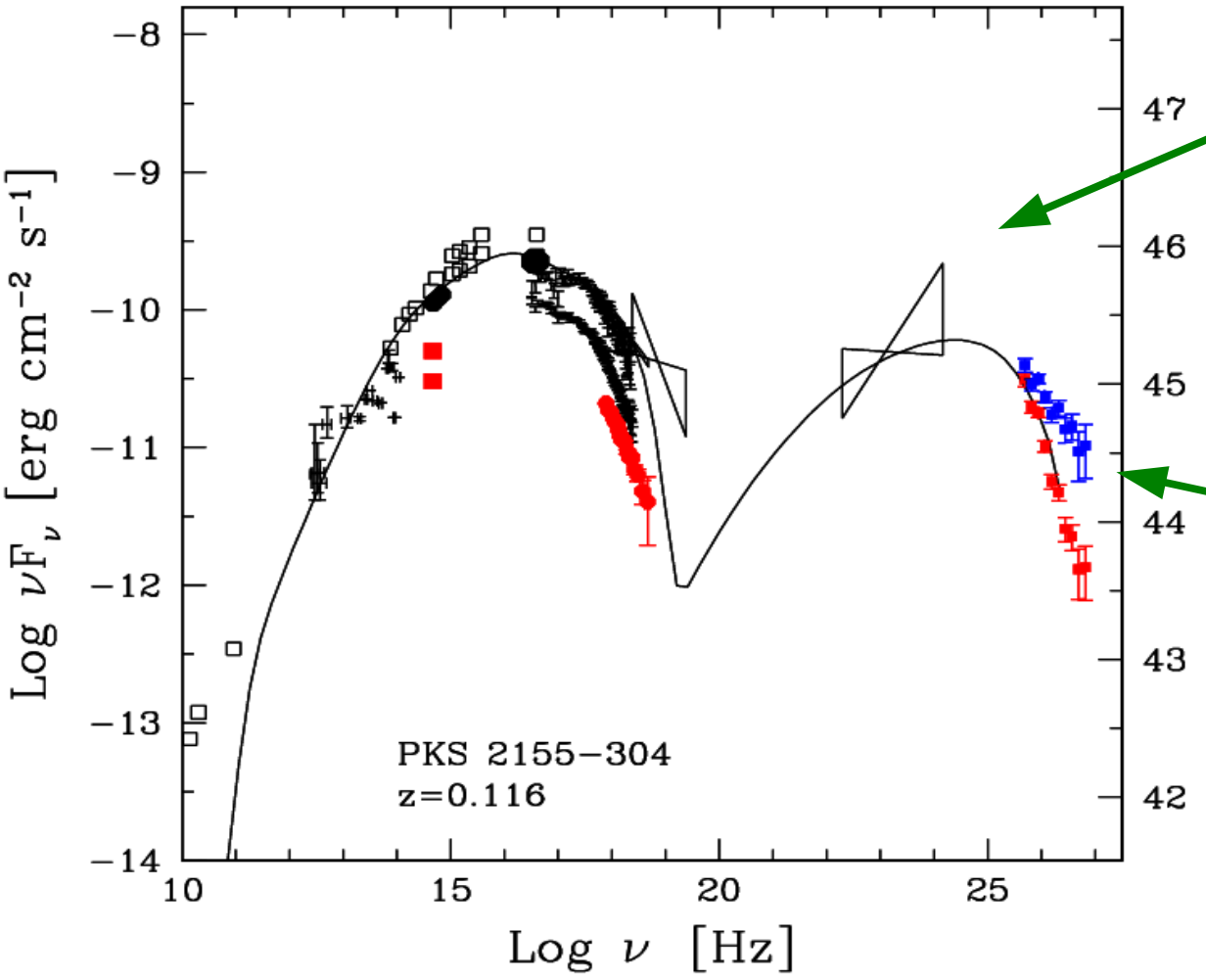


1ES 1101-232



Expected spectra: always hard ($\Gamma < 2$)

It seems so, but... is it true ??



EGRET
VP 404.0

Vestrand et al. 1995

HESS spectrum:
EBL-corrected
observed

Aharonian et al.
2004, 2005

Expected spectra: always hard ($\Gamma < 2$)

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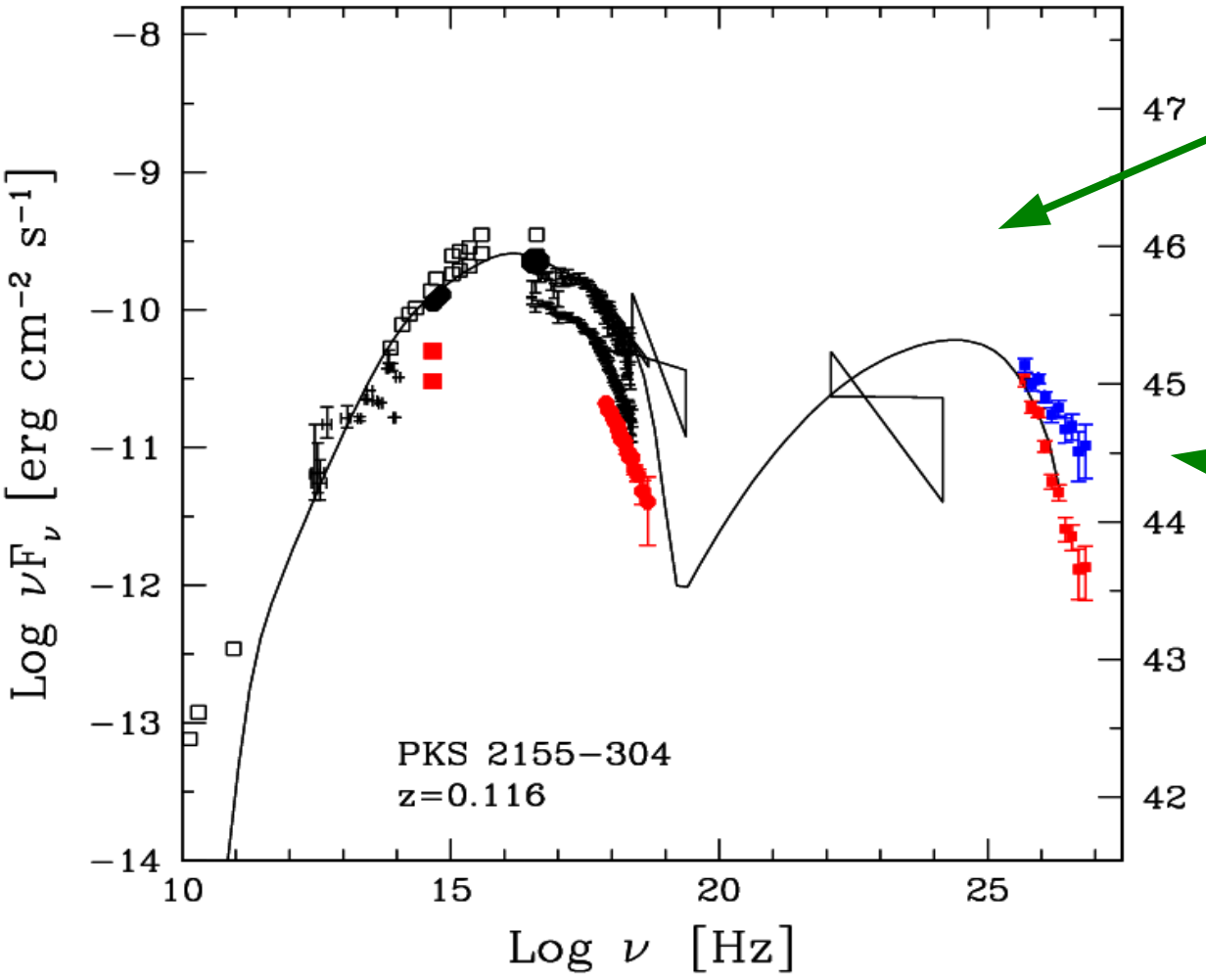
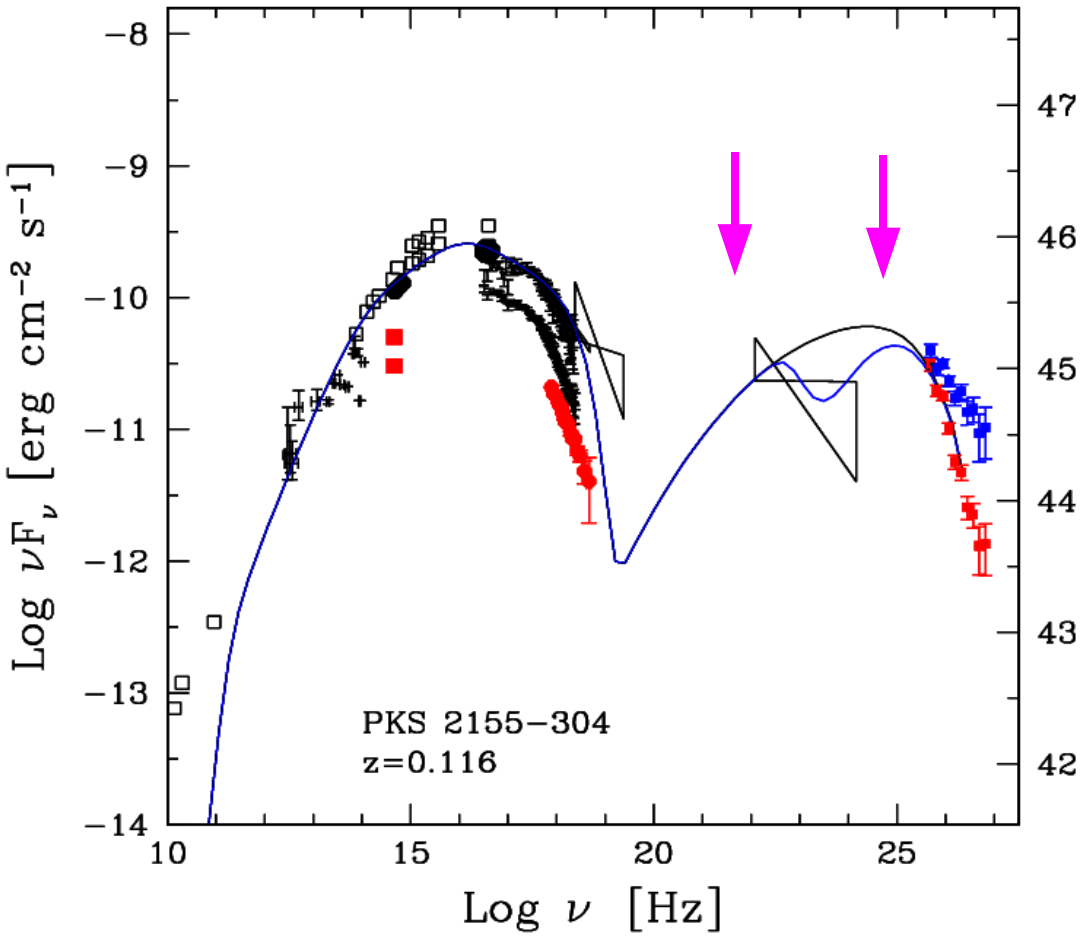


EGRET
3rd catalogue
(4 years obs.)
Γ=2.35±0.26
STEEP !

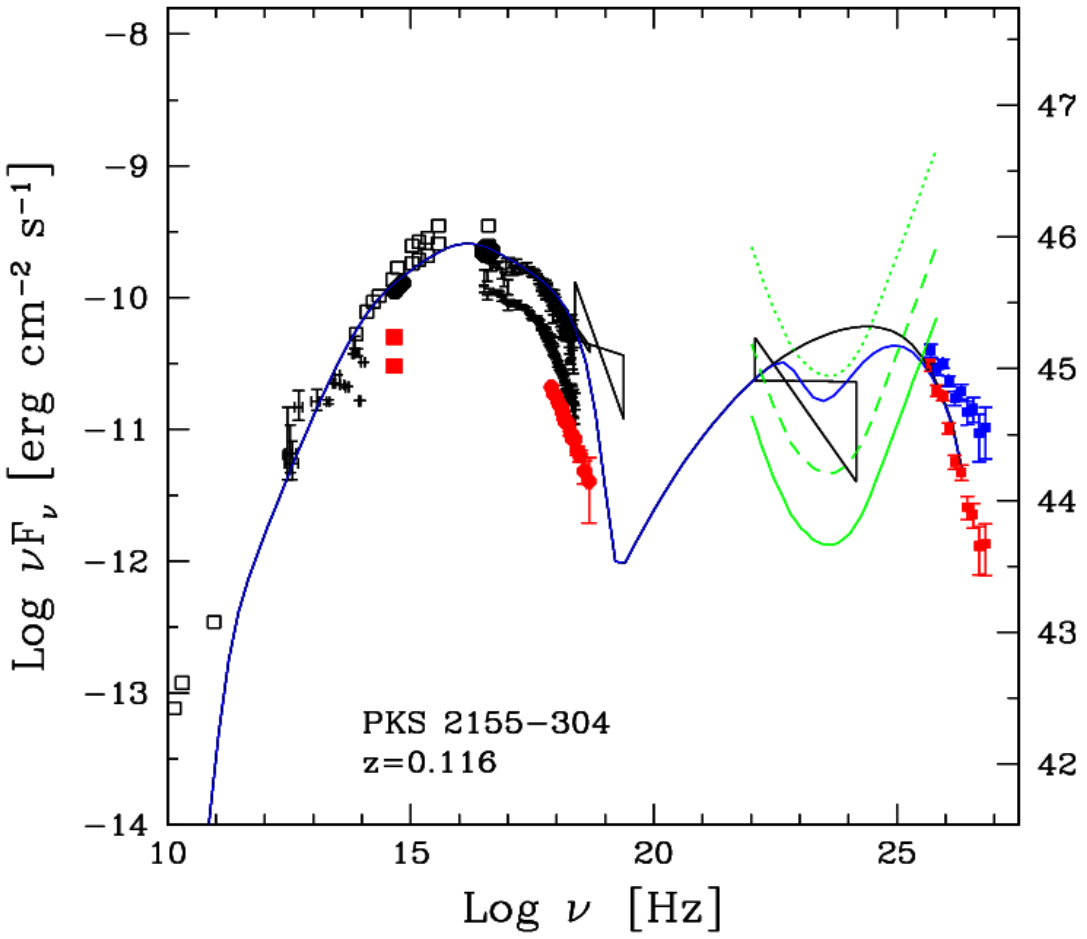
Both EGRET & HESS: typical spectra over several years

