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Collective Flavor Oscillations For Supernova Neutrinos and r-Process Nucleosynthesis

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The effect of collective flavor oscillations of neutrinos driven by neutrino-neutrino interaction at the very high density region of core collapse supernovae controls
the emitted flux of neutrinos of different flavors. In the process one or more
swaps of the flavors for both neutrinos and antineutrinos take place depending on the initial neutrino flux and distributions, particularly for the inverted mass hierarchy. We study the effect of this on the possibility of having a neutron-rich region compatible with r-process nucleosynthesis. The minimal requirement
for r-process is the electron-to-nucleon ratio Ye < 0.5, but a more favorable condition may be Ye < 0.45 . In this work we consider a two
flavor model, with e-type and x-type neutrinos along with their antiparticles and with the oscillation parameters mass squared difference = 0.003
eVˆ2 in agreement with realistic 1–3 mixing and a small effective mixing angle
of 0.00001 . As in supernovae the four species, mu and tau type neutrinos and
antineutrinos have identical spectra, this study itself may give indications of the real situation. Different models of neutrino energy distributions are used. For each of the distributions initial fluxes of different flavors are varied and exclusion plots for these initial neutrino fluxes show the allowed regions for r-process nucleosynthesis .The electron fraction(Ye) as a function of the
radius of the core is calculated and it shows an oscillatory behavior in the bipolar region before saturating to a constant value. This shows that for the allowed fluxes one gets neutron-rich regions for r-process in the neutrino driven wind.But other considerations of baryon density and entropy in these regions need to be studied.

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