Inter Galactic Magnetic field constraints through the gamma ray observations of the Extreme High-frequency-peaked BL Lac candidate HESS 1943+213

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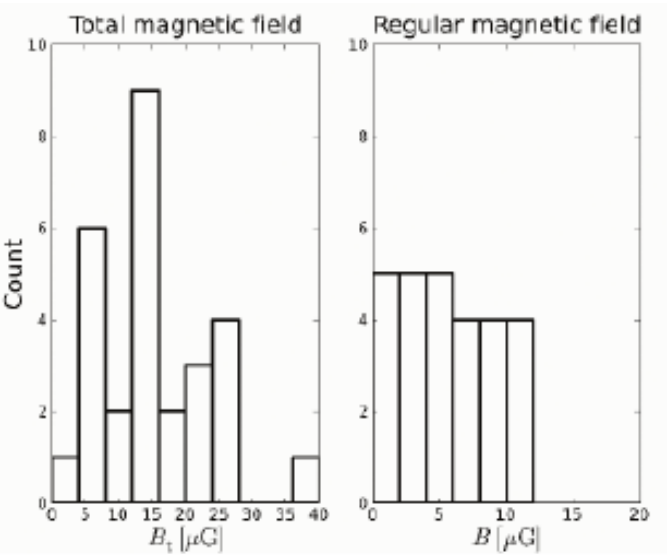
Why the IGMF?

Contribute to solve the long-standing problem of the origin of galactic MFs



A. Fletcher (2011)

Two-fold mechanism

Seed fields

- Small strength
- Small coherence length

Amplification

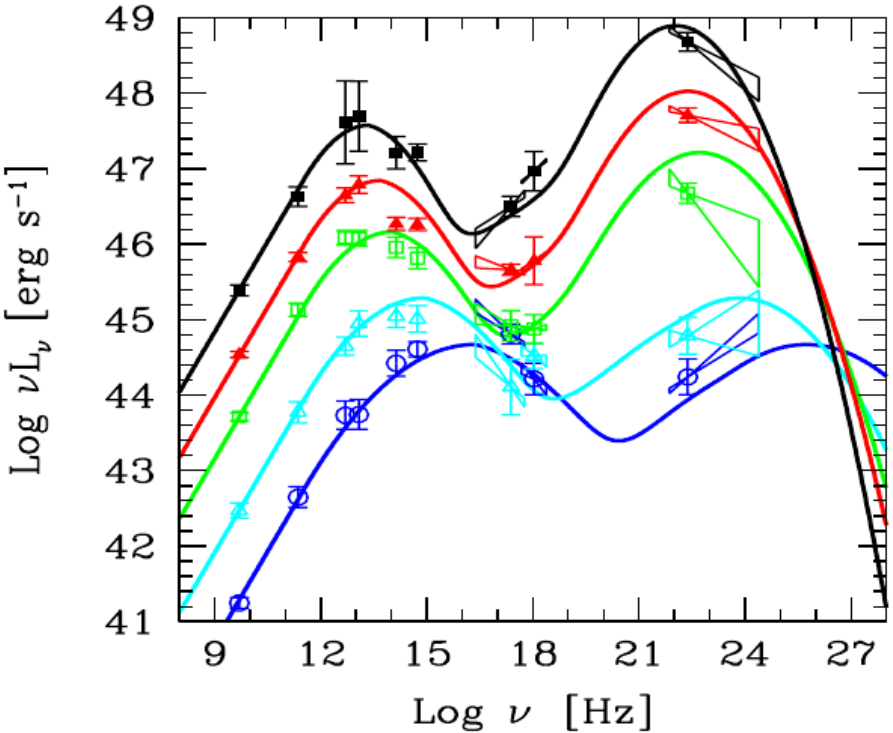
- Increase strength
- Create coherent structure

