Improved predictions of nuclear reaction rates for astrophysics with the TALYS reaction code

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(Dated: November 1, 2008)

Nuclear reaction rates for astrophysics applications are traditionally determined on the basis of Hauser-Feshbach reaction codes which make use of a number of approximations that have never been tested, such as a simplified width fluctuation correction, the neglect of delayed or multiple particle emission during the electromagnetic decay cascade, or the absence of the pre-equilibrium contribution at increasing incident energies.

Thanks to the developments brought to the TALYS reaction code, in particular to estimate Maxwellian-averaged reaction rates, we can now predict with an increased accuracy and reliability those of astrophysical relevance and test the aforementionned approximations. We show that TALYS predictions may significantly differ from those obtained with other codes, in particular for nuclei for which no or little nuclear data is available. Also, the pre-equilibrium process is shown to influence the astrophysics rates of exotic neutron-rich nuclei significantly. Finally, the Maxwellian-averaged (n,2n) reaction rate is calculated for all nuclei and its competition with the radiative capture rate discussed.