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The Nuclear Structure of ^{74}Ge from Inelastic Neutron Scattering

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Inelastic neutron scattering (INS) provides non-selective or statistical population of low-lying, low-spin ($J^\pi \leq 6$) states. As such, the reaction populates non-yrast states allowing a determination of the comprehensive level scheme. In addition, the Doppler-shift attenuation method following INS can be utilized to measure level lifetimes in the femtosecond regime. Overall, the method allows the extraction of γ -ray energies, level energies, level lifetimes, a_2 and a_4 angular distribution coefficients, branching ratios, and multipole mixing ratios. These data can then be used to calculate reduced transition probabilities, which are a sensitive test of the nuclear structure and can be compared to theoretical calculations to further our understanding.

The germanium nuclei have been of recent interest for multiple reasons. First, ^{76}Ge is one of the leading candidates for the observation of neutrinoless double-beta decay. The structure of both the parent and daughter are important for calculating the nuclear matrix element for the process, which cannot be experimentally determined. Moreover, the deformation of the parent and daughter have an impact on the magnitude of the matrix element; similar deformations would lead to a larger matrix element, and thus a shorter lifetime for the decay. Thus, understanding the nuclear structure of these nuclei becomes important. The Ge nuclei are also interesting from a structural perspective. Open questions of triaxiality among these isotopes remain a topic of investigation. In order to better understand the structures of the Ge nuclei, we have undertaken studies of $^{76,74,72,70}\text{Ge}$ using inelastic neutron scattering. A number of new structural features have been identified and characterized in each nucleus, but ^{74}Ge will be the focus of this presentation. Large-scale shell-model calculations have been performed and show remarkable agreement with experimental data.

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