Low-energy Radioactive Ion Beam Decay Spectroscopy Station at HRIBF

Uranium atoms undergo fission (dividing into two new "daughter" neutron-rich nuclei) when bombarded by neutrons or protons. The large energy released in this process is used to produce electricity at nuclear power plants. Although discovered nearly 70 years ago, a complete, detailed understanding of the fission mechanism and the properties of all its products is still unknown. Particularly important is the total decay energy (heat) and the number of neutrons released by the daughter nuclei, which subsequently undergo beta (β-) radioactivity. The decay properties of these nuclei can be calculated using existing models but theoretical descriptions are based mostly from the studies of different isotopes which may have different properties. Neutron-rich nuclei can emit neutrons immediately following β-decay, thus changing the mass of the daughters and the resulting decay patterns. The largest decay heat and neutron emission probability can be expected for the fission products with very asymmetric numbers of neutrons and protons. Therefore, it is critical to extend our experimental knowledge and understanding of the properties of the most neutron-rich nuclei.

Low-**e**nergy **R**adioactive **I**on **B**eam **S**pectroscopy **S**tation (**LeRIBSS**), a new experimental end-station (see Fig. 1) under construction at the HRIBF is dedicated to the studies of such exotic nuclei. Radioactive beams (RIBs) are produced at HRIBF by protons bombarding uranium targets. The beams pass through a high-resolution ($\Delta M/M$ better than 10^{-4}), mass-analyzing magnet and will be delivered to LeRIBSS. Here, RIBs are of the highest quality and intensity and will be deposited onto a new fast-moving tape collector. A universal detector support called CARDS can support all detectors needed for decay studies including a proposed high-efficiency β-delayed neutron counter. Experiments at LeRIBSS can be done with negative and positive-charged ions and will accept RIBs from all planned HRIBF upgrades (IRIS2 and proposed electron driver). IRIS-2 beams, an upgrade of the present High Power Target Laboratory, will be merged with the existing RIB delivery system in front of the high resolution injector magnet. Ion energies of about 200 keV should be large enough to provide an implantation timing signal from a microchannel plate detector equipped with an ultra-thin carbon nanofoil. This will allow us to study the shortest-lived isotopes by improving the signal-to-noise by correlating the implantation and decay events.

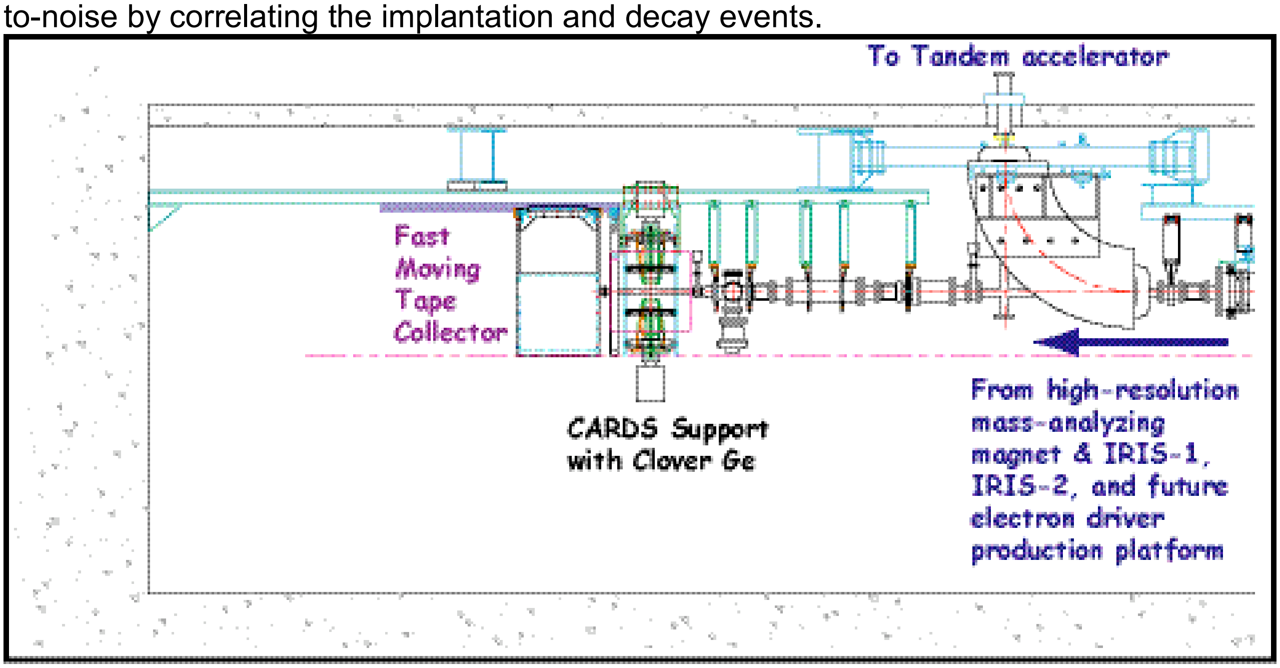

Figure 1: Schematic drawing of LeRIBSS in the RIB injection hall. The low energy radioactive beam, after being separated by the high resolution injector magnet, will be transmitted straight to the LeRIBSS tape collector.