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A new method with minimized systematic error sources to detect axion dark matter in storage rings using an rf Wien filter

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Axion, a hypothetical pseudo-scalar particle, is a direct consequence of Peccei-Quinn mechanism which was proposed to solve the strong CP problem in 1977. It is also a plausible candidate for dark matter. The axion feebly interacts with the Standard Model (SM) particles, which makes it extremely challenging to detect a sign of its existence. Nevertheless, there have been many efforts to search for the axion-SM interaction, the prevailing method among which is a cavity haloscope seeking for the axion-photon interaction, more suited for axion-frequencies above 100MHz. On the other hand, there is another branch of interaction, namely a coupling between the axion and the nuclear electric dipole moment (EDM), which induces an oscillating EDM at the axion Compton frequency. Storage ring EDM experiment provides a powerful method sensitive to a proton EDM as small as 10^{-29} e.cm. We extend the storage ring EDM concept to measure an oscillating EDM with a comparable sensitivity, by exploiting a new spin resonance scheme using an rf Wien filter. The new method does away with the severe spin resonance systematic error sources, by careful combination of frequencies used. We introduce this new method from a basic working principle to a projected sensitivity on the axion-EDM coupling constant.

In-person participation

Yes

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