- *We consider:*

Secondary particle production from **hadronic p-γ interactions** of **external target photons** with **isotropically distributed CR protons** in the **co-moving blazar jet frame**

-> externally isotropic target photon distribution appears anisotropic (beamed) in co-moving jet frame

- To describe the interaction probability in the co-moving jet frame we calculate the **gyro-phase averaged interaction rate**

- *We then modified the* **SOPHIA2.0**[1] **Monte Carlo code to take into account the corresponding non-isotropic interaction angle distribution**

- When **comparing to** Dermer et al (2014)[2] we found **~2-3 times higher interaction rates in our work** for mono-energetic (photon energy ε_0) target photon fields
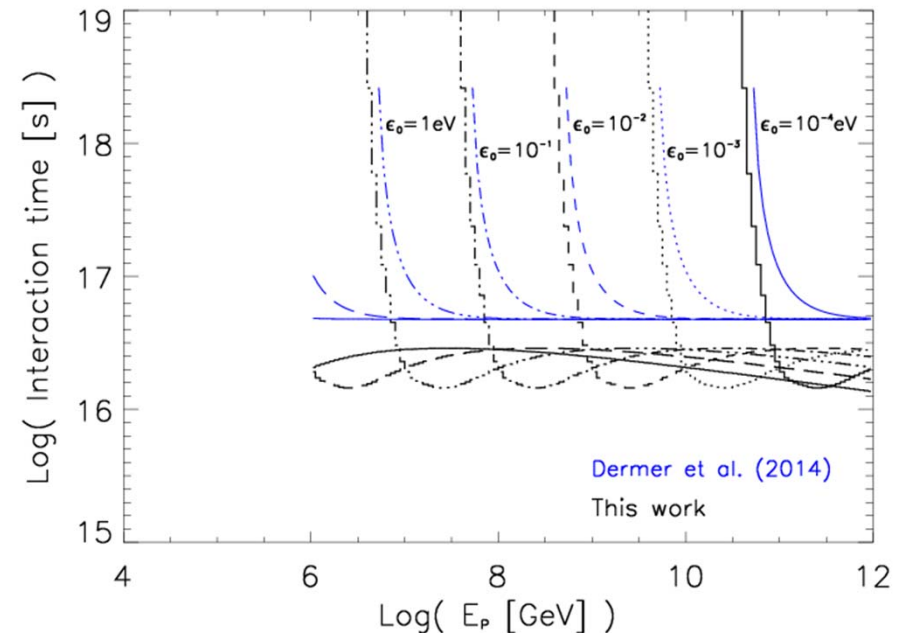
Interaction time in the co-moving jet (with bulk Lorentz factor Γ=10) frame for an externally isotropic target radiation field of differential density $n(\varepsilon)$=1cm$^{-3}\delta(\varepsilon-\varepsilon_0)$ with (jet-frame) ε_0=10^{-4}eV (solid), 10^{-3}eV (dotted), 10^{-2}eV (short dashed), 0.1eV (dash-dotted), 1eV (dash-triple-dotted line),… as calculated in Dermer et al (2014) (blue curves) and compared to our work (black curves).

- *We here consider:*

Emission region within BLR line target radiation field *[see DMI2014[(2)]]* **&** **isotropically** (co-moving jet frame) **distributed proton spectrum**

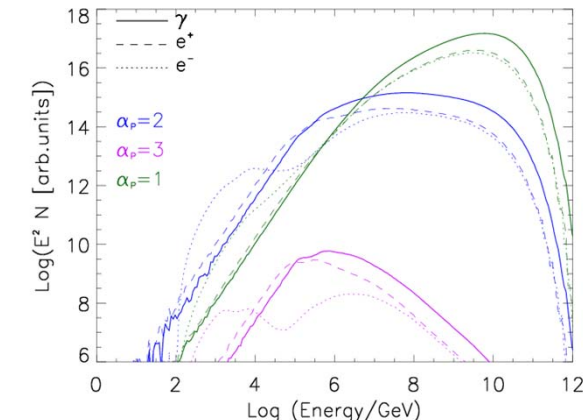$$N_P \sim E^{-\alpha_P} \exp(-E_P/E_{P,max}), \quad E_{P,max}=10^{10}GeV$$
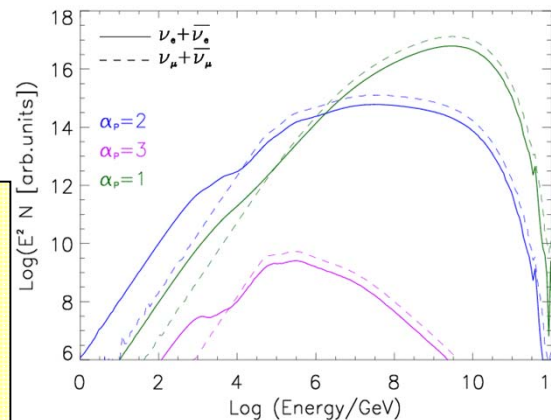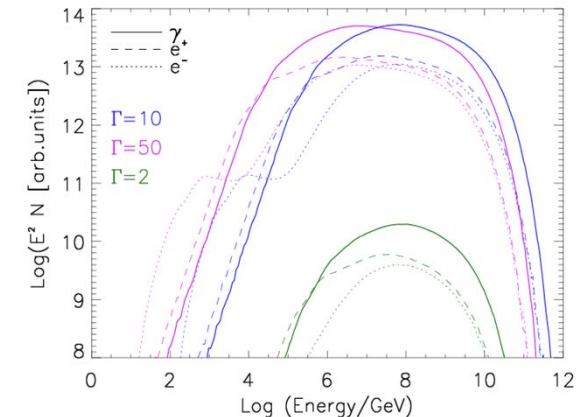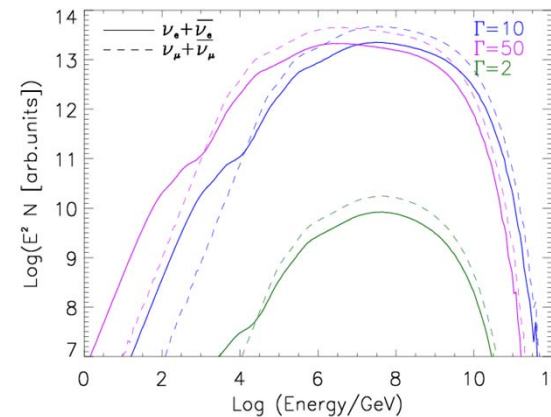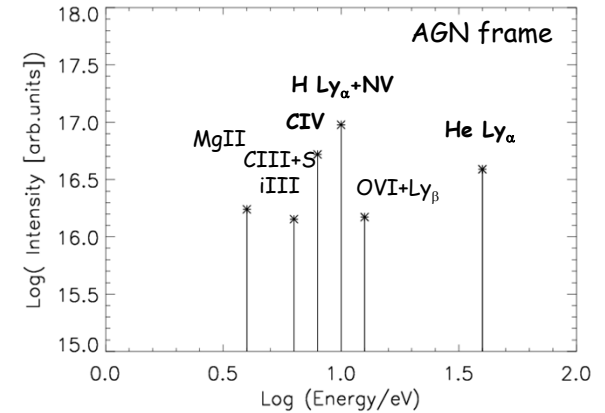
- **Examples of secondary particle spectra:**

