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

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Axion-like particles (ALPs) can induce localised  $\mathcal{O}(10\%)$  oscillatory modulations in the spectra of photon sources passing through astrophysical magnetic fields. Ultra-deep Chandra observations of the Perseus cluster contain over  $5 \times 10^5$  counts from the central AGN, NGC1275, and represent a dataset of extraordinary quality for ALP searches.

We use this dataset to search for X-ray spectral irregularities from the AGN. The absence of irregularities at the  $\mathcal{O}(30\%)$  level allows us to place leading constraints on the ALP-photon mixing parameter  $g_{a\gamma\gamma} \leq 1.5 - 5.4 \times 10^{-12} \text{GeV}^{-1}$  for  $m_a \leq 10^{-12}$  eV, depending on assumptions on the magnetic field realisation along the line of sight.

At  $\mathcal{O}(10\%)$  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  $g_{a\gamma\gamma} \sim 1 - 5 \times 10^{-12} \text{GeV}^{-1}$ .

### Summary

**Primary author:** RUMMEL, Markus

**Presenter:** RUMMEL, Markus

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