General Poster

PUSH: 1D CCSN models for nucleosynthesis calculations

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After several decades of intense modeling, the detailed description of the explosion mechanism of core collapse supernovae (CCNS) remains elusive. It is well established that the gravitational collapse of the iron core of a massive star leads to the formation of a proto neutron star, and of an outgoing shock wave. However, this wave is predicted to stall inside the core, due to the energy loss in nuclei dissociation and neutrino (ν) emission. Detailed multidimensional models suggests that neutrino re-absorption behind the shock front, aided by multidimensional fluid instabilities, can revive the shock. However, the high computational complexity of these models and the missing consensus among different simulations still prevent the possibility to perform broad parameter space exploration, for example, in mass and metallicity of the progenitor stars. Relevant astrophysical questions, like which are explosive nucleosynthesis yields of such stellar explosions, or what are the properties of the compact remnants, require broad parameter studies and, as a consequence, physically motivated, but computationally feasible exploding models. PUSH is a spherically symmetric (1D) model of CCSN explosions which employs general relativistic hydrodynamics, spectral ν transport and microphysical equation of states. Differently from previous 1D explosion models (like piston or thermal bomb models), it uses artificially enhanced ν heating to revive the shock and it evolves the electron fraction (a crucial parameter for the nucleosynthesis) with more accuracy for tens of seconds after the shock revival. The free parameters of the model have been calibrated to reproduce the observables of the nearby supernovae 1987A. In this poster, we will present the model and the calibration procedure. Furthermore, we will discuss the potentialities of PUSH to predict explosive nucleosynthesis yields for large sets of progenitors.