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E0 Transitions and Shape Coexistence in 54,56,58Fe

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Doubly magic nuclei and their nearest neighbours serve as an ideal testing ground for the nuclear shell model, and consequently enable us to define effective nuclear interactions. Collective states in nuclei near 56Ni can be attributed to multiparticle-multihole excitations from the 1f7/2 to the 2p3/2, 1f5/2 and 2p1/2 orbits across the N, Z=28 shell gap. Properties of excited 0+ states as well as E0 and E2 transition strengths are sensitive probes of the underlying nuclear structure.

A systematic study of the stable N=28-32, even-even iron isotopes was performed and E0 transitions between the lowest excited 0+ states and the ground states were measured. Data were obtained in an experimental campaign at the ANU Heavy Ion Accelerator Facility. Excited states of 54,56,58Fe were populated using (p,p') reaction at beam energies of 6.9 MeV (54Fe), 6.7 MeV (56Fe) and 7.0 MeV (58Fe). Internal conversion electron and electron-positron pair spectra were measured using the superconducting electron spectrometer "Super-e", and singles γ-rays were measured with a HPGe detector. In addition, the investigation is supplemented with information on angular distributions, angular correlations, and $\gamma-\gamma$ coincidences, measured with the CAESAR detector array under the same experimental conditions. In order to deduce E0 matrix elements, the experimental data was evaluated using the available lifetime information from Doppler-shift attenuation measurements following inelastic neutron scattering, carried out at the University of Kentucky. Results and interpretation of the systematic study, as well as a more detailed description of the experiment and procedure will be presented in this talk.

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