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Radioactive ion beams for nuclear astrophysics at Texas A&M University

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We have developed indirect techniques to determine reaction rates at stellar energies for radioactive nuclei that are important in stellar evolution. The work to date has focused on measurements that are relevant for (p,gamma) reactions. The techniques that we have developed include determinations of Asymptotic Normalization Coefficients from transfer reactions to fix direct capture reaction rates and measurements of beta-delayed proton decay to determine resonances near the proton threshold.

Most of the work done at TAMU has used secondary radioactive beams that have been produced in-flight with stable beams from our K500 superconducting cyclotron, and then separated from other reaction products by our recoil mass spectrometer MARS. This technique leads to secondary beams that have a rather broad energy and angular acceptance. Thus the experiments that can be carried out with them are limited.

A facility upgrade began at the TAMU Cyclotron Institute in January, 2005, that will soon allow us to produce accelerated radioactive beams. The radioactive ion beams will be produced by accelerating, in our K500 superconducting cyclotron, radioactive ions that will be produced by intense particle beams from our K150 cyclotron. This will lead to ion beams with very small energy spread and low emittance. The re-accelerated beams will then be used to extend our indirect measurements for nuclear astrophysics to heavier radioactive nuclei.

In the presentation, I will first describe the recent work that we have been doing related to nuclear astrophysics. I will then give an overview of the upgrade project along with projections for accelerated secondary beams that will be produced following the upgrade. Finally I will discuss how we plan to use the accelerated beams to extend our determinations of (p,gamma) reaction rates for nuclei that participate in the rapid proton capture (rp-)process.

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