# RIKEN RI Beam Factory Project

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RIKEN RI beam factory is a next-generation heavy-ion accelerator facility, which is dedicated to utilizing short-lived radioactive-isotope (RI) beams produced by the in-flight method. It aims at providing the world's most intense primary beam over a wide range of nuclides. The maximum energy of the primary beam reaches 400 MeV/nucleon for light ions and 350 MeV/nucleon for heavier nuclei up to uranium, and the goal of the intensity is higher than 1pμA. Such capability in conjunction with a large-acceptance fragment-separator, BigRIPS, allows an efficient production of RI beams, and enables considerably broader access to nuclei much further from the β-stability line especially towards the neutron-rich side. The RI beam factory will provide a new creation of excitement not only in nuclear physics, but also in astrophysics, and in fields of other fundamental sciences.

The RIBF project is divided into two phases, namely Phase I and II. In Phase I, which is currently under construction at Wako main campus, three cyclotrons will be newly constructed for further acceleration of a primary beam extracted from the existing K540 RIKEN Ring Cyclotron (RRC). They are a fixed-frequency Ring Cyclotron (fRC), Intermediate Ring Cyclotron (IRC) and Superconducting Ring Cyclotron (SRC), whose K values are 520, 980 and 2500, respectively. The cascade operation of these cyclotrons will boost the primary beam energy up to 400 MeV/nucleon for light ions and 350 MeV/nucleon for very heavy ions up to uranium. Two BigRIPS separators will be newly constructed for the RI-beam production. A time-sharing system for the primary beams installed in the beam transportation system from the SRC to BigRIPS enables to perform two completely independent experiments using independent RI beams.

RI beams will be produced mainly by projectile fragmentation. In addition, in-flight fission of a uranium beam will be also employed to produce very neutron-rich nuclei in medium mass region, whose production cross section has been found to be much larger than that of projectile fragmentation. Since fission fragments have much larger momentum and angular spread, BigRIPS is carefully designed to maximize the transmission for the fission fragments. The momentum and the angular acceptance of BigRIPS are ±3% and ±40 mrad, respectively. The first experiment in Phase I will be scheduled in the year 2004.

In the second phase of the RIBF project, a new-generation accelerator-complex, called MUSES (MUlti-uSe Experimental Storage rings), will be constructed. It consists of an accumulator-cooler ring (ACR), an electron linac and an electron-RI collider. The collider is for the structure study of unstable nuclei by electron scattering. In order to obtain the maximum luminosity of electron-RI collision, a RI beam extracted from BigRIPS is cooled in the ACR by means of the stochastic cooling and the electron cooling, and then transferred to the collider rings. The collider includes two storage rings for electron and RI beam, and 500-MeV electrons storaged in the electron ring collide against an RI beam at the collision point. The electron-RI collider provides an absolutely unique opportunity to determine the electromagnetic form factor of unstable nuclei.

The cooled RI beam storaged in the ACR will be also used for various unique experiments. For nuclear physics, for example, proton elastic scattering of a storaged RI beam using an internal hydrogen-gas target will determine the nucleon distribution, and the precise mass measurement of unstable nuclei will be possible when the ACR is operated in isochronous mode. Experiments for atomic physics taking full advantages of a well-cooled atomic beam with an electron cooler at the ACR are also discussed.