

QCD axion couplings at finite density

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The QCD axion is one of the best motivated particles for physics beyond the Standard Model (SM) with a phenomenology mainly controlled by the unknown axion decay constant f_a which determines its mass m_a as well as its couplings to SM fields. The strongest bound on the mass of the axion is obtained by energy loss arguments from observation of the supernova SN1987A, where the dominant process of axion production is the one-pion-exchange (OPE). In the extreme environments found in SN and NS density corrections to this process play a significant role.

In our study we systematically determine the density dependence of the $N + N \rightarrow N + N + a$ process in heavy baryon ChPT at finite density and calculate the axion-nucleon vertex corrections at one loop order. We show that the axion emission from SN and NS is significantly changed due to finite density effects and discuss the resulting implications including an updated bound on the axion mass m_a .

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