UHECR Interactions As The Origin of Very High-Energy γ-rays From BL Lacs

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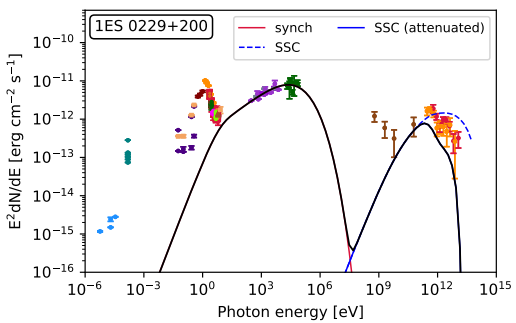
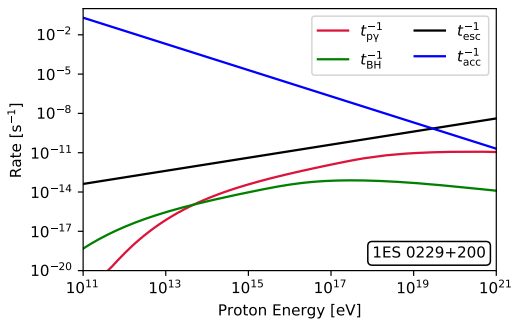
One-zone leptonic model



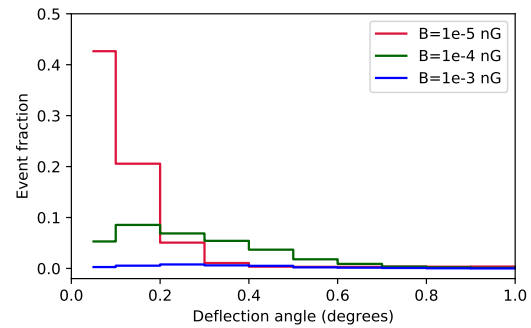
- $\gamma\gamma$ absorption & Klein-Nishina effect reduces the VHE γ-ray flux. One-zone modeling provides the jet parameters R, δ, B, Γ, $E_{e,\mathrm{max}}$

Accln & loss rates



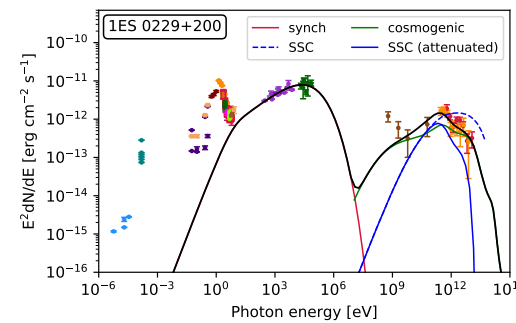
- The escape rate is higher than the energy loss rate for protons inside the jet, and lower than the acceleration rate up to $E_{p,\mathrm{max}} = 10^{19}$ eV

Deflections in EGMF



- A random turbulent EGMF with $\mathbf{B}_{\mathrm{rms}} \approx \mathbf{10^{-5}}$ nG constricts the UHECRs coming from 1 Gpc along the observer's line of sight.

Lepto-hadronic model



- High-energy peak is explained by a combination of SSC and line-of-sight UHECR interactions and we find that $L < L_{\mathrm{Edd}}$ in this model

Multi-messenger Implications:

- *The neutrino flux from individual BL Lacs obtained is too low to be detected by currently operating and upcoming future detectors*
- *For $E_{p,\mathrm{max}} = 10$ EeV and deflections in the EGMF and GMF, identifying UHECRs coming from individual BL Lacs will be difficult*

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