Contribution ID: **1** Type: **not specified**

Astrophysics using Radioaluminum beams at REX-ISOLDE

Wednesday, 8 February 2006 16:40 (30 minutes)

This project involves two main components, namely the development of a ISOLDE production target (or targets) for the release of short-lived proton and/or neutron-rich aluminum isotopes, and to subsequently to use such beams, e.g. 25,26mAl to initiate a program in nuclear astrophysics using REX-ISOLDE involving particle transfer reactions and elastic/inelastic scattering reactions. Of particular interest are studies related to radiative proton capture reactions on 25,26mAl. These are considered of importance for the production/destruction of the gamma observable (using satellite detection systems) radioisotope, 26Al. Production of neutron-rich beams can be used for appropriate decay studies of key isotopes.

Summary

An important question in nuclear astrophysics is what is the production site of the gamma observable isotope, 26Al, in the universe. Proposed sites include core collapse supernovae, ONe novae, Wolf-Rayet stars and Asymptotic Giant Branch stars. A large uncertainty in determining the production rate are due in part to the uncertainties in key nuclear reactions, namely 26g,mAl(p,g)27Si and 25Al(p,g)26Si. These are part of the production and destruction sequence for 26Al in such environments. Recently the 26gAl((p,g)27Si reaction was measured directly in inverse kinematics with an intense 26gAl beam (~5x109/s) and using the DRAGON facility at ISAC. However, the Al production target released aluminum relatively slowly which reduced significantly the intensity of the much shorter 25,26mAl isotopes. Given a relatively intense beam (>10e7 /s) of either isotope at ISOLDE, elastic scattering and particle transfer reactions could be performed which could be of importance to determining key parameters of these radiative capture reactions. This project involves two proposals, namely, the first to perform target R&D studies to obtain an appropriate, fast releasing aluminum production target, and the second, to initiate the development and use of appropriate detection systems to perform appropriate elastic scattering and perhaps transfer reaction studies at REX-ISOLDE with beams of 25,26mAl (as available). This nuclear astrophysics project is of interest to a new collaboration of scientists. Such developments can also lead to the development of a neutron rich production target which could be used to study decays of key neutron-rich isotopes of aluminum.

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Session Classification: Nuclear Physics IV