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the dark universe as seen from astroparticle propagation

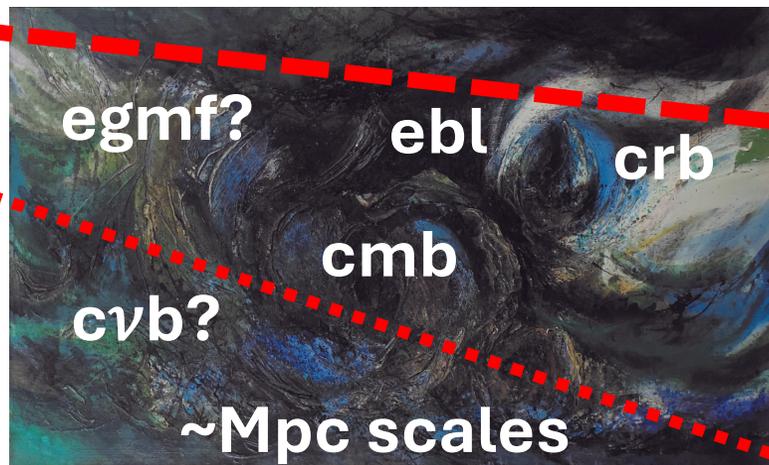
2° Undark School – LAPTh, Annecy – 03/2026

extreme
sources?

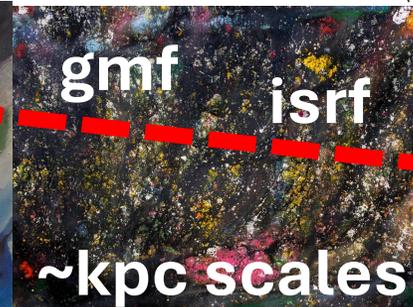
γ rays

neutrinos

dark matter or
exotic physics?



(H. Domoto)

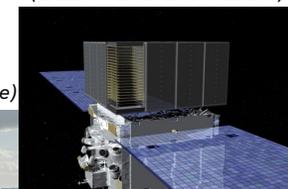


(F. J. Brown, «Milky Way», 1977)

(credit: LHAASO website)



(credit: Fermi-LAT website)



MC code to simulate
astroparticle propagation!

CR Propa

(credit: IceCube website)



spectral, spatial, compositional,
and/or temporal distortions in
observables?

e.g. simulating photon-ALP interconversion at gamma-ray energies in astrophysical environments

from the mixing theory...

$$\mathcal{L}_{\text{ALP}-\gamma} = g_{\text{a}\gamma\gamma} \mathbf{E}_\gamma \cdot \mathbf{B} a$$

