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Optimization of the Efficiency of a Neutron Detector to Measure (α, n) Reaction Cross-Section[1] JESUS PERELLO, Florida Intl Univ, FERNANDO MONTES, TONY AHN, National Superconducting Cyclotron Laboratory, ZACH MEISEL, Michigan State University, JOINT INSTITUTE FOR NUCLEAR ASTROPHYSICS TEAM — Nucleosynthesis, the origin of elements, is one of the greatest mysteries in physics. A recent particular nucleosynthesis process of interest is the charge-particle process (cpp). In the cpp, elements form by nuclear fusion reactions during supernovae. This process of nuclear fusion, (α,n), will be studied by colliding beam elements produced and accelerated at the National Superconducting Cyclotron Laboratory (NSCL) to a helium-filled cell target. The elements will fuse with α (helium nuclei) and emit neutrons during the reaction. The neutrons will be detected for a count of fused-elements, thus providing us the probability of such reactions. The neutrons will be detected using the Neutron Emission Ratio Observer (NERO). Currently, NERO's efficiency varies for neutrons at the expected energy range (0-12MeV). To study (α,n), NERO's efficiency must be near-constant at these energies. Monte-Carlo N-Particle Transport Code (MCNP6), a software package that simulates nuclear processes, was used to optimize NERO configuration for the experiment. MCNP6 was used to simulate neutron interaction with different NERO configurations at the expected neutron energies. By adding additional 3He detectors and polyethylene, a near-constant efficiency at these energies was obtained in the simulations. With the new NERO configuration, study of the (α,n) reactions can begin, which may explain how elements are formed in the cpp.

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