Double humped IC peak ??



- 2 particle populations ?
- Bulk motion Comptonization ?
  - Var. few min. ⇒ compact region, & Γ~100
  - Cold e^- + 1 keV phot. ⇒ 10 MeV
- Internal absorption due to narrow-band circumnuclear radiation field ?

GLAST answer in few months / one year



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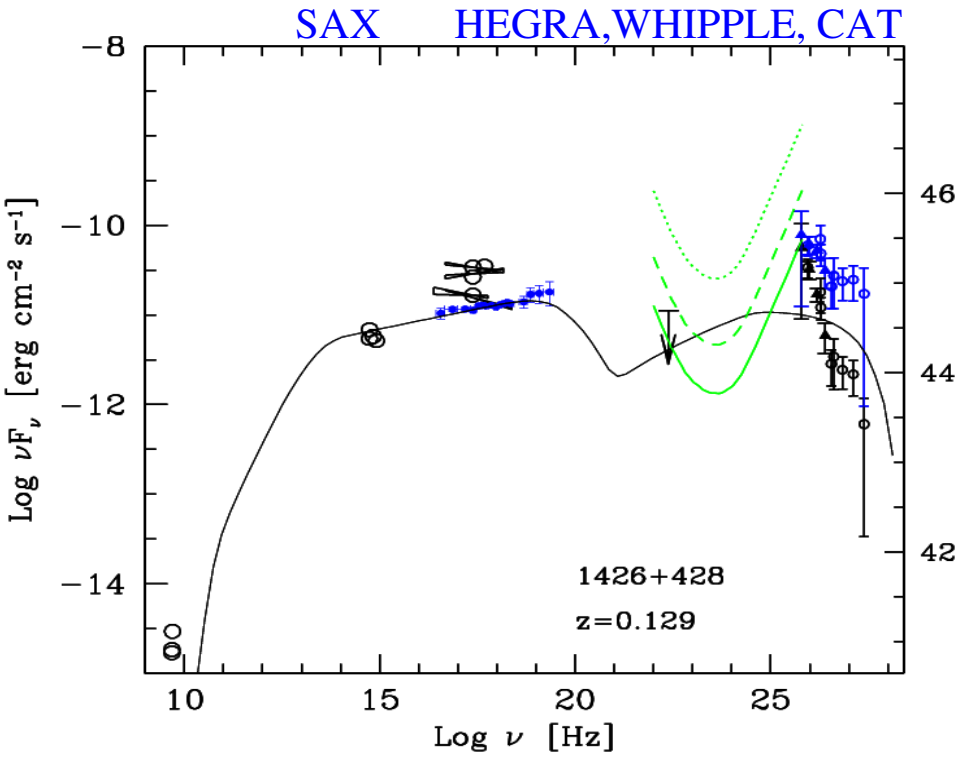
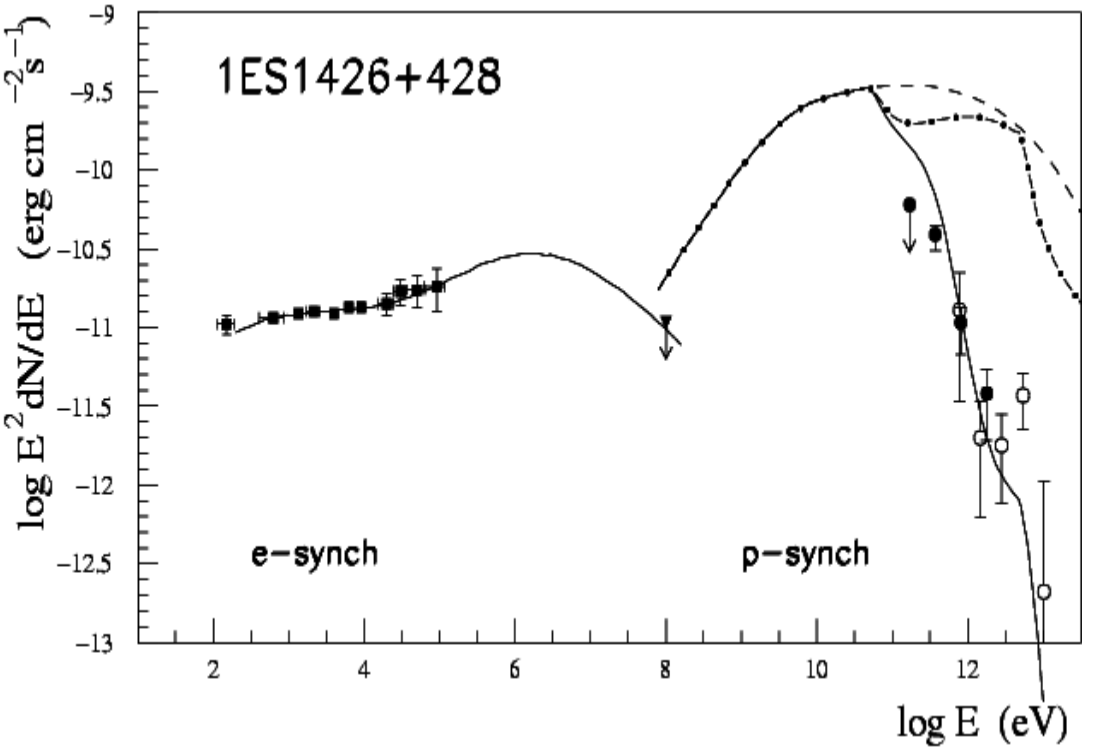
Test electron/proton synchrotron scenario





