A multidimensional implementation of the Advanced Spectral neutrino Leakage scheme

JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

ID 4527927
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Year 2019
Title A multidimensional implementation of the Advanced Spectral neutrino Leakage scheme
Journal Monthly Notices of the Royal Astronomical Society
Volume 490
Number 3
Pages / **Article-Number** 4211-4229
Keywords astrophysics, hydrodynamics, neutrinos, radiative transfer, neutron stars, supernovae
We present a new, multidimensional implementation of the Advanced Spectral Leakage (ASL) scheme with the purpose of modelling neutrino-matter interactions in neutron star mergers. A major challenge is the neutrino absorption in the semitransparent regime, which is responsible for driving winds from the merger remnant. The composition of such winds is crucial in the understanding of the electromagnetic emission in the recently observed macronova following GW170817. Compared to the original version, we introduce an optical-depth-dependent flux factor to model the average angle of neutrino propagation, and a modulation that accounts for flux anisotropies in non-spherical geometries. We scrutinize our approach by first comparing the new scheme against the original one for a spherically symmetric core-collapse supernova snapshot, both in 1D and in 3D, and additionally against a two-moment (M1) scheme as implemented in 1D into the code GR1D. The luminosities and mean energies agree to a few per cents in most tests. Finally, for the case of a binary merger remnant snapshot we compare the new ASL scheme with the M1 scheme that is implemented in the Eulerian adaptive mesh refinement code FLASH. We find that the neutrino absorption distribution in the semitransparent regime is overall well reproduced. Both approaches agree to within <15 per cent for the average energies and to better than <35 per cent in the total luminosities.
Publisher Oxford Academic
ISSN/ISBN 0035-8711
URL https://academic.oup.com/mnras/article/490/3/4211/5594017
edoc-URL https://edoc.unibas.ch/75171/
Full Text on edoc No;
Digital Object Identifier DOI 10.1093/mnras/stz2911
ISI-Number WOS:000503993100081
Document type (ISI) Article