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Probe Dark Matter Axions with Broadband and Narrowband methods

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The cosmological axions/axion-like particles can compose a significant part of dark matter, however the uncertainty of their mass is large. Here we propose to search the axions broadbandly using a cylindrical capacitor, in which the static electric field converts dark matter axions into an oscillating magnetic field. A superconductor ring-coil pickup system can further boost the sensitivity. This proposed setup is capable of wide mass range searches. On the other hand, The hyperfine splitting between the spin 0 singlet ground state and the spin 1 triplet state of hydrogen is $0.59 \times 10^{-5} \text{eV}$, which is close to the mass of the QCD dark matter axions. With some additional adjustment by the Zeeman effect, quantum transitions could be induced between these hydrogen states. We believe this method will be efficient for a narrowband search of the QCD axions.

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