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Gamma-Ray Angular Distribution and Linear Polarization Measurements with GRETINA and the Structure of 25Ne

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In the region of neutron-rich nuclei centered around ^{32}Mg (Z=12, N=20) known as the N=20 Island of Inversion, the conventional neutron magic number N=20 is known to no longer hold. Furthermore, around ^{24}O (Z=8, N=16) a newly emerging neutron magic number of N=16 has been suggested. Detailed spectroscopy of the excited states in nearby ^{25}Ne (Z=10, N=15), which abides in this zone of rapidly changing nuclear structure, can therefore provide important data probing nuclear shell evolution and its underlying mechanisms. Here, results from an ^{18}O beam on ^{9}Be target fusion evaporation experiment using the Gamma Ray Energy Tracking In-beam Nuclear Array (GRETINA) and the Fragment Mass Analyzer (FMA) at Argonne National Laboratory will be discussed. The angular distribution and linear polarization of the gamma rays emitted following fusion evaporation can be exploited as powerful spectroscopic tools to aid in the determination of the spins and parities of nuclear levels. A variety of types of transitions including mixed dipole-quadrupole transitions with both ΔJ=0 and 1 and stretched quadrupole transitions from the intense fusion evaporation products ^{25}Mg, ^{25}Na, and ^{22}Ne were analyzed to benchmark the performance of GRETINA in angular distribution measurements and as a Compton polarimeter. These techniques were then applied to the observed ^{25}Ne transitions, helping to clarify its level scheme. Shell model calculations using the FSU Hamiltonian were also performed which successfully reproduce the experimental results.

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