(AGN frame; all neutrons decayed;

viewing angle $\theta=5^o$)

$\alpha_P = 2$

bulk Lorentz factor $\Gamma = 10$

We found:

$EM_{[\gamma+e^++e^-]}$ –power / ν –power

~ 1

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A previous approximation of the co-moving (') BLR target photon field uses a isotropically distributed blackbody photon field with peak intensity at

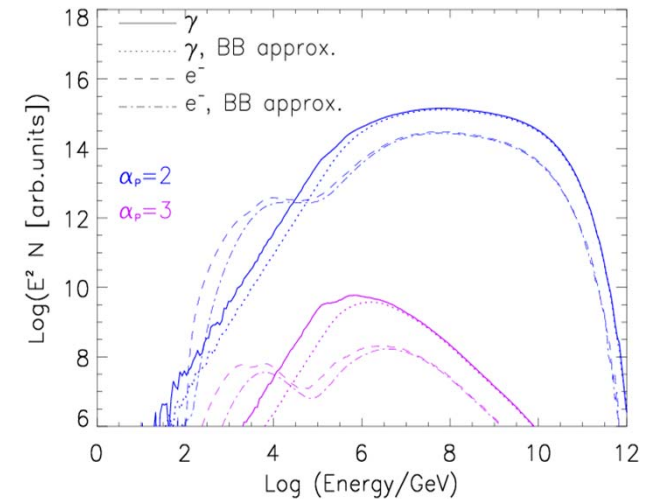$$\nu'_{peak} \approx 1.5 \Gamma \nu_{Ly\alpha}$$

[Tavecchio & Ghisellini 2008; Böttcher, Reimer & Marscher 2009; Reimer 2009]

-> Comparing this approximation to our work we found:

Blackbody approximation underestimates secondary particle yields @ low-energy part of spectrum.

$\alpha_P = 2,\ \theta=5^o$

$\Gamma = 10,\ \theta=5^o$
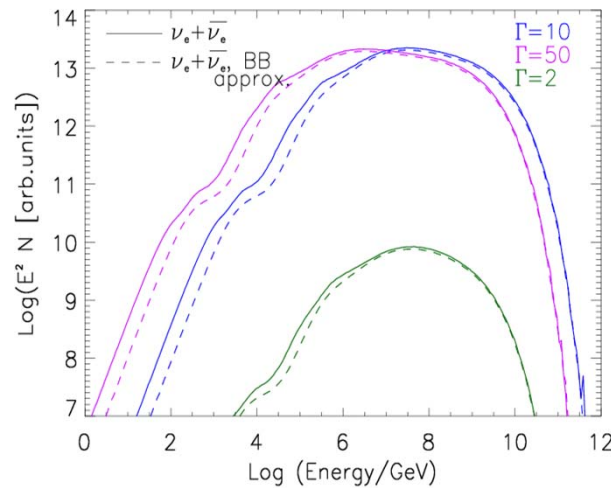
References:

(1) A. Mücke, R. Engel, J.P. Rachen, R.J. Protheroe, T. Stanev 2000, CPC, 124, 290
(2) C.D. Dermer, K. Muras, Y. Inoue, 2014, JHEA, 3, 29 (DMI14)
(3) F. Tavecchio & G. Ghisellini, 2008, MNRAS, 386, 945
(4) M. Böttcher, A. Reimer & A. Marscher, 2009, ApJ,703, 1168
(5) A. Reimer, 2009, ,Int.J.Mod.Phys.D, 18, 1511