



Contribution ID: 206

Type: Talk

Searches for Axion-Like Particles with NGC1275: Observation of Spectral Modulations

Thursday 7 July 2016 17:30 (20 minutes)

Axion-like particles (ALPs) can induce localised $O(10\%)$ oscillatory modulations in the spectra of photon sources passing through astrophysical magnetic fields. Ultra-deep Chandra observations of the Perseus cluster contain over 5×10^5 counts from the central NGC1275 AGN and represent a dataset of extraordinary quality for ALP searches. We use these to search for X-ray spectral irregularities from the AGN. The absence of irregularities at the $O(30\%)$ level allows us to place leading constraints on the ALP-photon mixing parameter $g_{a\gamma\gamma} \sim 1.5 - 5.4 \times 10^{-12} \text{GeV}^{-1}$ for axion mass $m_a \sim 10^{-12} \text{eV}$, depending on assumptions on the magnetic field realisation along the line of sight. At $O(10\%)$ level two modulations are present at high statistical significance, an excess in the 2-2.2 keV region and a deficit at 3.4-3.5 keV. We are unable to account for these through conventional instrumental or astrophysical processes and, interpreted as a signal, they would correspond to an ALP-photon coupling in the range $g_{a\gamma\gamma} \sim 1 - 5 \times 10^{-12} \text{GeV}^{-1}$. This talk is based on 1605.01043.

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Session Classification: Dark Matter and Particle Astrophysics

Track Classification: Dark Matter and Particle Astrophysics