Blazars as probes for the measutrment of the IGMF

Gamma-gamma reaction and cascade development

$$\gamma\gamma \rightarrow e^{+}e^{-}$$

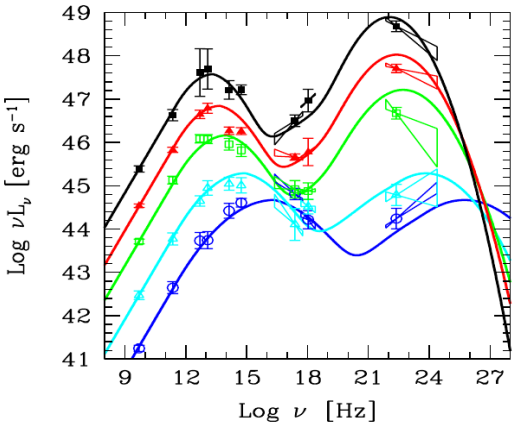
$$E_0 = \frac{0.52}{E_{eV}}\, TeV$$



Fossati et al. (1998)

Blazars as probes for the measutrment of the IGMF

Gamma-gamma reaction and cascade development



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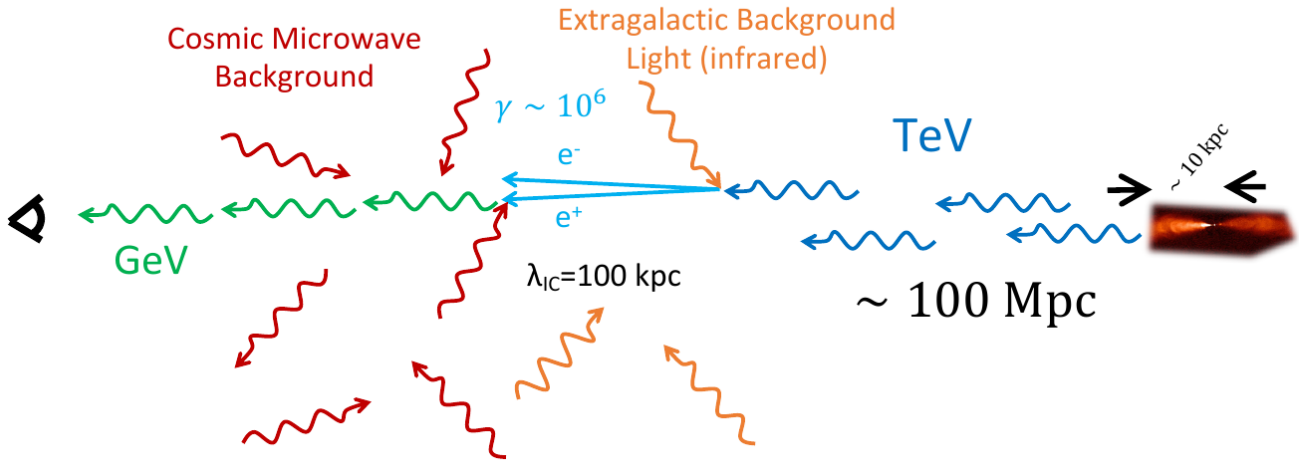
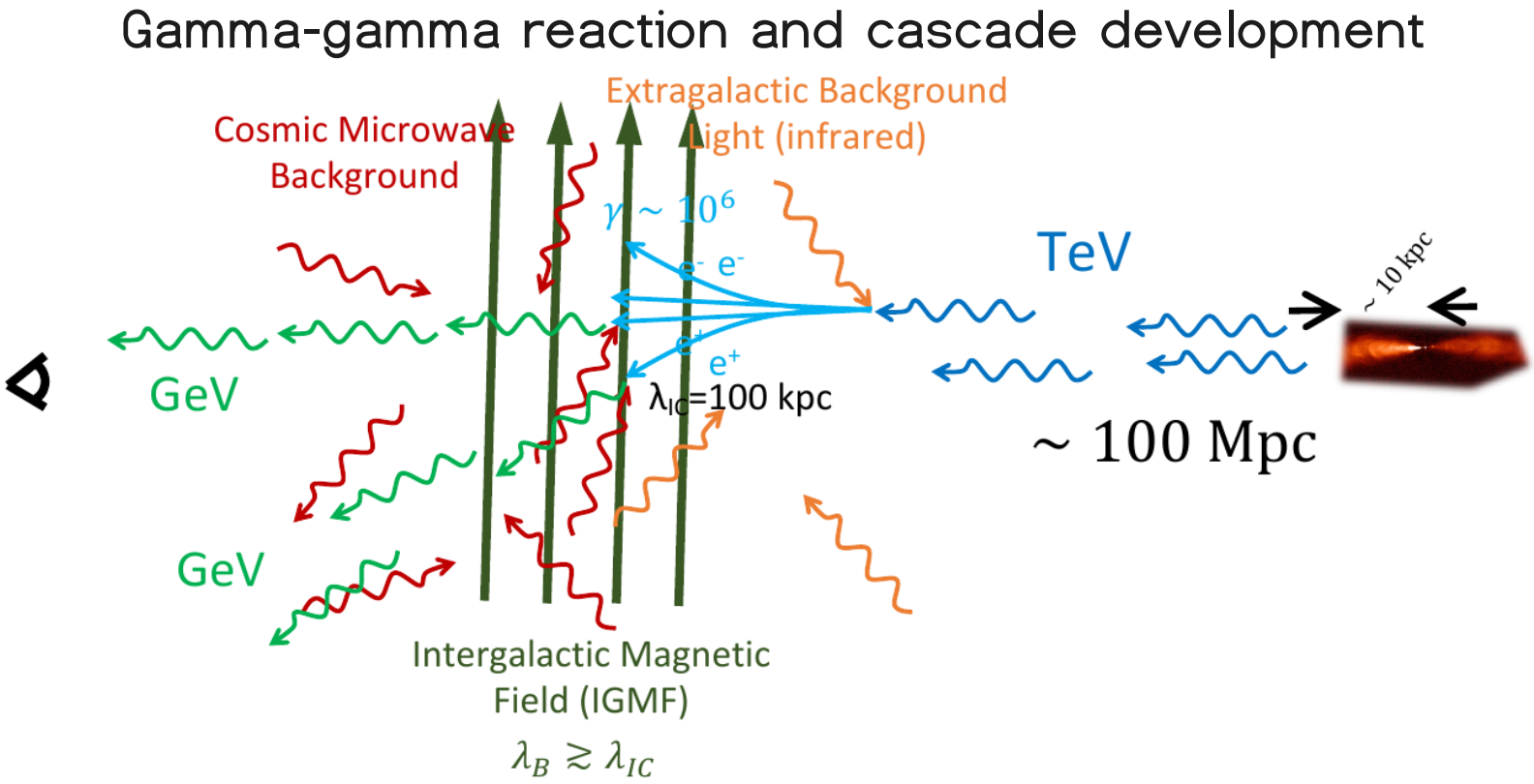