Electrons,SSC: very low B ~0.1-0.01G

Costamante et al. 2001, 2003
Ghisellini et al. 2002

Protons: B=100G , R= 3×10^{15} cm
δ=20 , particle index= 2
X-rays from secondary electrons
γ–γ on external fields: 100, 1 eV

Aharonian et al. 2004

HBL → extreme BL → higher ??

Synch peak: 10 –1000 eV → 1–100 KeV → max energy ??

Maximum (theoretically possible) acceleration rate:

= minimum acceleration time $t_{min} = \eta\, R_L/c$

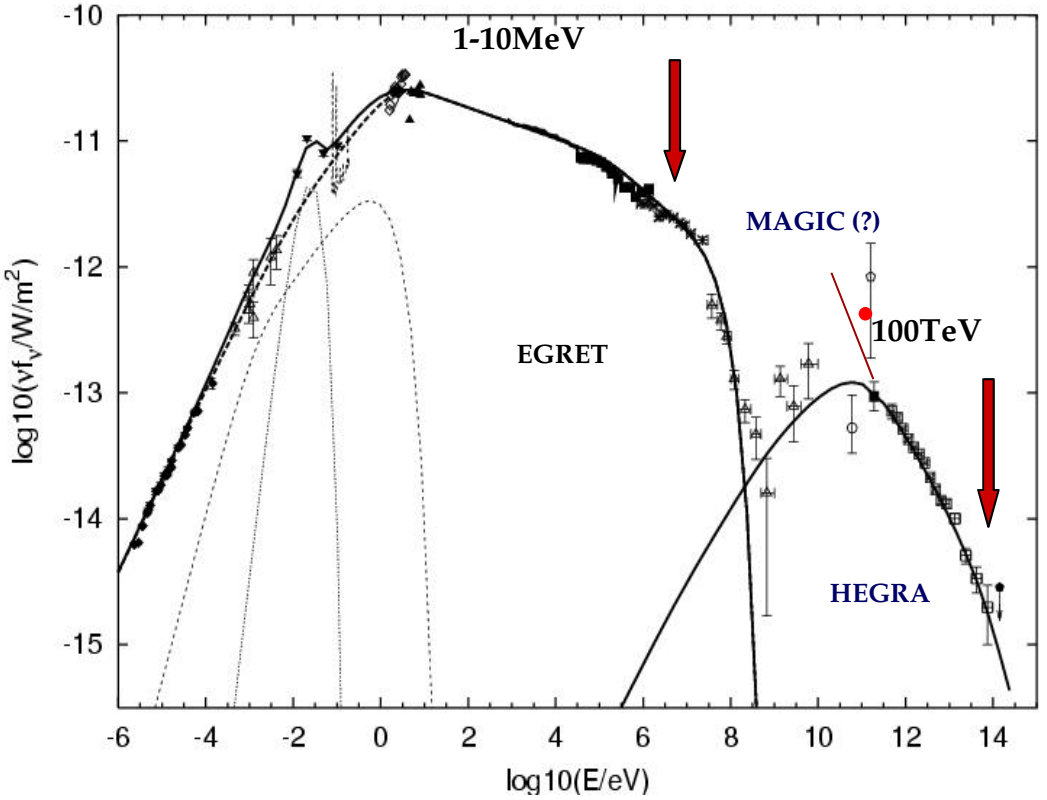
$\eta \geq 1$; low η (1-10) $\Rightarrow$ extreme accelerators

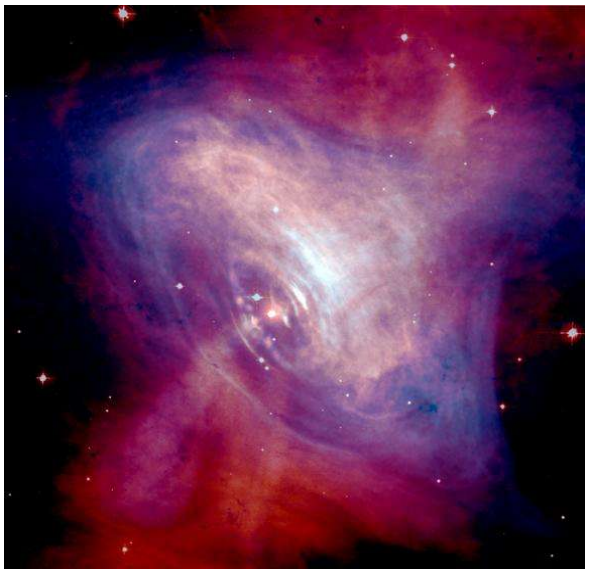
From $t_{acc} = t_{cool}$ $\Rightarrow$ max synchrotron frequency for electrons indep. of B

$$h\nu_{cutoff} = (9/4)\, \alpha_f^{-1}\, mc^2 \approx 150\, \eta^{-1}\ \text{MeV}$$

(see e.g. Aharonian 2004 and refs therein)

Example of extreme accelerator: Crab !





Standard MHD theory
(Kennel & Coroniti 84)

Synchrotron cut-off $h\nu_{cutoff}$ = 10-20 MeV $\Rightarrow \eta \approx 10$

acceleration at 10% of max rate

Are blazars extreme accelerators ??

Maximum (theoretically possible) acceleration rate:

= minimum acceleration time $t_{min} = \eta\, R_L/c$

$\eta \geq 1$; low η (1-10) $\Rightarrow$ extreme accelerators

From $t_{acc} = t_{cool}$ $\Rightarrow$ max synchrotron frequency for electrons indep. of B

$$h\nu_{cutoff} = (9/4)\, \alpha_f^{-1}\, mc^2 \approx 150\, \eta^{-1}\ \text{MeV}$$

