Contribution ID: **56** Type: **Oral**

The effects of an extended neutrino sphere on supernova neutrino oscillations

Monday, 2 July 2018 14:30 (30 minutes)

The neutrino flavour evolution in a supernova can be described either in terms of neutrino fields or as the evolution of individual neutrinos. There is no reason to think that the two approaches should give contradicting results, and both have their advantages. One of the advantages of using individual neutrinos is that it becomes clear that the finite width of the neutrino sphere must lead to averaging over the oscillation phase due to the different emission points, and therefore to a reduction of the effective mixing angle. This very significant effect is usually ignored in the literature. In this talk, I will explain the details of the argument and interpret it in terms of the density matrix formalism by taking into account the often neglected collision term.

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Session Classification: Parallel Session 1-5