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Hunt for axions with high-energy astrophysical neutrinos

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Neutrinos are elementary particles with unique properties that make them ideal probes of new physics beyond the Standard Model. The highest-energy neutrinos known, produced in astrophysical phenomena, offer us an opportunity to look for new fundamental particles at energies not reached by particle accelerators on Earth. One possible new particle is the axion, originally postulated as a solution to the strong CP problem of the Standard Model, and, also, a dark matter candidate. We investigate the potential existence of the axion indirectly: as the high-energy astrophysical neutrinos travel billions of light-years on their journey towards the Earth, they might encounter a cosmic background of axions. If a neutrino-axion interaction happens, it will leave characteristic features like bumps and dips in the shape of the neutrino energy spectrum. We search for these features in astrophysical high-energy neutrino events detected by the IceCube neutrino telescope. The method allows us to look for tiny coupling strengths and axion masses down to 10^{-11} eV. Our preliminary findings are promising, since current IceCube observations seem to be able to constrain the existence of neutrino-axion couplings in a sizable part of the model parameter space.

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Field of study

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