A NEW MODEL FOR THE EXTRAGALACTIC GAMMA RAY BACKGROUND

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TeVPa - Stockholm 2011

WHAT THE EGB IS

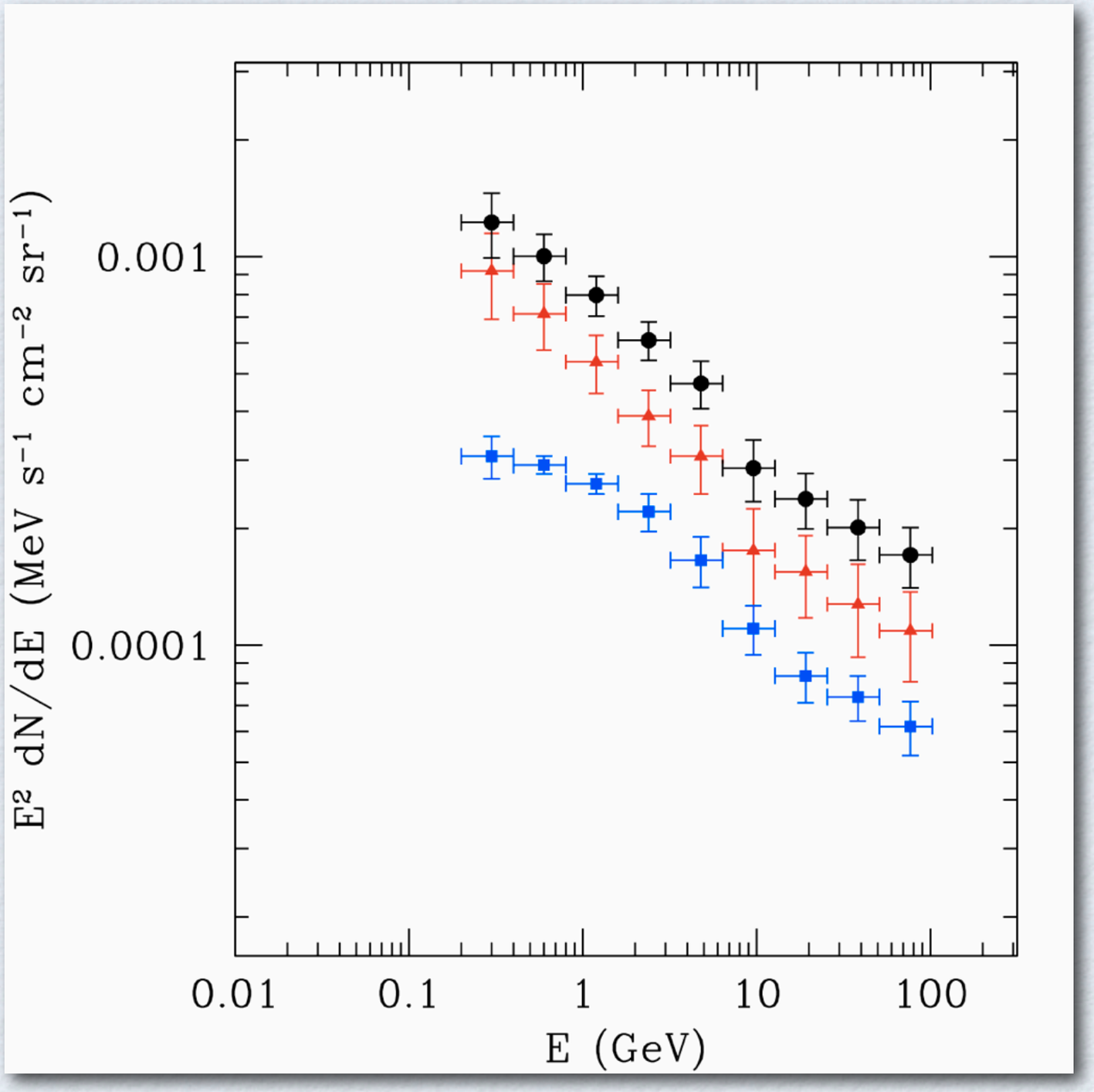
Take all sky detected by Fermi LAT and subtract the Galactic emission

EGB = resolved sources + all the rest

blazars;
star-burst galaxies

unresolved blazars;
star-forming galaxies;
star-burst galaxies;
AGNs;
radio galaxies;
Dark Matter;
Intergalactic shocks
...