$$D_e \simeq 3.24 \cdot 10^{-2}(1+z_{\gamma\gamma})^{-4}\left[\frac{E'_e}{10\mathrm{TeV}}\right]^{-1}\mathrm{Mpc}$$

$$D_\gamma(E'_{\gamma_0}, z) \simeq 40\frac{1}{(1+z)^2}\left[\frac{E'_{\gamma_0}}{20\mathrm{TeV}}\right]^{-1}\mathrm{Mpc}.$$

Neronov & Semikoz (2009)

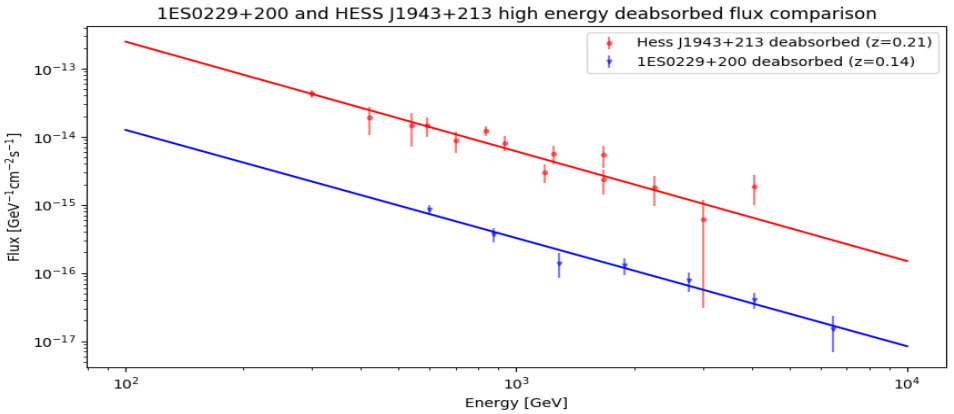
Blazars as probes for the measutrment of the IGMF