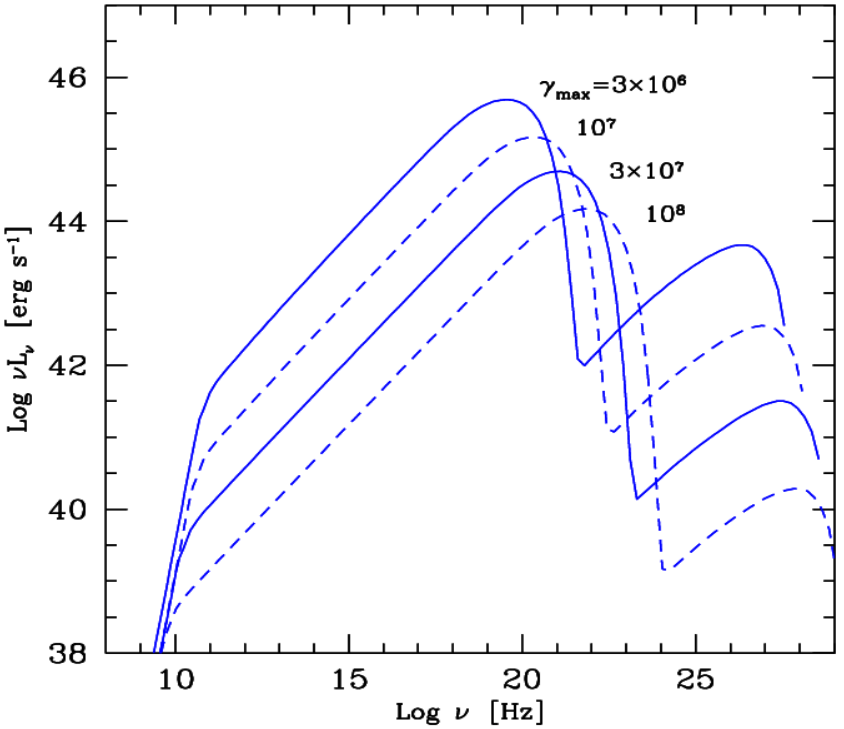
Blazars (even extreme BLLacs): $h\nu = 100 / \delta$ keV

1-10 keV $\leftrightarrow$ $150\, \eta^{-1}$ MeV $\Rightarrow$ $\eta > 10^5$ NOT extreme accelerators !

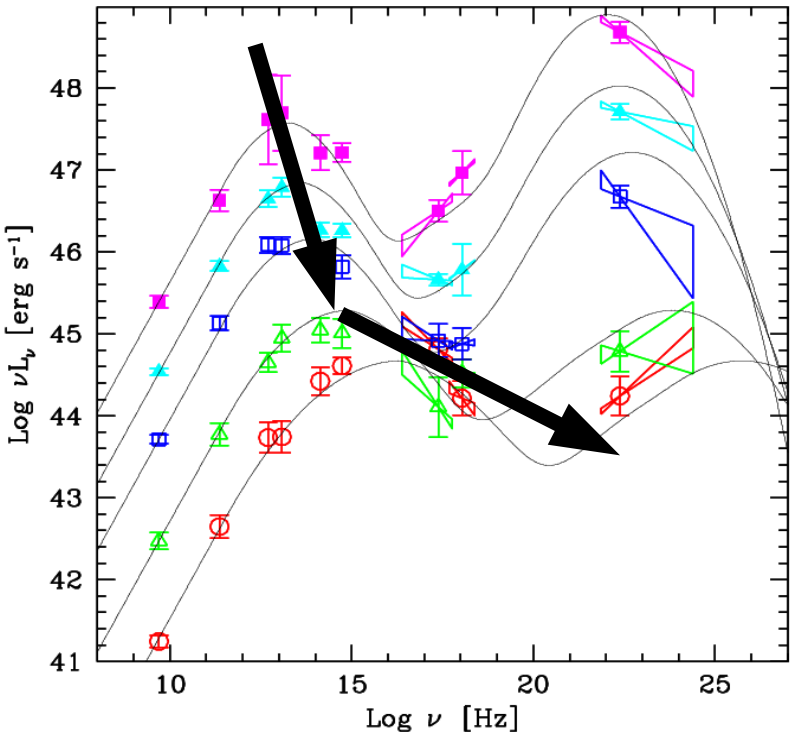
Can BLLacs accelerate at $\eta \approx 1$-10 ??

