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Millimeter-wave WISP search with lock-in Light-Shining-Through-a-Wall

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The millimeter-wave photons are a crucial tool to address axion-like particles in the meV mass range, which is motivated in the post-inflationary scenario of axion. This mass range is the least constrained in the dark photon search as well. In dark matter halo WISPs search, it was reported that single photon sensors overwhelm the sensitivity of quantum-limited coherent detectors if the photon frequency is over 10 GHz. This is because the signal bandwidth is limited to Q~1e6 from the Maxwell Boltzmann distribution of dark matter halo. However, in the Light-Shining-Through-a-Wall (LSW) type experiments, one can phase-lock the coherent detectors to the generator so that the relative optical coherency becomes extremely high. Therefore, the signal bandwidth of LSW experiments can be several orders of magnitude higher than halo or solar WISPs search and the signal-to-noise ratio of the classical coherent method can surpass the single photon sensor. In this talk, we describe the implementation of the coherent detection method in the 30 GHz LSW method and show the results of proof-of-principle experiments. An EMC/EMI strategy to avoid cross-talks around 30 GHz is also presented. The expected search range is around the dark-photon mixing parameter of 1e-8 in the mass range of 1e-4 eV.

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