THE FERMI EGB



EGB MODEL: INGREDIENTS

i) blazar (FSRQ + BL-Lac) component;
ii) star-forming galaxy component.

EGB MODEL: IDEA

We simultaneusly fit the Log N- Log S of Fermi sources and the total EGB with a two component model with two free parameters.

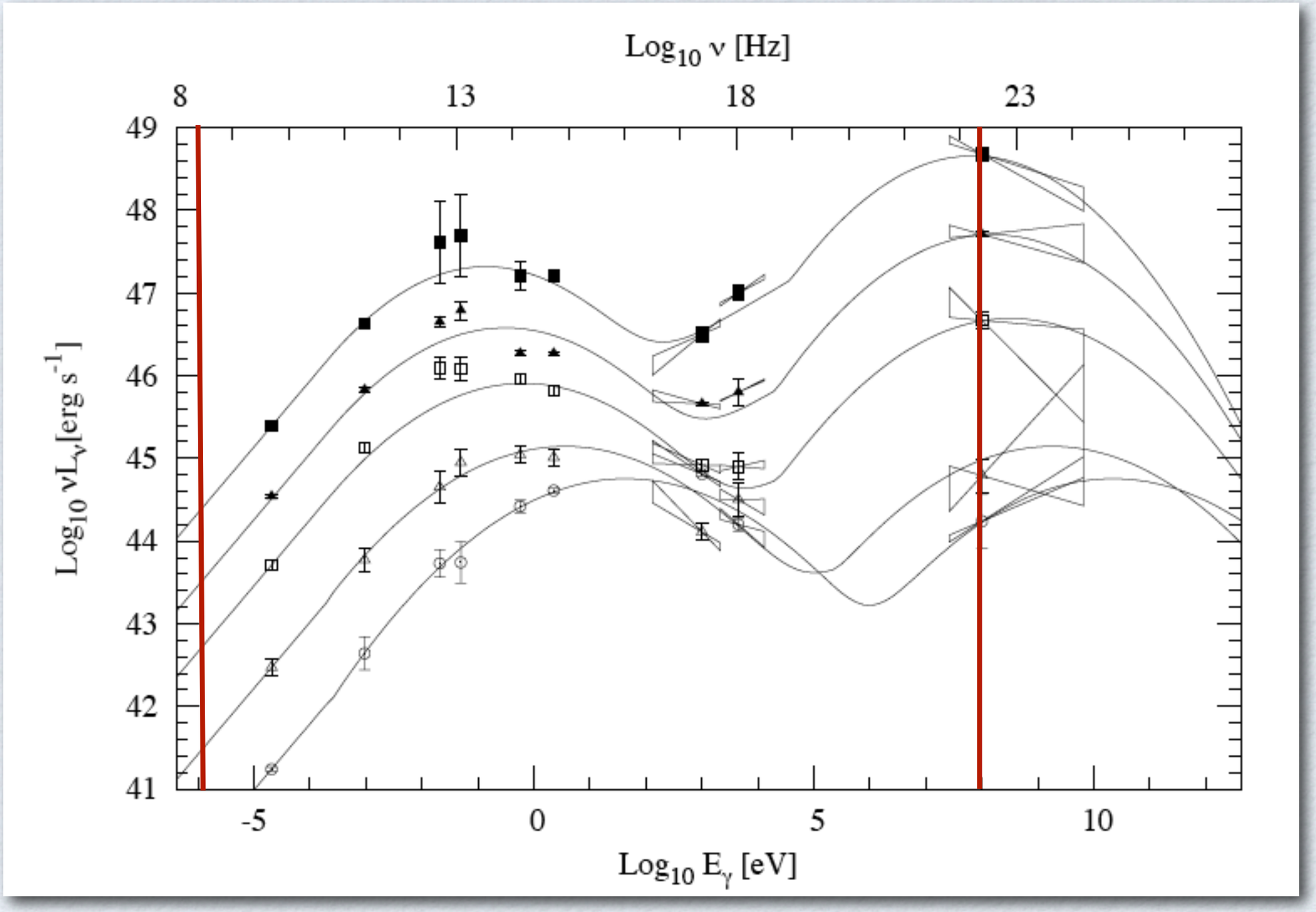
EGB MODEL: BLAZAR COMPONENT

Two basic elements:

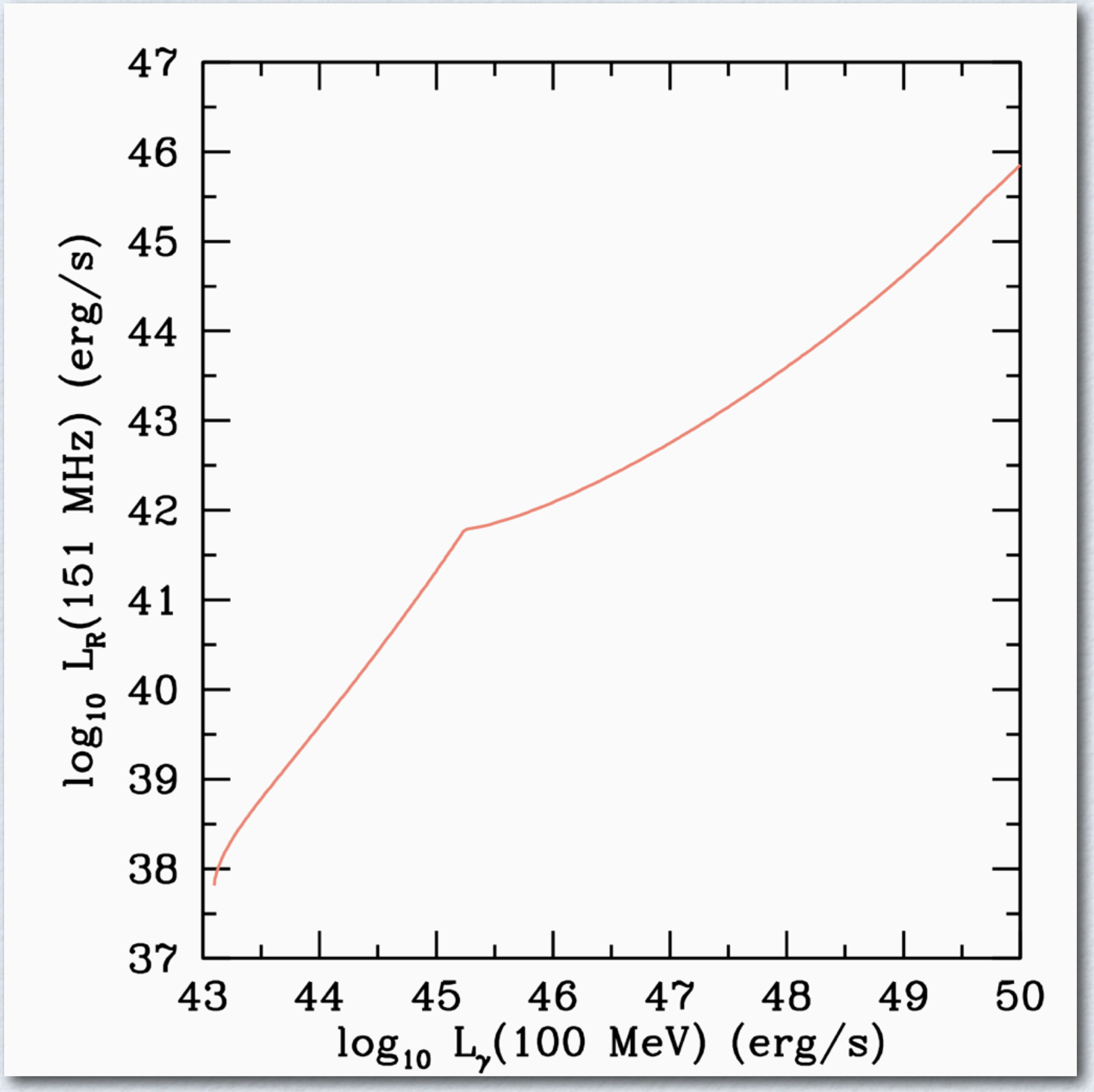
- Radio LF (@ 151 MHz; FR I and FR II) (Willott et al. 2001);
- Blazar Flux (using the Blazar SED) (Fossati et al. 1998).

