The ν process in self-consistent supernova simulations

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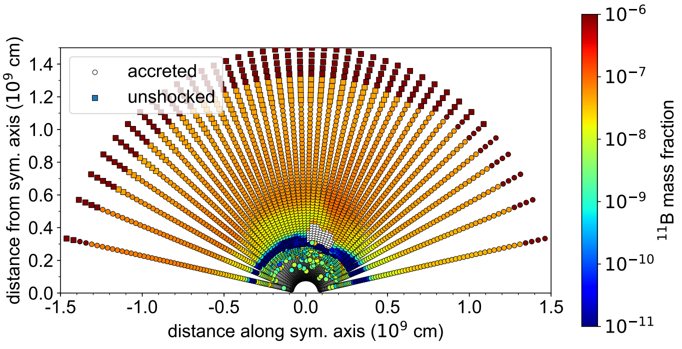
Neutrinos play a curcial role for core-collapse supernova explosions and their nucleosynthesis. All flavors of neutrinos are emitted from the hot and dense environment of a collapsing massive star in such tremendous numbers that they not only help to revive the explosion shock wave but also affect the composition of the outer layers of the star that have been chemically enriched during the life of the progenitor star. The neutrinos carry high energies compared to the thermal energies encountered in the stellar mantle and can either be captured on nuclei in an inverse β decay or induce spallation reactions, i.e. lead to nuclear excitations that decay by particle emission. The effect of these interactions on the final composition of the ejecta is called the ν process and has been suggested to contribute to the production of ^{7}Li, ^{11}B and ^{19}F as well as ^{138}La and ^{180}Ta [1]. For the first time we have investigated this process with a set neutrino-nucleus cross sections for all nuclei in the reaction network, including multi-particle emission channels and based on experimental data where available. We have explored a range of 1D models of piston driven explosions and for tracers from 2D self-consistent simulations [2]. This allows us to study the ν process with neutrino properties that are consistent with the explosion and we find that the time dependent realistic neutrino properties have important effects on ν process nucleosynthesis and might provide the key to reconcile a low production of ^{11}B with sufficiently high yields of ^{138}La and ^{180}Ta to explain their solar abundances.

The figure shows the ^{11}B mass fraction for tracers from a 2D supernova simulation that allows us to study the ν process in the innermost ejecta where the neutrino fluxes are very high. We find contributions to the yields of ^{7}Li, ^{11}B and ^{36}Cl.



References

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