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STAX: a new technique for detecting Axions (15' + 5')

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We propose a new improved detection scheme for axion-like particles search based on a Light-Shining-Through-Wall (LSW) experiment in a photon frequency domain never explored before. We expect to extend the present exclusion limits on the axion-photon coupling constant, Gaγγ, by at least four orders of magnitude with respect to the present limits from similar configuration experiments, as we have proved by explicit calculations. [Capparelli, Cavoto, Ferretti, Giazotto, Polosa, Spagnolo, arXiv1510.06892]
Axions appear in very well motivated extensions of the Standard Model, including the Peccei-Quinn mechanism proposed to solve the long-standing strong-CP problem. Together with the weakly interacting massive particles of supersymmetric theories, axions are also a favored candidate to puzzle out the Dark Matter issue. There are three classes of experiments searching for axions: haloscopes, helioscopes and laboratory searches, including LSW experiments. Among these different approaches, the LSW seems to be the most effective, since it is not depending on stellar and astrophysical models and allows a higher axion flux. The photon-axion conversion rate is independent of the energy in our search range and the double conversion rate of the LSW experiments depends only on luminosity, i.e. from the number of photons produced by the source before the wall, and the magnetic field (intensity and extension). The best photon sources currently available on the market, the gyrotrons, operate typically below the THz region, namely between 30 GHz and 1THz, and may exceed an output power of 1 MW. In these microwaves region, a single photon detection is extremely difficult and this is the reason why LSW experiments never operated in this range. Nevertheless, a LSW experiment in this microwave range could increase the sensitivity of the axion search by several orders of magnitude with respect to the current exclusion limits of this class of experiments. We suggest a new technique, based on transition-edge-sensors (TES), operating below 10mK temperature to detect single photons with an energy of 30-100 GHz, where gyrotrons sources have the highest power in output.

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