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Experiments with photon beams at the HIGS facility

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The angular-momentum selectivity in photon-induced nuclear reactions enables strategic investigations of nuclear and nucleon structure via excitation of the internal electric charge and current distributions as expressed through single-particle and collective motion responses. The narrow energy resolution and high polarization of laser Compton gamma-ray (γ -ray) beams offer a complementary probe to bremsstrahlung beams for studying nuclear phenomena. The High Intensity Gamma-ray Source (HI γ S) at the Triangle Universities Nuclear Laboratory (TUNL) is the highest intensity Compton gamma-ray source in the world [1]. The γ -ray beam at HI γ S is produced by Compton-back scattering of electrons from photons inside the optical cavity of a storage-ring based free electron laser. This unique facility provides circularly and linearly polarized γ -ray beams with beam polarization greater than 95% and beam energy resolution as low as 2% over the energy range from 2 to 110 MeV. These beam capabilities enable a broad research program that includes nuclear structure and reactions, nuclear astrophysics, fission, few-nucleon reaction dynamics, nucleon structure, and detector R&D.

An overview of the current research program at HI γ S will be presented that includes highlights of recent results in several research areas, e.g., studies of collective electromagnetic nuclear responses using nuclear resonance fluorescence, photon-induced reactions important in nuclear astrophysics, photofission, few-nucleon reaction studies, and the determinations of the low-energy electric and magnetic structure parameters of the nucleons using Compton scattering. The talk will conclude with a discussion about future directions for the HI γ S research program and the facility.

[1] H.R. Weller *et al.*, "Research Opportunities at the Upgraded HIGS Facility," *Prog. Part. Nucl. Phys.* **62**, 257 (2009).

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