

## **The HIGS Facility--A Free-Electron Laser Generated Gamma-ray Beam for Nuclear Physics**

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The High Intensity Gamma-ray Source (HI $\gamma$ S) is a joint project between TUNL and the Duke Free Electron Laser Laboratory (DFELL). This facility utilizes intra-cavity back-scattering of the UV-FEL light in order to produce a  $\gamma$ -flux enhancement of approximately  $10^3$  over the existing sources. At present, gamma-ray beams with energies ranging from 2-to-50 MeV are available with intensities of  $10^5$ - $10^6$   $\gamma$ /s, energy spreads of 1% or better, and 100% linear polarization. An upgrade is presently underway which will allow for the production of  $\gamma$  rays up to an energy of about 225 MeV having intensities in excess of  $10^8$  /sec/MeV. The primary component of the upgrade is a 1.2 GeV booster-injector which will permit the operation of the ring at full-flux and full energy. The booster injector will provide for efficient injection at any chosen operating energy of the storage ring from 300 MeV to 1.2 GeV. In addition, an upgrade of the present OK-4 FEL to a helical undulator system (OK-5) is underway. This new system has many advantages over the present one, including making switchable linear and circularly polarized beams available, an increase in power and a decrease in mirror-damaging radiation. The full system, including the booster injector, is expected to be ready for use by 2006. TUNL researchers, in collaboration with outside theoretical and experimental colleagues, have proposed a broad based research program in nuclear physics which is designed to exploit the unique flux, energy resolution and polarization of the HIGS beams. Recent experiments performed at HI $\gamma$ S include a measurement of the asymmetry as a function of angle in Compton scattering of polarized  $\gamma$ -rays from  $^{16}\text{O}$  at 40 MeV, and a series of nuclear resonance fluorescence experiments which enabled us to make parity assignments to a number of dipole states in  $^{92}\text{Zr}$  and  $^{96}\text{Mo}$ . A description of the presently available facility and the anticipated facility following the present upgrades will be given, along with a description of recent and planned experimental results.