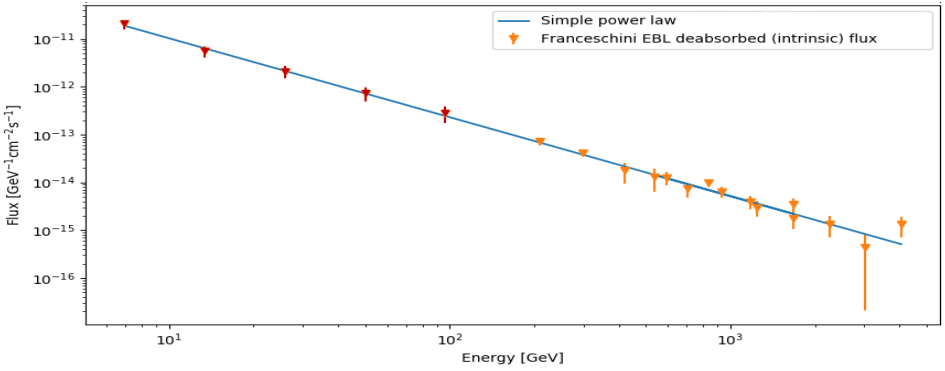


HESS J1943+213: a particularly good blazar

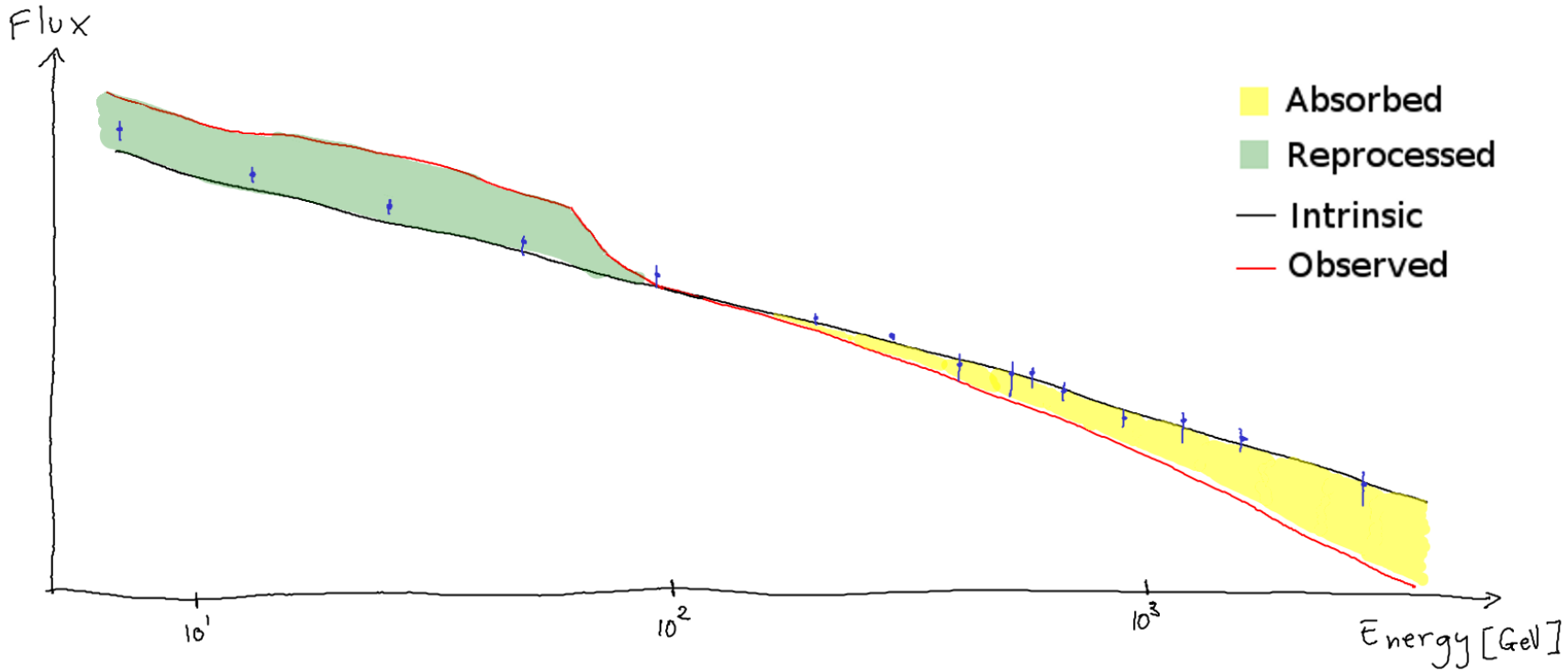
HESS J1943+213 characteristics

- Higher VHE flux than archetypal source
