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Inferences on the Axion Mass through the Maximum Entropy Principle

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We present a formulation of the Maximum Entropy Principle (MEP) that has provided a precise theoretical determination of the Higgs boson mass, within the context of the Standard Model. Motivated by this result we use MEP to infer the axion mass, taking into account a generic low energy effective theory with an axion-neutrino interaction, in addition to the typical axion-eletromagnetic field interaction. Under the assumption that the axion decay into a pair of photons and also into pairs of neutrinos, we construct, from its branching ratios, the Shannon entropy function associated to an initial ensemble of axions. Two cases are considered for inferring the mass of the axion if it can decay into all the three neutrinos, in addition to photons. The first assumes MEP fixes all the free parameters, and leads to the infered interval 0.1 eV<m_A<0.2 eV for the axion mass. The second assumes that only the axion mass is fixed by MEP, and leads to the interval 0.1 eV<m_A<6.3 eV, taking into account a DFSZ type model with right-handed neutrinos plus the astrophysical bounds on the axion mass. Both mass intervals are derived using the mass squared differences determined by the data on the neutrinos oscillations, along with cosmological bound on the sum of the neutrinos mass. Moreover, MEP determines a viable dark matter candidate light axion if it is allowed to decay into photons and the lightest neutrino only.

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