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

Based on G.L., L. Mastrototaro, P. Carenza, L. Di Luzio, M. Giannotti, A. Mirizzi, PRD 105 (2022) 12, 123020, ArXiv:2203.15812 [hep-ph]
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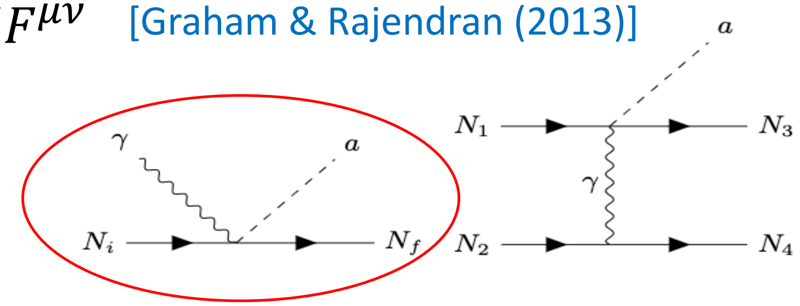
$$\mathcal{L}_a^{nEDM} = -\frac{i}{2} g_d a \overline{N} \gamma_5 \sigma_{\mu\nu} N F^{\mu\nu}$$ [Graham & Rajendran (2013)]

In a supernova, Compton is the dominant production process.

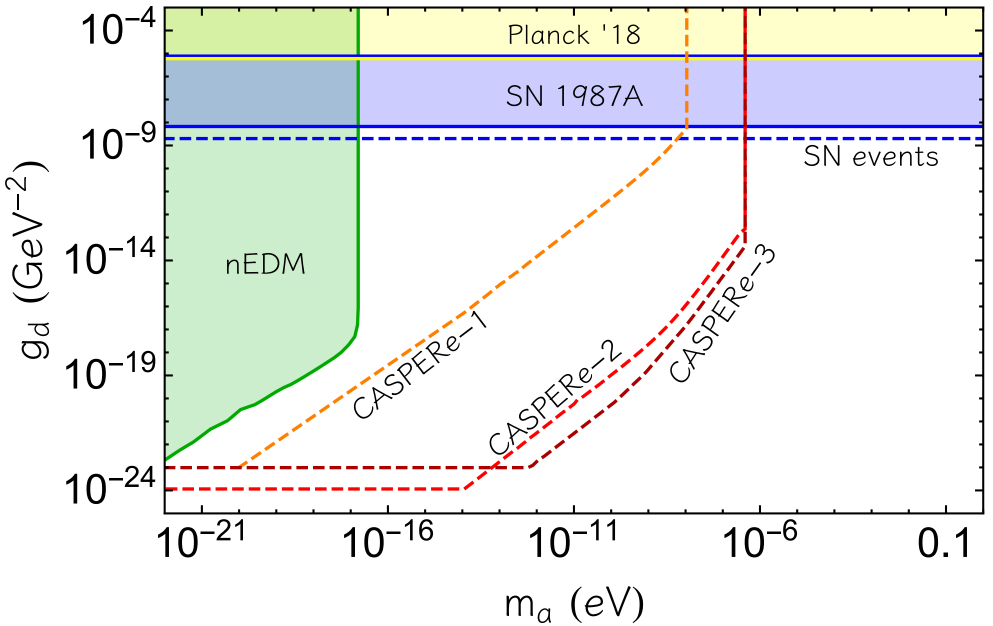


SN 1987A COOLING BOUND

Observation of SN 1987A can constrain exotic energy losses. [Ellis & Olive (1987) , Raffelt & Seckel (1988)]

Axion emission must not shorten the duration of the neutrino burst ➡ Bound on the axion luminosity:

$L_a \lesssim 3{\times}10^{52}$ erg/s at 1 s after core bounce



DETECTION PERSPECTIVES

For $g_d \gtrsim 2\times10^{-9}\ \mathrm{GeV}^{-2}$ axions can be detected in future neutrino detectors.

Detection possibility complementary to *CASPERe* experiment. [Jackson Kimball et al., (2020)]