- Intermediate redshift (0.21)
- PL index 1.83





Determination of the IGMF from the spectrum



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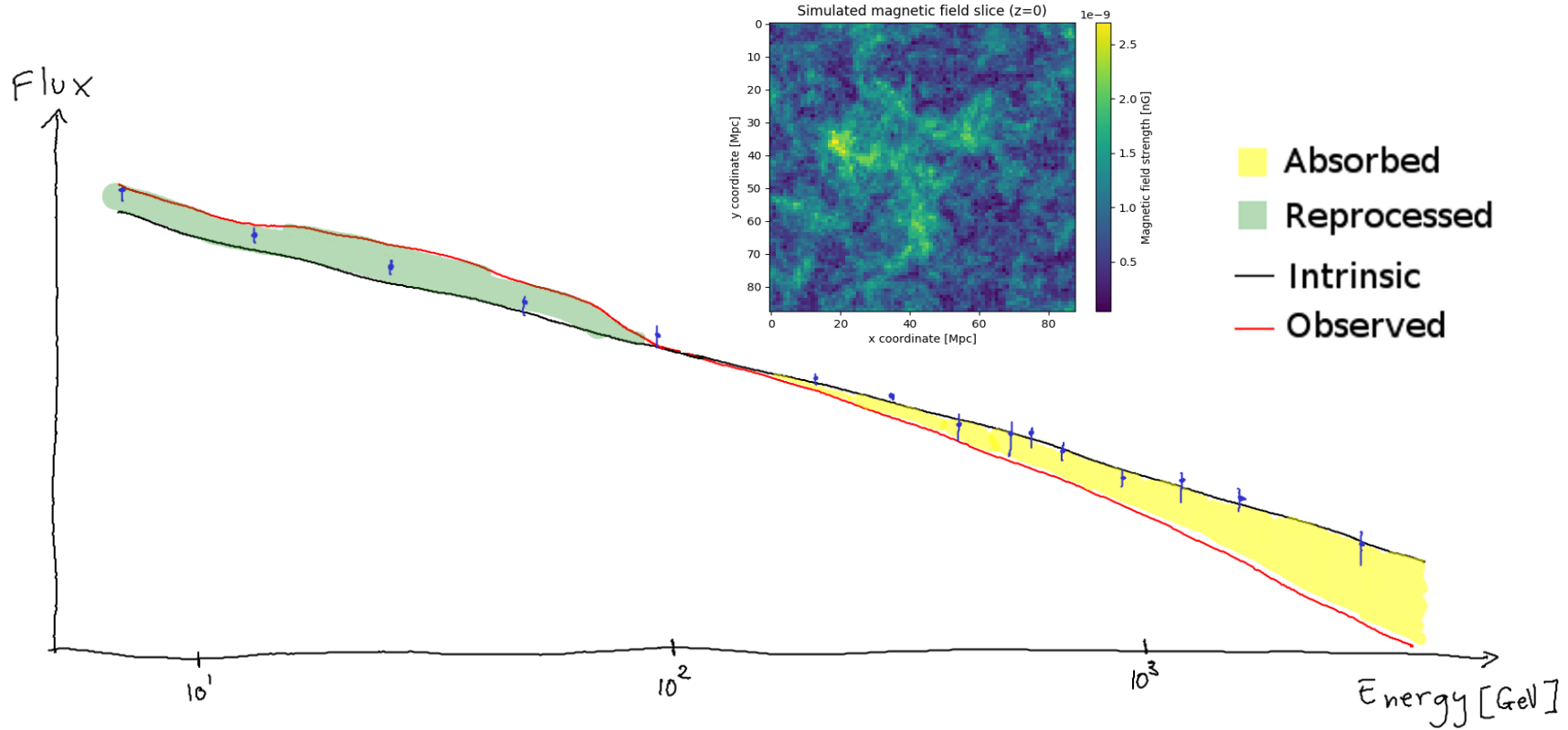


