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Effects of dynamo-enhanced magnetization and oscillations in supernova neutrino energy spectra

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Neutrinos emitted during the gravitational core collapse supernova are the most direct probe of processes in the stellar interior which are inaccessible to electromagnetic observations. Interpretation of signals from future flares by, e.g., JUNO, DUNE, IceCube-Gen2, KM3NeT, Baikal-GVD detectors, requires consideration of a complex set of physical effects [1] including generation of ultra-strong magnetic inductions, nonlinear evolution of neutrino fluxes etc. In this work we analyse neutrinos bursts emitted by a protoneutron star at supernova explosion taking into account effects of magnetization and oscillations. The neutrino acceleration near the neutrino sphere due to nuclear scattering caused by the Gamow-Teller neutral current interaction is shown. The effect of oscillations in the outer layers of stars significantly enhances the hardness of the spectrum of electron antineutrinos. Such an enhancement of the high-energy spectrum component is particularly pronounced for the inverted mass ordering and favorable for ground-based detection of supernova neutrinos. The possibilities of Cherenkov underwater detectors – KM3NeT and Baikal-GVD – for observation of supernova neutrinos and revealing the mass ordering are discussed.

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