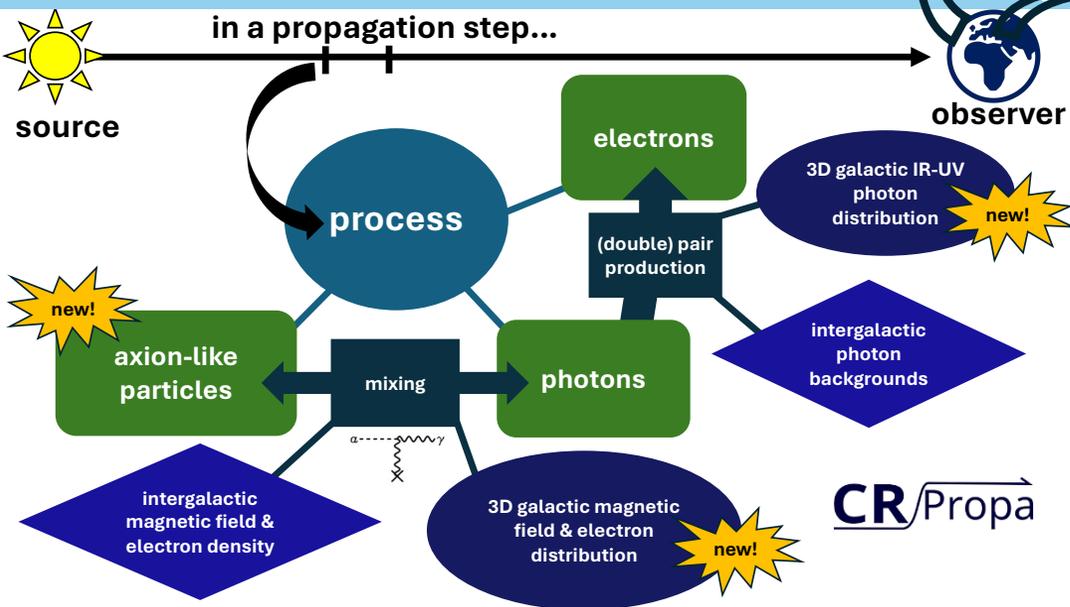
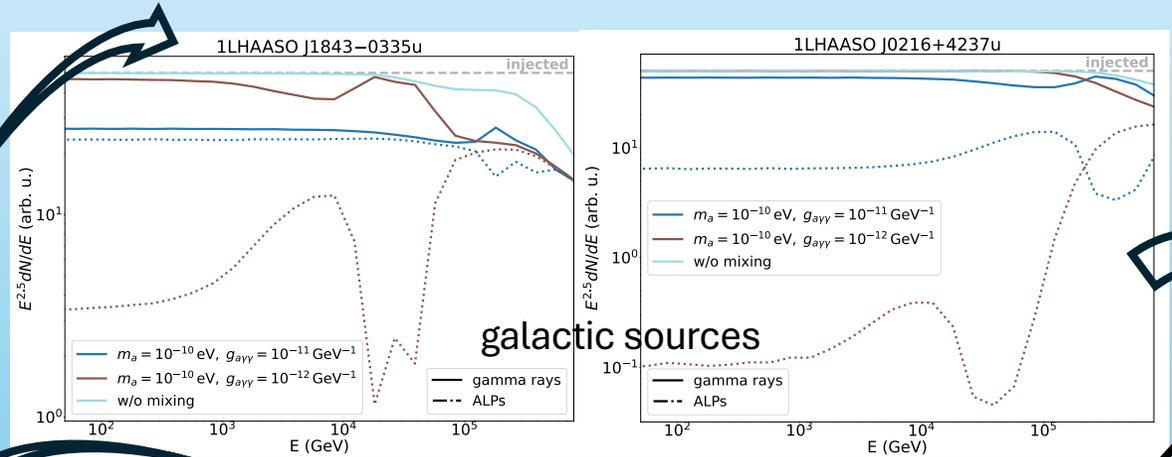
coupling constant

photon polarization

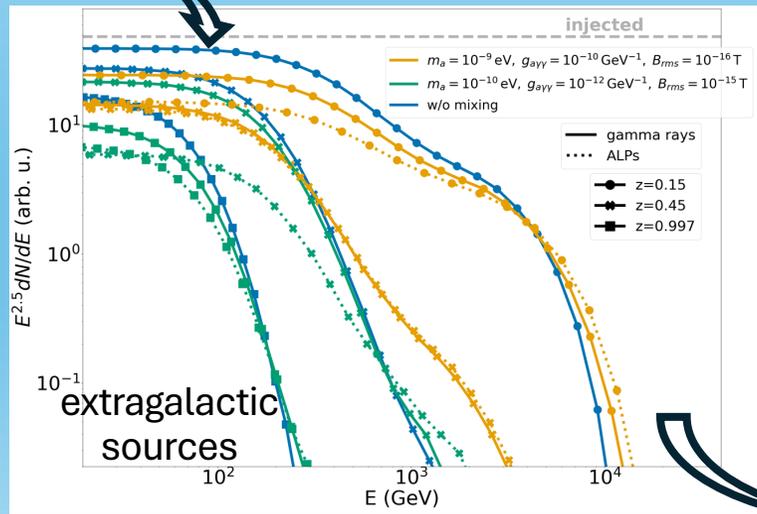
external magnetic field

axion-like particle field

... to the simulation framework



mixing during propagation...



comparing with detections to constrain $m_a, g_{a\gamma\gamma}$?