Conservative hypotheses for the IGMF

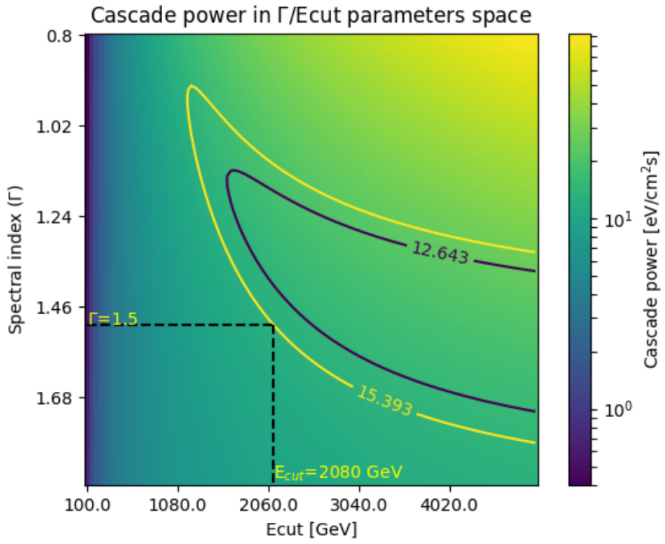
Exclude all effects that can mimick an IGMF

- Expected GeV flux depends on measured TeV flux (with large errors)
- Systematically underestimate the VHE flux to exclude the risk of overestimating it

$$\frac{dN}{dE} = N_{300}\left(\frac{E}{300GeV}\right)^{-\gamma} e^{-E/E_{\rm cut}}$$

Minimize the “cascade power”

