The Study of the Isovector Giant Quadrupole Resonance (IVGQR) in Nuclei

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Abstract: The isovector giant quadrupole resonance (IVGQR) is a global feature of nuclei which corresponds to a mode of collective oscillation involving many if not all of the particles in the nucleus. As such, its detailed properties provide insight into the response function of nuclear matter. Discovered in the early 1970s, the IVGQR received much attention. However, due to the lack of precise and reliable measurements, experimental and theoretical interest waned in the late 1980s. One of the most direct and unambiguous means of observing the IVGQR is via polarized Compton scattering where it can be observed as a result of its interference with the Giant Dipole Resonance (IVGDR). Due to the lack of highly polarized beams, previous measurements of this type have resulted in ambiguous results with large uncertainties. The HIγS facility resolves these issues by providing intense, nearly mono-energetic, 100% polarized beams. These beams, in combination with the realization that the E1-E2 interference term that appears in the polarization observable has opposite signs in the forward and backward angles respectively, makes it possible to obtain an order of magnitude improvement in the uncertainties of the parameters which describe the IVGQR. To demonstrate the power of this technique the IVGQR was measured in $^{209}$Bi for my dissertation work. If mapped over a large mass range, accurate IVGQR parameters will provide constraints on state of the art nuclear models which should lead to a new level of understanding of the structure of nuclear matter.