Improving the Performance of the Holifield Radioactive Ion Beam Facility

Research employing beams of radioactive ions is widely recognized as critical to furthering our understanding of the physics of nuclei, as well as the synthesis of nuclei and the generation of energy in cosmic stellar explosions. The Holifield Radioactive Ion Beam Facility (HRIBF) at ORNL provides such beams; it is currently unique worldwide in its ability to deliver accelerated beams of heavy neutron-rich species that are especially interesting to both nuclear structure and astrophysics studies. A program is underway to substantially improve HRIBF. In early FY2006 we completed the High Power Target Laboratory (HPTL), providing greatly improved R&D capability in radioactive ion beam (RIB) production, purification and manipulation. A second RIB production station (IRIS2) is now being configured using shielded space and hardware developed for HPTL. After completion in 2009 at a cost of $4.7M, IRIS2 will provide badly needed redundancy in critical RIB production hardware, more scope for advanced beam manipulation techniques, and substantially enhanced operational efficiency, increasing the number of beam hours available to researchers by ~50%.

The next step in our plan for improvement of HRIBF is a proposal to install a turn-key electron accelerator capable of delivering a high-power beam (up to 100 kW) at modest energy (25 to 50 MeV). This is the most cost-effective way to maintain leadership-class capability in the neutron-rich beam program. With existing HRIBF target technology such a facility can generate a fission rate about 25 times greater than the current HRIBF proton beam, but since photo-fission is a much "cooler" process the yields of the most neutron-rich species are much more strongly enhanced. As an example, the yields of ^{132,134,138}Sn yield will be ~300, 1000, and 12000 times larger than current HRIBF capability respectively. Expected improvements in target technology would lead to higher yields. By concentrating on neutron-rich species, with a ~$20M investment HRIBF will remain competitive with new $200M class facilities due to be completed outside the U.S. in the next decade. Expected post-accelerated beam intensities are shown in Figure 1.

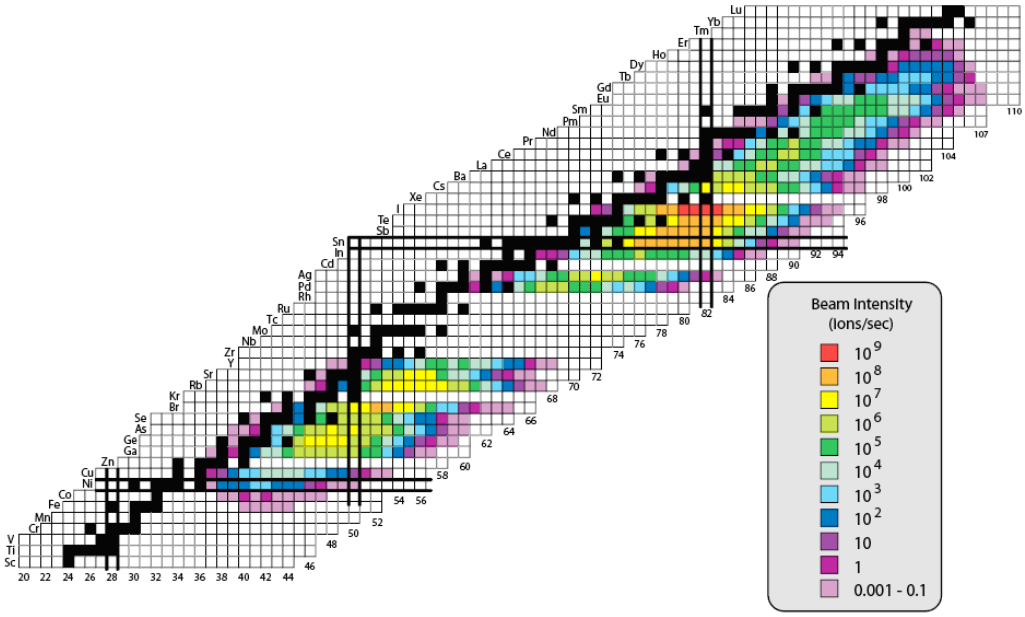

Figure 1. Projected post-accelerated intensities from HRIBF with an electron-beam production accelerator providing 60 kW of beam power.