Direct Measurements of Low-Lying Monopole Transitions in 28Si

Jacob Towers[1], David Jenkins[1], and Tibor Kibedi[2]
[1]University of York, UK, [2]Australian National University, Australia

We report the first model-independent measurements of the $0_2^+ \rightarrow 0_1^+$ and $0_3^+ \rightarrow 0_1^+$ transitions in ^{28}Si. Two inelastic proton scattering experiments have been performed using the Super-e pair spectrometer at the Australian National University's Heavy Ion Accelerator Facility. The squares of the dimensionless monopole transition strengths, $\rho^2(E0)$, were extracted from the observed absolute pair intensities. In a two-state mixing view, $\rho^2(E0)$ values can be related to the difference in the root-mean-square charge radii of the respective initial and final states. Provided that a transition is not suppressed by low mixing ratios of the wavefunctions of the initial and final states, a larger $\rho^2(E0)$ can serve as an indicator of significant changes in the deformation of the nucleus during that transition. Our preliminary values for the low lying monopole transitions in ^{28}Si are $\rho^2(E0, 0_2^+ \rightarrow 0_1^+) \times 10^3 = 246(25)$ and $\rho^2(E0, 0_3^+ \rightarrow 0_1^+) \times 10^3 = 5.9(21)$. The significant monopole strength of the $0_2^+ \rightarrow 0_1^+$ transition could be attributed to significant mixing between the β-vibration and ground state bands, but a change in the root-mean-square charge radius is also required. In the case of the $0_3^+ \rightarrow 0_1^+$ transition, we suggest that the transition strength is being suppressed by low mixing ratios between the prolate and ground state bands as a significant change in deformation is expected. Data from the second experiment is currently being processed to reduce the preliminary uncertainties. A further experiment targeting the $0_3^+ \rightarrow 0_2^+$ transition using electron conversion spectroscopy has been proposed.