Effects of neutrino oscillation on supernova neutrino: inverted mass hierarchy

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We study the effects of neutrino oscillation on supernova neutrino in the case of the inverted mass hierarchy ($m_3 \ll m_1 < m_2$). This is an extended study of our previous study[2] where all analyses are performed with normal mass hierarchy ($m_1 < m_2 \ll m_3$). Numerical analysis using a realistic supernova and presupernova model allow us to discuss quantitatively a possibility to probe neutrino oscillation parameters and mass hierarchy. We show that we can break the degeneracy of the solar neutrino problem and probe the magnitude of θ_{13} to some extent by the ratios of high-energy events and low-energy events at SuperKamiokande and SNO, R(SK) and R(SNO), respectively, and the presence of the Earth effects. Further, if the magnitude of θ_{13} is known roughly, we can identify the mass hierarchy.

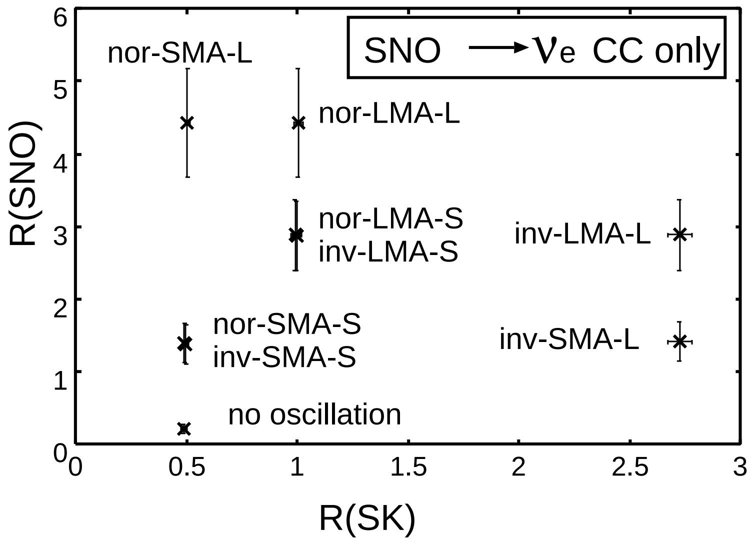

Figure 1: Plot of $R_{\rm SK}$ vs $R_{\rm SNO}$. Only $\nu_e d$ CC events at SNO are considered for $R_{\rm SNO}$. R(SK) and R(SNO) are the ratios of high-energy events ($>$ 25 MeV) and low-energy ($<$ 25 MeV) events at SuperKamiokande and SNO, respectively. As for the names of the models, for example, inv-LMA-L means that solution of the solar neutrino problem is set to LMA, θ_{13} is rather large (near the upper bound) and the mass hierarchy is inverted.

References

[1] K. Takahashi and K. Sato, submitted to Phys. Rev. D.
[2] K. Takahashi, M. Watanabe, K. Sato and T. Totani, Phys. Rev. D **64** (2001) 093004.