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Hunting for axions and axion-like particles with the nEDM and n2EDM experiments at PSI

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Ultralight Axions and axion-like particles are important dark matter candidates. If they are responsible for a significant proportion of dark matter, and are thus present in a large number density, they can be viewed as a galactic-scale classical field oscillating at a frequency proportional to their mass m_a. Interactions of a coherently oscillating axion dark matter field with gluons could then induce an oscillation in the neutron EDM. By using data from the nEDM experiment at the Paul Scherrer Institut this allows us to set laboratory constraints on the axion-gluon coupling.

We present a refined analysis of the data from the nEDM experiment at PSI which improves the limits on the oscillation amplitude, and thus coupling strength, by a factor of two for mass ranges between 10^{-24} eV $\leq m_a \leq 10^{-17}$ eV (corresponding to frequencies between $2{\cdot}10^{-8}$ Hz - $5{\cdot}10^{-5}$ Hz) compared to our previously published results. Furthermore, we will discuss progress and prospects in complementary (co-)magnetometry experiments and searches for axion-mediatied fifth-force effects in the same apparatus. Finally, we give predictions on the exclusion limits that will be achieveable with the data from the n2EDM experiment at PSI, which is expected to start data-taking in 2023.

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