Nucleosynthesis in neutron rich neutrino-driven winds: Impact of \((\alpha,n)\) reactions on abundances from Sr to Ag

Jorge Pereira\(^1,2\), Almudena Arcones\(^3\), Fernando Montes\(^1,2\)

\(^1\) National Superconducting Cyclotron Laboratory, Michigan State University, East Lansing, MI 48824, USA
\(^2\) Joint Institute for Nuclear Astrophysics, http://www.jinaweb.org
\(^3\) Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Germany
\(^4\) GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt, Germany

Neutrino-driven winds from nascent neutron stars following Supernovae explosions have been proposed as a possible source of “light” r elements (from Sr through Ag with \(A\sim88\)-110). In these events, \((\alpha,n)\) reactions occurring after the temperature has dropped out of nuclear statistical equilibrium are key to move matter beyond the so-called iron group towards the region of heavier proton number.

Due to the lack of experimental measurements, the relevant reaction rates have mostly (if not exclusively) been calculated with codes based on the statistical Hauser-Feshback model. Although these codes have been satisfactorily cross checked with experimental data in regions near stability, their accuracy is more questionable as one moves towards more exotic regions where no experimental information is available.

We have investigated the sensitivity of reaction models to different nuclear-physics “inputs” (alpha potentials, masses, level densities, etc.). We have also evaluated the uncertainty of the rates by comparing the results obtained using different models to calculate these “inputs”. Finally, we have identified the most important \((\alpha,n)\) reactions in the synthesis of elements between Sr and Ag.

This work was supported by the America National Science Foundation grants PHY 08-22648 (JINA), PHY 01-10253, the Deutsche Forschungsgemeinschaft through contract SFB 634, ExtreMe Matter Institute EMMI, and the Swiss National Science Foundation