



Old Dominion University

Department of Physics

Colloquium

Tuesday, March 29, 2016

" The origin(s) of the heavy elements and what can nuclear physics say about it? "

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The NRC report "Connecting Quarks to the Cosmos" identified eleven of the most challenging open questions for all of physics in the 21st century. One of these eleven questions includes the identification of the site(s) for the production of the heaviest elements found in nature. Most of the elements above Fe are thought to have been produced by either the slow (s-process) or rapid (r-process) capture of neutrons in astrophysical environments. The s-process proceeds close to stability and astrophysical sites have been identified, while the r-process allows the production of nuclei much further from stability and potential sites remain unresolved.

Nuclear masses, beta-decay rates, and neutron-capture cross-sections play an important role in identifying the astrophysical constraints for a possible site for the r-process. Many of the nuclei that may be involved in an r-process lie far from stability and themselves present a challenge and impetus to experimental nuclear physics. The challenge is predominantly in the development of new facilities that can reach ever more exotic nuclei and the associated detection developments and techniques to detect ever fewer events in difficult measurements. Nuclear mass models and mass measurements have a pivotal role in both the impetus side of experiments and the simulation/constraint side of astrophysical site calculations. We have recently reported¹ on the sensitivities of the r-process to nuclear masses, n-capture rates, beta-decay rates, and beta delayed neutron emission probabilities under various astrophysical trajectories. These sensitivity studies have now for the first time have been carried out with the propagation of an individual mass uncertainty in a correlated way. We identify key nuclei in the study whose mass has a substantial impact on final r-process abundances and thereby set strict constraints on the astrophysical trajectories that have been considered while highlighting the nuclei that could be measured at existing and future radioactive beam facilities.

Presentation: **OCNPS 200 @ 3:00 pm**
Refreshments: **OCNPS Atrium @ 2:30 pm**

All interested persons are cordially invited to attend.