Probing the Parameter Space of Axion-Like Particles Using Simulation-Based Inference

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Photons, ALPs & magnetic field

Photons can convert to ALPs by mixing induced in the external magnetic field – causing the so called "wiggles", irregularities in the spectra of astrophysical objects.



ALP Parameter Inference with Simulation-Based Inference (Neural Ratio Estimation)



Perseus cluster in X-ray. Credit: NASA, Chandra

CTAO



Define simulated spectra as a parameters of interest and nuisance parameters

Parameter of interest (Intrinsic + ALP)

ALP mass, *ma* (vary) ALP coupling to photons, *gaγ* (vary) NGC1275 intrinsic spectrum amplitude(fixed) NGC1275 intrinsic spectral index(fixed) NGC1275 intrinsic cut-off energy(fixed) Other Nuisance (fixed) Search for imprints of ALPs in the simulated spectrum of NGC 1275 γ-rays spectra (50 h of flaring states) × Instrument response (Prod5-North-20deg-AverageAz-4LSTs09MSTs.180000s-v0.1.fits.gz) × Absorption from EBL x

"Wiggles" from photon-ALP-oscillations

Is our network ready?

How to improve it further and how to apply it to real data?

Let's discuss all these at poster session B-<u>Thursday between 12 pm - 3 pm</u>



Poster ID: 72

