NEW MEASUREMENTS FOR THE ASTROPHYSICALLY IMPORTANT $^{40}Ca(\alpha,\gamma)^{44}Ti$ REACTION

Abstract

by

Daniel Robertson

The short-lived ^{44}Ti radionuclide is an important signature of explosive nucleosynthesis in core-collapse supernovae. Direct detection in the supernova remnant Cassiopeia A, and the expected production in the innermost layers of a supernova event, allows the extraction of important information concerning explosive nucleosynthesis. A new measurement of the $^{40}Ca(\alpha,\gamma)^{44}Ti$ reaction has been performed through two different experimental approaches. An excitation curve measurement was performed over the energy range $E_{\_}$ = 4600 - 3000 keV, using α-particles incident on a ^{40}Ca target. This measurement was used to aid in the commissioning of a new accelerator mass spectrometry (AMS) facility developed during this work, at the University of Notre Dame. Using this facility, a series of ^{44}Ti activation measurements using a ^{40}Ca beam incident on a ^{4}He gas target, were performed and measured, all within the same E_{α} = 4600 - 3000 keV energy range. A new reaction rate has been derived from the resultant excitation curve. This has increased the expected yield of ^{44}Ti in proposed supernova environments by 40 % from previous prompt γ-ray measurements. The strong correlation between this experimental data and that collected from the newly formed AMS facility,

successfully commissions the facility for use in the measurement of reaction cross-sections of astrophysical interest.