$$I_{\rm blaz}(E_0) = \frac{1}{4\pi}\int_0^\infty dz\,\frac{dV}{dz}\int_{\log L_\gamma^{\rm min}}^{\log L_\gamma^{\rm max}} d\log L_\gamma\,\frac{d\Phi_\gamma(L_\gamma,z)}{d\log L_\gamma}\;\frac{dn(L_\gamma,z)}{dE}e^{-\tau_{\gamma\gamma}(E_0,z)}$$

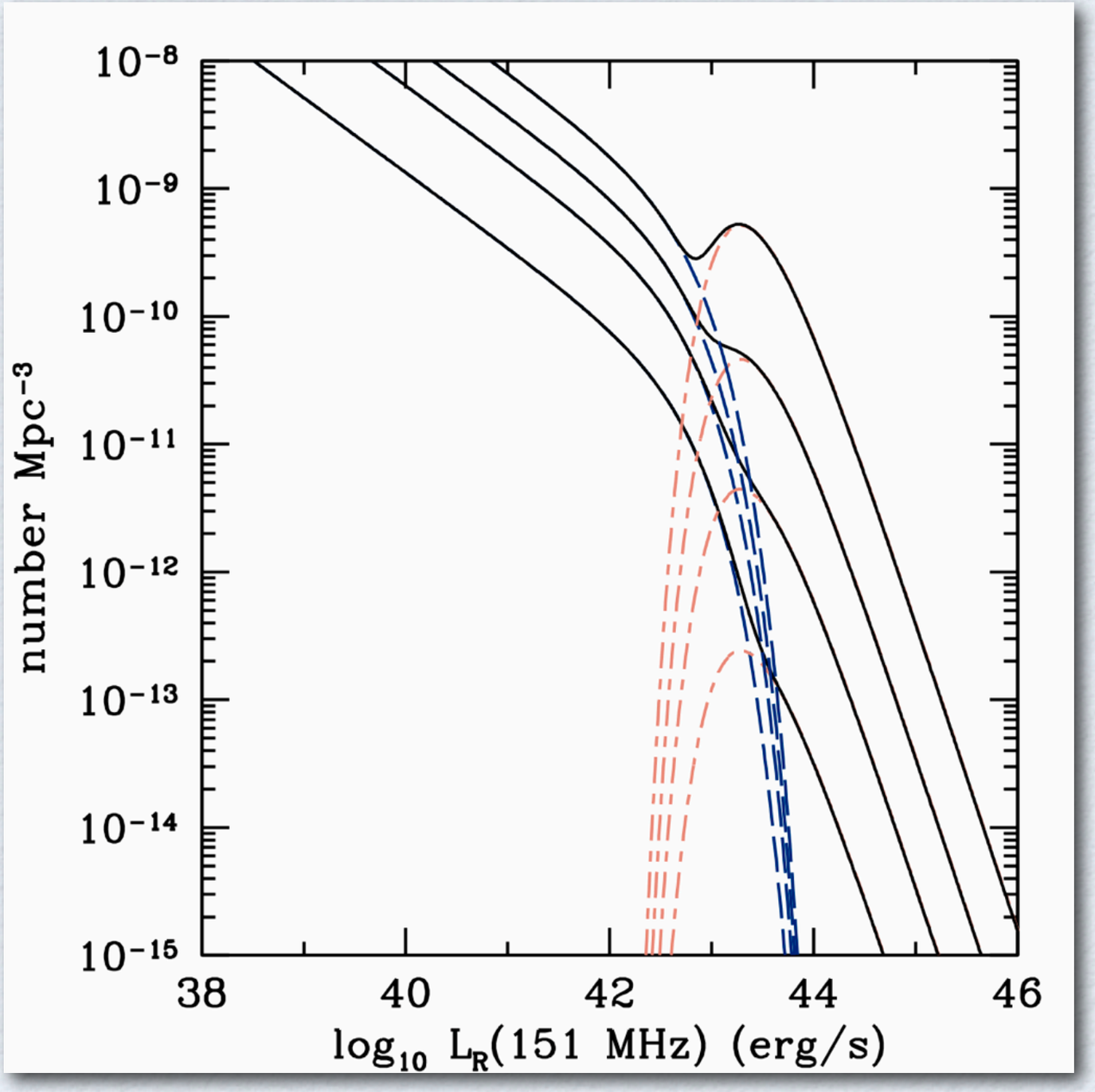
THE BLAZAR SEQUENCE



See Fossati et al 1998; Inoue & Totani 2010

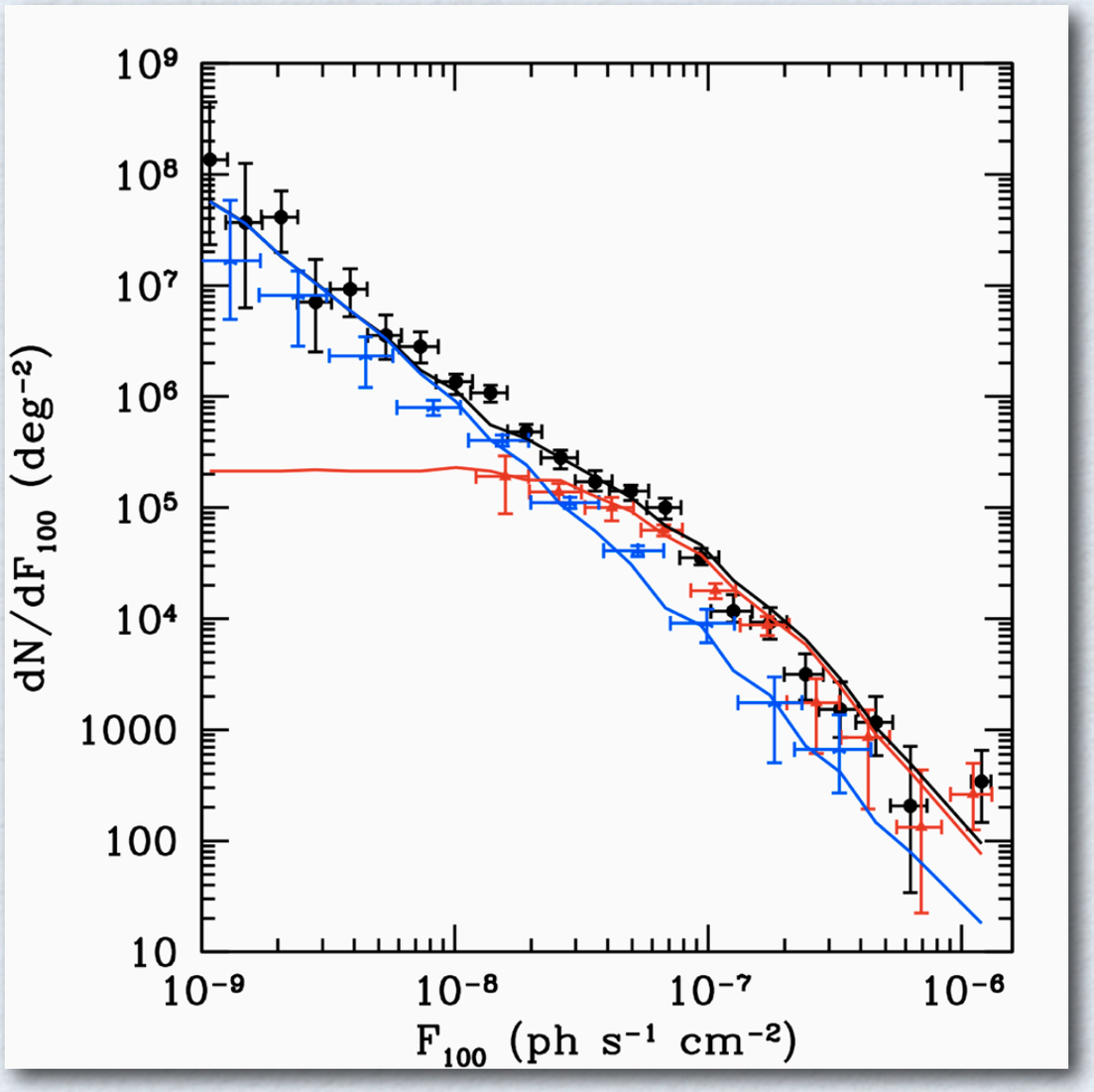

47