$$P = \int_{300GeV}^{\infty} E\frac{dN}{dE}dE$$



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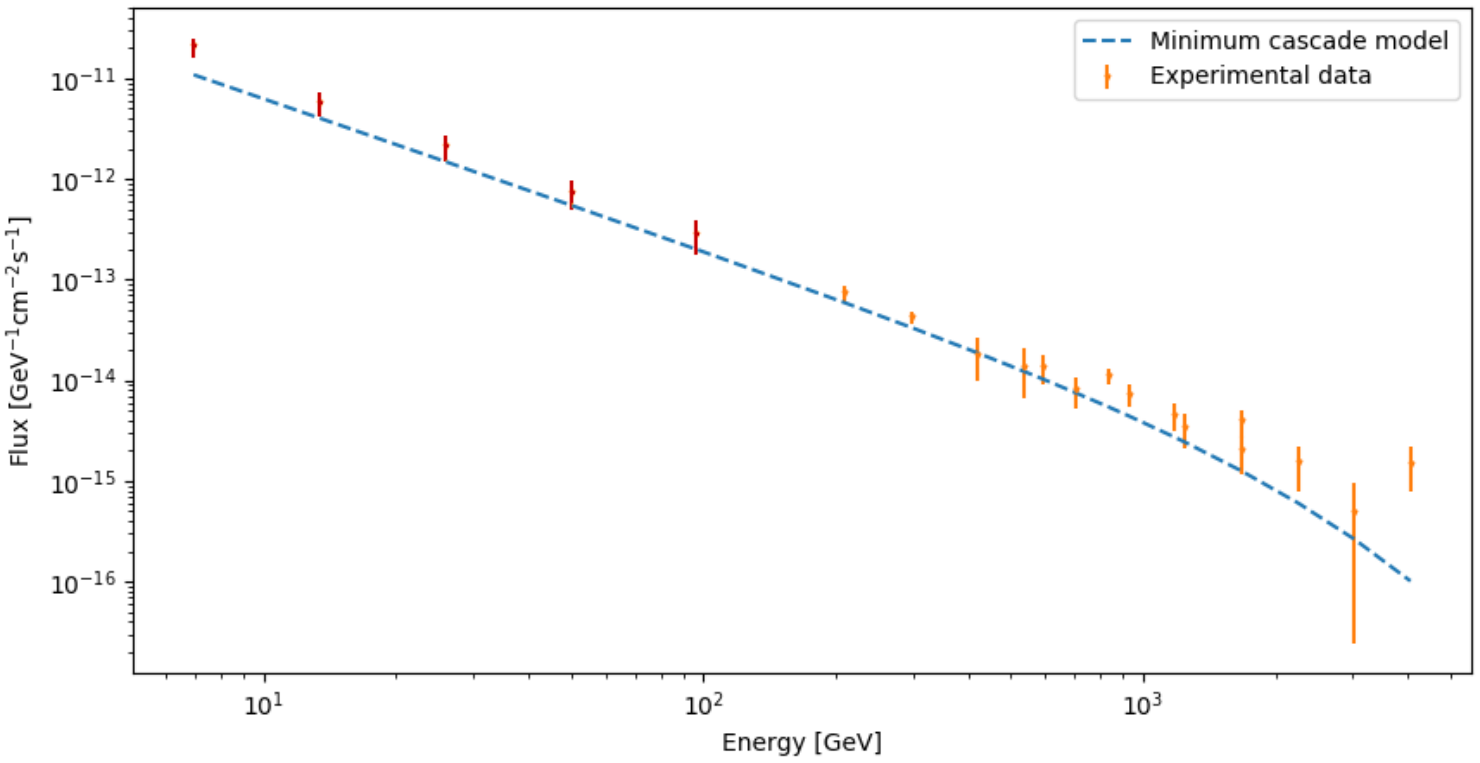
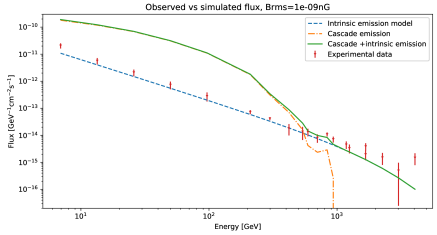
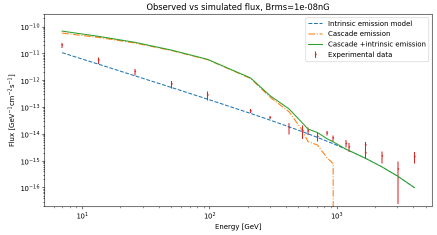
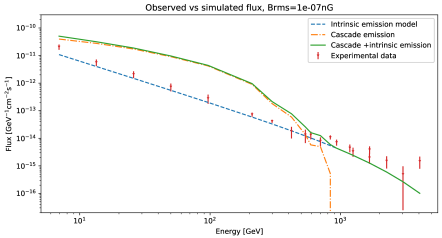


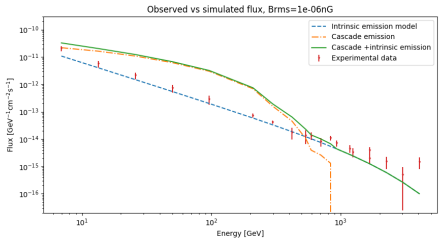
Simulation of the IGMF effects on the cascade emission

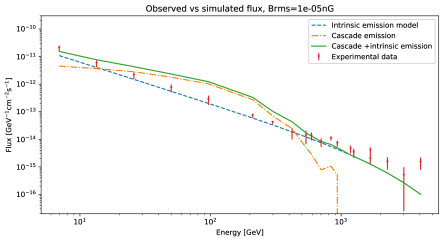
Effects of an increasingly stronger IGMF on the flux

