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Searching for axion dark matter with the MeerKAT Radio Telescope

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Axions provide a natural and well-motivated dark matter candidate, with the capability to convert directly to photons in the presence of an electromagnetic field. A particularly compelling observational target is the conversion of dark matter axions into photons in the magnetospheres of highly magnetised neutron stars, which is expected to produce a narrow spectral peak centred at the frequency of the axion mass. From 10 hrs MeerKAT radio telescope observations of the isolated neutron star J0806.4-4123 we obtain flux spectra in the frequency range 769-1051 MHz, finding no evidence of this phenomenon. We therefore constrain the Primakoff coupling of axion dark matter, $g_{a\gamma\gamma}\lesssim 6 \times 10^{-11}/GeV to 95% C.L., in the mass range 3.18-4.35 μeV. This result serves the strongest constraint in the mass range 4.2 - 4.35 μeV.

Presenter: HOUSTON, Nick (BJUT)

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