46
45
44
43
42
41
40
39
38
37
log10 LR(151 MHz) (erg/s)
43
44
45
46
47
48
49
50
log10 Lγ(100 MeV) (erg/s)

THE BLAZAR LF



(Willott et al 2001)

BLAZAR DIFFERENTIAL logN-logS



$$N(>F_{\rm ph}) = \frac{1}{4\pi}\int_0^\infty dz\,\frac{dV}{dz}\int_{\log L_\gamma^{\rm min}}^{\log L_\gamma^{\rm max}} d\log L_\gamma\,\frac{d\Phi_\gamma(L_\gamma,z)}{d\log L_\gamma}$$

$$\frac{\Phi_\gamma(L_\gamma,z)}{d\log L_\gamma} = \kappa\,\frac{\Phi_{151\rm Mhz}(L_{151\rm MHz},z)}{d\log L_{151\rm MHz}}$$

$$k = 3.93 \pm 0.01 \times 10^{-4}$$

EGB MODEL: STAR-FORMING GALAXY COMPONENT

Basic idea:

π^0 → CRs → SNR → SFR

$$I_{\rm gal}(E_0) = \frac{1}{4\pi}\int_0^\infty dz \frac{dl}{dz}\,\frac{(1+\mathcal{R})}{m_{\rm H}\xi(H_2)}\langle q_{\rm H}(E)\rangle\,\dot{\rho}_{\rm SFR}(z)e^{-\tau_{\gamma\gamma}(E_0,z)}$$