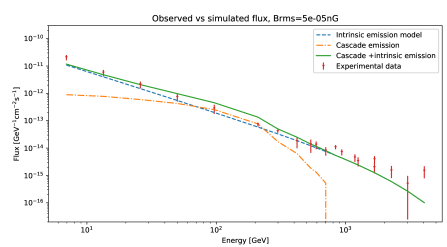


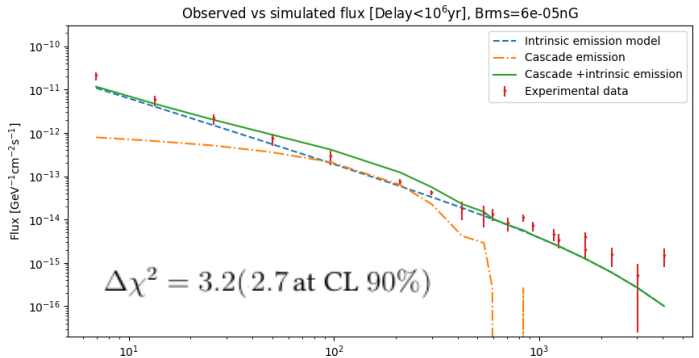


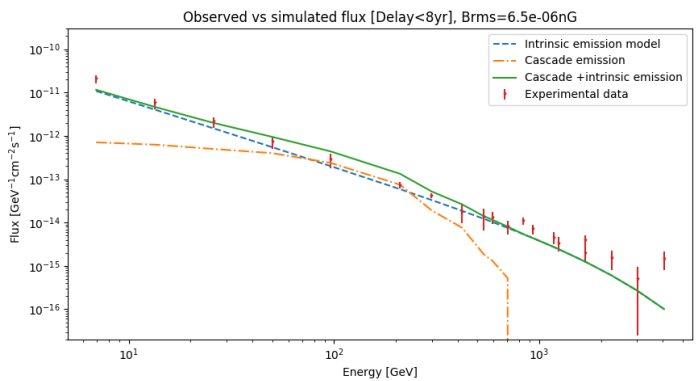












Comparison with other studies

Author (date)	Source	Γ	E_{cut}[GeV](type)	z	Stability [yr]	B_{RMS} limit [G]
Dermer et al. (2011)	1ES 0229+200	1.2	5000 (exp/sharp)	0.14	∞ (3)	$3{\cdot}10^{-16}$ (10^{-18})
Dolag et al. (2011)	1ES 0229+200	1.66	20000 (sharp)	0.14	10^4	$5{\cdot}10^{-15}$
Taylor et al. (2011)	RGB J0710+591	1.6	1000 (exp)	0.13	∞(2)	
	1ES 0229+200	1.2	5000 (exp)	0.14	∞(2)	10^{-15} (10^{-18})
	1ES 1218+304	1.7	2500 (exp)	0.18	∞(2)	
Neronov & Vovk (2010)	1ES 0347-121	1.5	800 (exp)	0.188	∞	$2{\cdot}10^{-17}$
	1ES 0229+200	1.5	3800 (exp)	0.14	∞	$3{\cdot}10^{-16}$
	1ES 1101-232	1.5	1000 (exp)	0.186	∞	
Tavecchio et al. (2011)	RGB 0152-017	-	-	0.08	∞	$3{\cdot}10^{-15}$
	1ES 0229+200	-	-	0.14	∞	$2{\cdot}10^{-15}$
	1ES 0229+200(B)	-	-	0.14	∞	$7{\cdot}10^{-14}$
	1ES 0347-121	-	-	0.188	∞	10^{-14}
	PKS 0584-322	-	-	0.069	∞	$5{\cdot}10^{-15}$
This work	HESSJ1943+213	1.5	2080	0.21	∞(8)	$6 \cdot 10^{-14}(6.5 \cdot 10^{-15})$

Further improvements and open questions

HESS J1943+213 looks promising, but

- Can we find more sources?
- Can we find better sources?
  Spectrum?
  Stability?
  Distance?
- Better modeling of the source?
- Better IGMF structure simulation (is it worth it?)