1 Introduction

We propose to continue the investigation of the isovector giant quadrupole resonance (IVGQR) outlined in the 2011 proposal [FAMW11]. The IVGQR is a collective mode of the nucleus characterized by the the out of phase oscillation of protons against neutrons. The restoring force is due to the symmetry energy term which appears in the nuclear equation of state and is a key parameter for describing neutron rich astrophysical systems such as neutron stars [FHP10]. A systematic determination of the IVGQR parameters (energy, width, and sum rule depletion) will provide important constraints on the density dependence of this term.

Measurement of the IVGQR presents several experimental challenges due to the large width of the resonance, the small cross section compared to the dipole excitation, and the availability of a suitably selective probe. Inelastic proton scattering strongly favors the nonspin-flip isoscalar mode [Bec81], while (e,e') measurements, though equally sensitive to isoscalar and isovector transitions [Dal92], report large uncertainties due to significant non-resonant backgrounds and model dependencies [HvdW01].

Nuclear photon scattering is an ideal tool for studying the IVGQR. The E2 contribution can be observed via the interference with the tale of the giant dipole resonance (GDR). This interference term gives rise to a fore/aft asymmetry from which the IVGQR parameters can be obtained [LHSZ81, NCD+86, SHS+88]. The first experiment to exploit the polarization degree of freedom was performed by Dale [DLA92] using a linearly polarized bremsstrahlung beam. Systematic uncertainties from Thomson scattering were minimized by comparing the ratio of cross sections parallel and perpendicular to the plane of polarization (the polarization ratio) at a single backward angle, while the effects of Delbrück scattering were shown to be minimal at the measurement angle for the relevant