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Gamma Ray Spectroscopy of 34Ar Using Fusion Evaporation

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One of the most prominent theories in describing nuclei is the nuclear shell model, which has accurately predicted many experimental trends in the atomic mass region of A=20-60 and beyond. One way to examine this model is by studying mirror nuclei-which have exchanged numbers of protons and neutrons. Differences between mirror nuclei's analogue nuclear levels and their decay patterns help in quantifying isospin symmetry in the nuclear force. Of particular interest is studying the neutron deficient ^{34}Ar and compare its structure to its mirror nucleus ^{34}S. Whilst ^{34}S has been extensively studied, ^{34}Ar has only been studied at low energies so far. In addition, shell model calculations of mirror energies for A=34 Ar-Cl-S seem to disagree with available experimental data.

Excited states were populated in the ^{34}Ar nucleus by a fusion evaporation reaction at the Laboratori Nazionali Legnaro (LNL-INFN) in 2015 using a ^{12}C beam to bombard a stationary ^{24}Mg target, and by evaporation of two neutrons from the ^{36}Ar compound nucleus. Other stronger channels were opened in this reaction which produce a high background with respect to the ^{34}Ar spectrum. Gamma rays were detected by the GALILEO array composed of 25 HPGe detectors. The EUCLIDES charged particle detector associates charged particles being evaporated, whilst the neutron wall array tagged neutrons. Coincident events between the charged particles, neutrons, and gamma rays are used to create spectra of specific nuclei. Analysis of this experiment will serve to provide more experimental data for the shell model to better extend our understanding of nuclei in this mass region.

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