USING \((n, xn\gamma)\) REACTIONS TO PROBE COLLECTIVE NUCLEAR STRUCTURE

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The \((n, n'\gamma)\) reaction has been utilized at the University of Kentucky accelerator laboratory for many years to study the structure of stable nuclei (1,2). Through the use of \(\gamma\)-ray excitation function and angular distribution measurements, detailed level schemes of stable nuclei can be established. In recent years, the Doppler-shift attenuation method (DSAM) has been applied following the inelastic neutron scattering reaction to determine the lifetimes of nuclear states (3), and collimated neutron "beams" have been employed in \(\gamma-\gamma\) coincidence measurements with an array of HPGe detectors in a close geometry (4,5). Recently, \(\gamma\)-ray detection facilities (6,7) for reactions induced by spallation neutrons, with energies of several hundred MeV, have become available at the Los Alamos Neutron Science Center (LANSCE), and initial measurements indicate that a large variety of reactions are possible. Evidence has been obtained for reactions with as many as 27 particles emitted (7). While the mechanisms of such reactions may be of interest, the primary spectroscopic advantage of utilizing higher-energy neutrons appears to be that neutron-rich nuclei which are not normally available for study with fusion-evaporation reactions can be accessed. A complement to these measurements with very energetic neutrons, \((n, 2n\gamma)\) and \((n, 3n\gamma)\) reaction studies have been explored with neutrons from the \(^2\text{H}(d,n)\) and \(^3\text{H}(d,n)\) reactions and the facilities at the University of Kentucky. Neutron energies as high as 22 MeV have been employed. Initial evaluations have focussed on data from the \(^{186}\text{W}(n, 2n\gamma)\)\(^{185}\text{W}\) and \(^{186}\text{W}(n, 3n\gamma)\)\(^{184}\text{W}\) reactions and indicate that a great deal of information can be obtained. The advantages of these measurements, as well as comparisons with data from reactions with spallation neutrons, will be presented.

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References: