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Constraints on Axions from Cosmic Distance Measurements

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Axion couplings to photons could induce photon-axion conversion in the presence of magnetic fields in the Universe. The conversion could impact various cosmic distance measurements such as luminosity distances to type Ia supernovae and angular distances to galaxy clusters in different ways. We consider different combinations of the most updated distance measurements to constrain the axion-photon coupling. Ignoring the conversion in intracluster medium (ICM), we find the upper bounds on axion-photon couplings to be around $5 \times 10^{-12}\ (\mathrm{nG}/B)\ \mathrm{GeV}^{-1}$ for axion mass below 5×10^{-13} eV, where B is the strength of the magnetic field in the intergalactic medium (IGM). When including the conversion in ICM, the upper bound gets stronger and could be as strong as $5 \times 10^{-13}\ \mathrm{GeV}^{-1}$ for $m_a < 5 \times 10^{-12}$ eV. While this stronger bound depends on the ICM modeling moderately, it is independent of the IGM parameters.

Summary

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