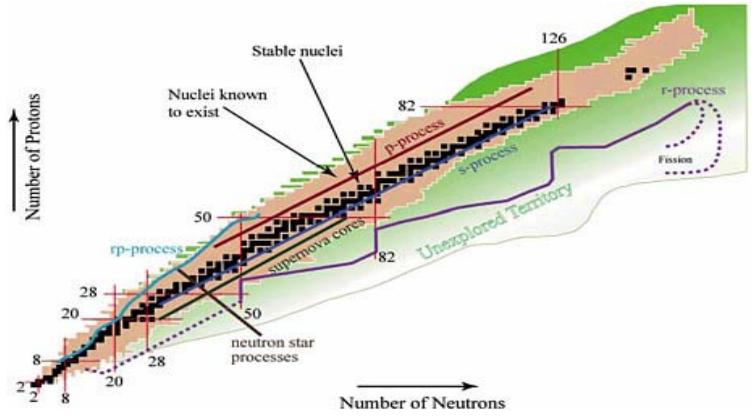
Light sd-Shell Neutron Capture



Neutron capture reactions play a significant role in nuclear astrophysics. It is through the process of rapid and slow capture of neutrons that the vast majority of the elements above iron are produced. While detailed neutron capture measurement data are available for most of the stable elements, considerable uncertainties are associated with neutron capture reactions with unstable neutron rich nuclei. In particular neutron capture on light neutron rich sd-shell may play a critical role for r-process nucleosynthesis in core collapse supernovae [1] as well as for n capture processes in the deeper crust of accreting neutron stars where a large flux of neutrons is released by electron induced transformation of rp-process ashes to the neutron drip line [2].

We have calculated the strength of resonant and non-resonant neutron capture reaction components using the OXBASH shell model [3]. For the calculation of level parameters we used a new nucleon-nucleon interaction developed specifically for neutron rich nuclei. With this approach a set of neutron capture reactions is being calculated for light neutron rich B to Mg isotopes from stability to the neutron drip line. The predictive power of the shell model approach and the reliability of the resulting rates are being tested by comparison of the predicted cross section with results of experimental studies of neutron capture on neutron rich stable nuclei.

The aim of this project will be to incorporate the new (n,γ) theoretical calculations in to a neutron star crust network code. Combining the (n,γ) rates with the already present newly calculated electron capture and pycnonuclear rates will provide the most complete picture of what a neutron star crust is made from.

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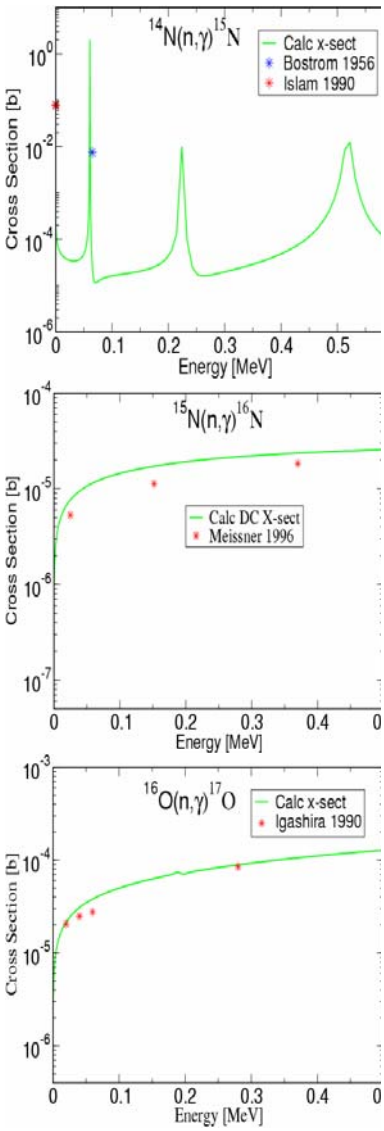

Calculated cross sections compared to experimental data for a few of the sd-shell nuclei considered. Once the formalism has been established, it can be used to calculate cross sections (and hence reaction rates) for many neutron rich systems of interest.

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