Free parameter: SF efficiency of molecular Hydrogen

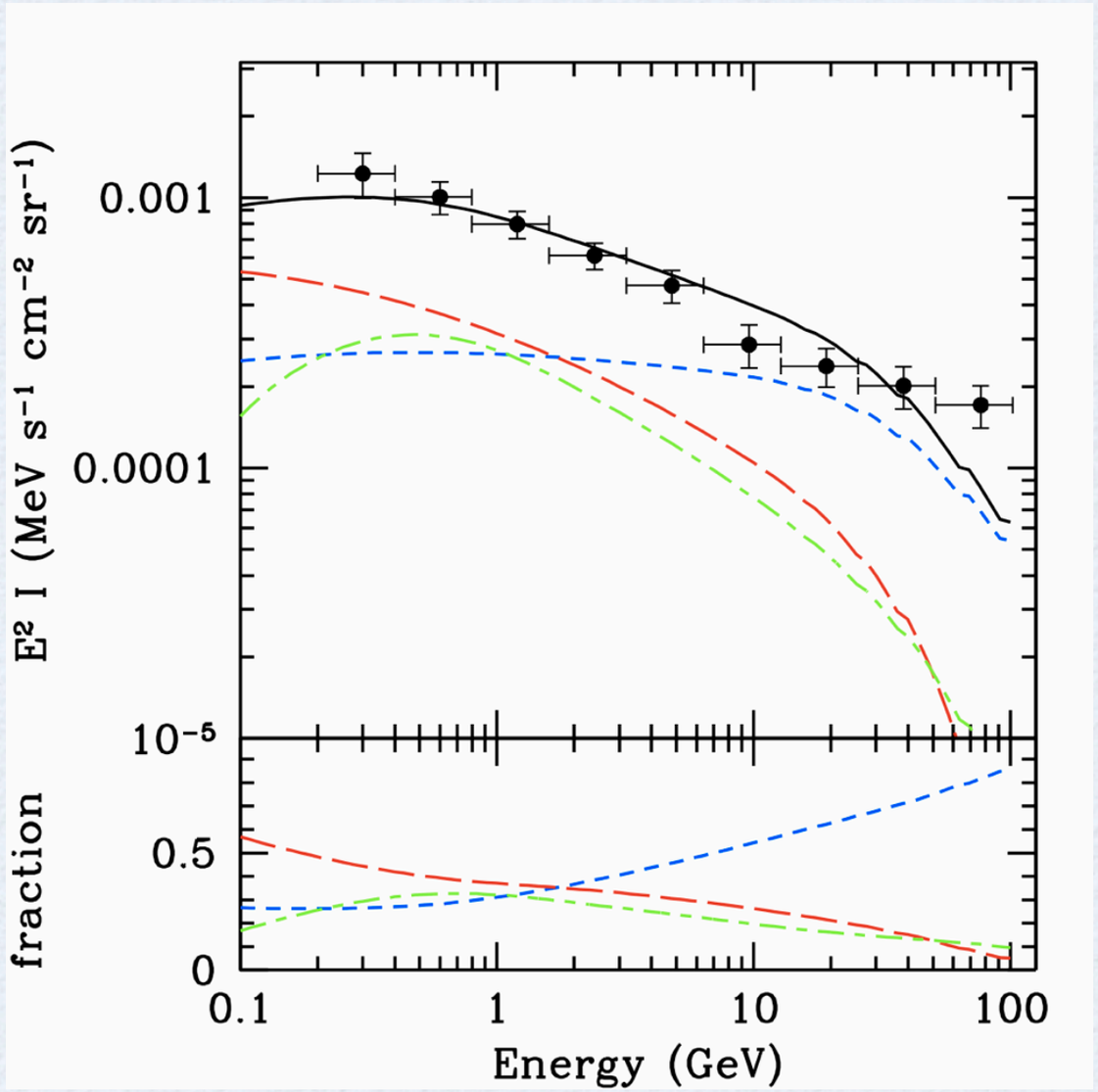
Pionic emissivity

Cosmic SFR

$\dot{\rho}_{\rm SFR} \sim \xi({\rm H_2})\rho_{\rm H_2}$

(see Stecker & Venters 2010 for details)

