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Supernova neutrino distribution: correlation of fit parameters with hydrodynamic spatial scales

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The minimum analytical model describing the neutrino radiation at conditions of core-collapse supernova, is considered. We find that such model contains four parameters. Each of these parameters depends on the radial coordinate and time. In addition, the numerical values of individual parameters have a large spread of values and significantly depend on the hydrodynamics of the explosion. Thus, it is important not only for finding neutrino parameters within the one of the supernova explosion models, but also the their generalization for other explosion models. For this purpose, we use results of the one-dimensional simulation of neutrino propagation, performed self-consistently with hydrodynamics in Prometheus-Vertex code. Both neutrino parameters and characteristic hydrodynamic scales were obtained for progenitor from 11.2 to 25 Solar masses at different times after a bounce. It is shown, that in the outer part of the supernova the angular distribution parameter of the neutrino correlates with the protoneutron star radius. In this region, the energy parameters can be considered as constant in radial coordinate. Fourth parameter can be fixed by the supernova neutrino luminosity. Thus, the proposed approach allows to obtain the radial dependence of the modeling parameters of neutrino radiation in various explosion models. Moreover, in the outer part the neutrino radiation is determined by four global parameters of the supernova: the protoneutron star radius, the neutrino luminosity, average neutrino energy and the width of the spectral distribution.

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