

Axion signatures from supernova explosions through the nucleon electric-dipole portal

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We consider axions coupled to nucleons and photons only through the nucleon electric-dipole moment (EDM) portal. This coupling is a model-independent feature of QCD axions, which solve the strong CP problem, and might arise as well in more general axion-like particle setups. We revise the supernova (SN) axion emission induced by the nucleon EDM coupling and refine accordingly the SN 1987A bound. Furthermore, we calculate the axion flux from a future Galactic SN and show that it might produce a peculiar and potentially detectable gamma-ray signal in a large underground neutrino detector such as the proposed Hyper-Kamiokande. The possibility to detect such a signal offers a way to search for an oscillating nucleon EDM complementary to CASPERe, without relying on the assumption that axions are a sizeable component of the dark matter. Furthermore, if axions from SN produce an observable signal, they could also lead to an amount of cosmological extra-radiation observable in future cosmic surveys.

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