EGB MODEL: RESULTS



$$k = 3.93 \pm 0.01 \times 10^{-4}$$

$$\xi = 4.07 \pm 0.4 \times 10^{-10}\ \mathrm{yr}^{-1}$$

$$\chi^2/\mathrm{d.o.f} = 1.15 \text{ where d.o.f} = 29$$

$$\xi \sim (5.25 \pm 2.5) \times 10^{-10}\mathrm{yr}^{-1}$$

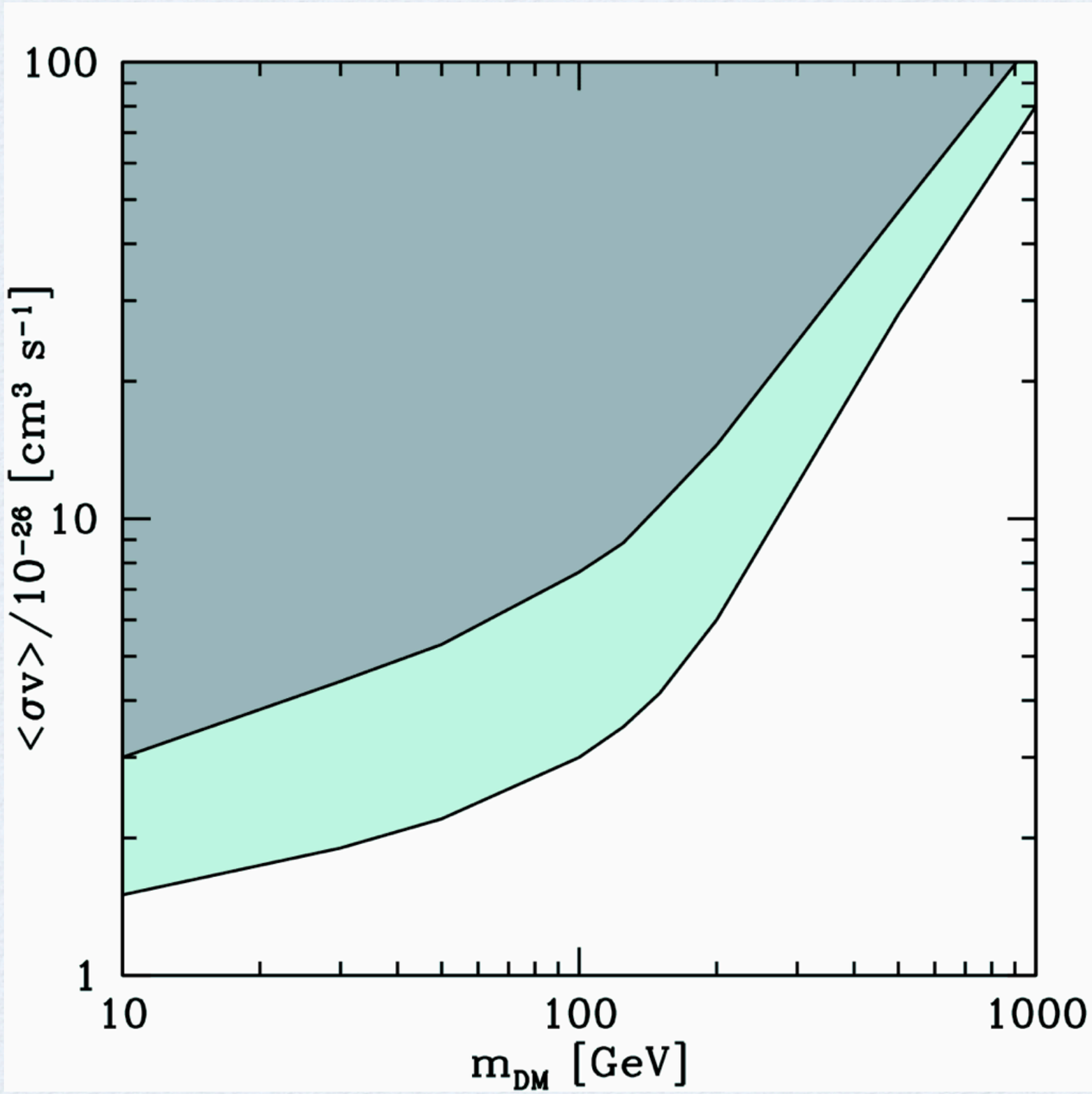
Leroy et al. 2008

CONCLUSIONS

- We proposed a new model for EGB with two components: star forming galaxies and blazars (FSRQs and BL-Lacs);

- We explain all the EGB Fermi points but the last at 75 GeV. This could be due to a galactic DM or to a blazar LF not precise at low redshift.

Thank you!


100
10
1
10
100
1000
$\langle\sigma v\rangle / 10^{-26}$ [cm^3 s^{-1}]
m_{DM} [GeV]