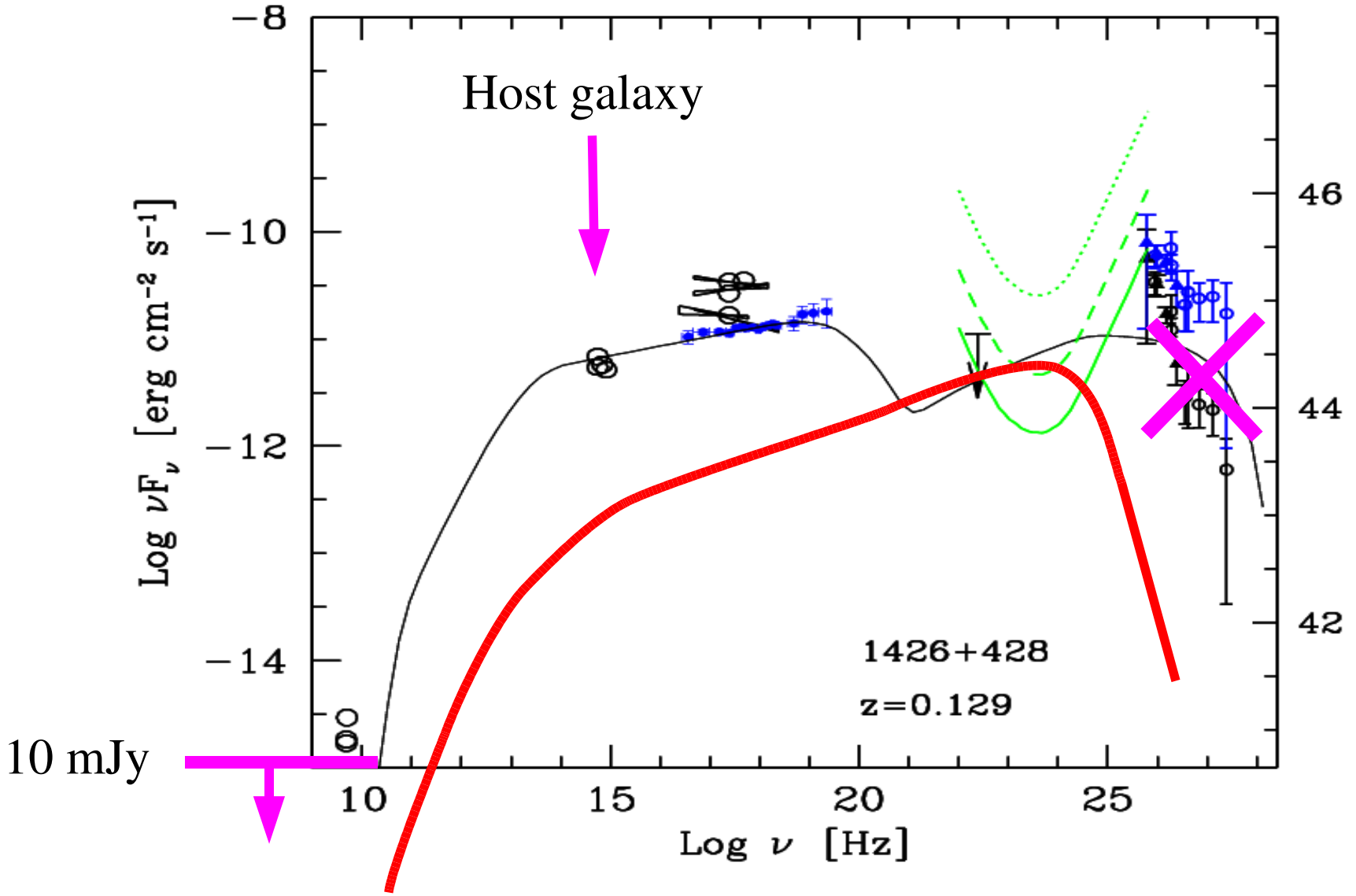
η=10, δ=20 $\Rightarrow$ synchrotron peak can be at ~200 MeV !

Do MeV-synchrotron BLLacs exist ?



Ghisellini 1998




Host galaxy
10 mJy
1426+428
z=0.129
Log νF_ν [erg cm⁻² s⁻¹]
Log ν [Hz]
−8
−10
−12
−14
46
44
42
10
15
20
25

MeV-synchrotron blazars

- could have escaped detection so far ! Bright only in MeV band.
  - Too faint in radio for large area surveys
  - dominated by thermal emission from host galaxy in optical
  - very faint (but hard) in X-rays

- Only GLAST can unveil the (extreme) BLLac nucleus inside !

  Signature: - variable γ-rays from normal (radio-weak) elliptical galaxy
  - X-ray follow-up: faint but hard non-thermal continuum

Summary

Great opportunities for new discoveries from GLAST on HBLs

- location and properties of IC peak in HBLs , EBL issues
  (essential MWL & coordination with Cherenkov Telescopes)
- test of EGRET hints on double-humped peaks
  → location and origin of gamma-ray emission
- possible discovery of a new class of sources
  → MeV synchrotron blazars: extreme particle acceleration