Holifield Radioactive Ion Beam Facility

Physics Division

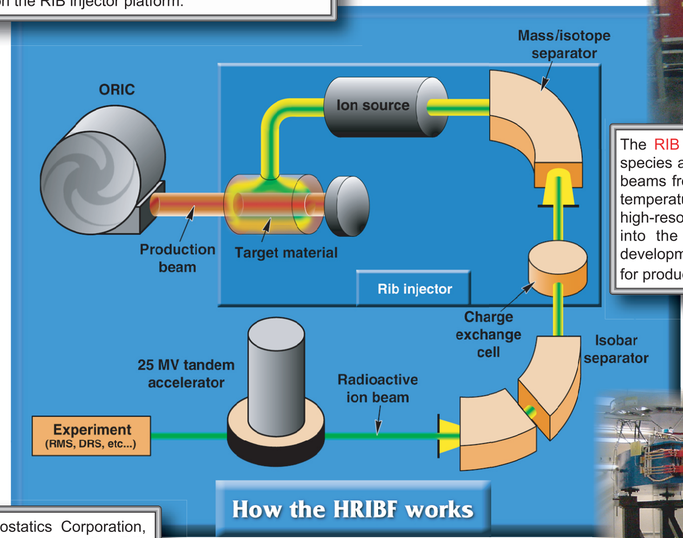
Oak Ridge National Laboratory

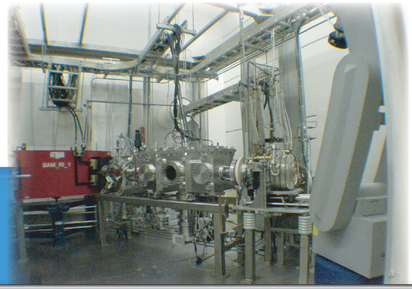
Radioactive Ion Beam Production at HRIBF

The Holifield Radioactive Ion Beam Facility (HRIBF) is an international user facility that produces beams of short-lived, unstable nuclei for research in nuclear structure and nuclear astrophysics.

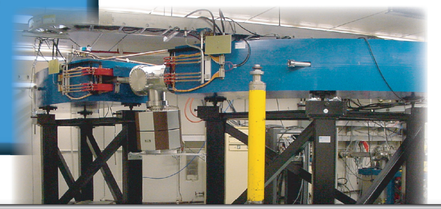
The primary mission of the Oak Ridge Isochronous Cyclotron (ORIC) is to serve as a driver for the production of radioactive ion beams (RIBs). ORIC provides high-intensity proton, deuteron, and alpha particle beams to a target-ion source assembly that is located on the RIB injector platform.

The 25 MV tandem accelerator, built by National Electrostatics Corporation, serves as a post-accelerator for radioactive ion beams produced on the RIB injector. It is the largest electrostatic accelerator in the world, with a voltage generator capable of producing a potential in excess of 25 million Volts at the terminal, which sits atop an insulating column inside a 100-ft-high by 33-ft-diameter pressure vessel. Beams of negative ions are accelerated from ground potential up to the terminal, stripped of some of their electrons, turned around by a 180-degree bending magnet, and then accelerated back down the column to ground potential. This folded configuration saves space and prevents unwanted ions (e.g. the wrong charge state) from being accelerated to high energy. The very high quality of the accelerated tandem beam and the ease with which beam energy can be varied are crucial to many research programs at HRIBF.





The RIB injector is the heart of the HRIBF since it is here that radioactive species are produced. Thick target material is bombarded by intense light-ion beams from ORIC creating radioactive nuclei which are ionized within a high-temperature ion source and formed into a beam which is then subjected to high-resolution isotope/isobar mass separation. This purified beam is injected into the tandem accelerator. Production of intense RIBs requires the development of innovative target/ion source techniques which are optimized for production of specific RIB species.



Due to the nature of the nuclear reactions which produce the RIBs and the proximity of stable target material elements to the mass of the radioactive ion, the probability of producing a beam containing several species with nearly identical mass-to-charge ratios is quite high. In order to achieve well defined experimental conditions by delivering a 'pure' beam to the target, a high resolution isobar separator is utilized to filter out these "isobars." The system has been designed to achieve a resolving power (m/Dm) of ~20,000 with a high quality beam.