DIAGNOSTICS FOR LOW-INTENSITY BEAMS *

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Beam diagnostics requirements at radioactive beam facilities are the same as at any facility delivering nuclear beams for experiments in the sense that one needs to beam intensity, the beam quality, and the species delivered. However, when dealing with diagnostics of radioactive beams, there are some aspects that require special attention.

- Low-beam intensities - below 1pA beam currents ($\leq 6{\times}10^6$ singly-charged ions/sec/cm^2)
- Delivered radioactive beams often contain contaminant species that need to be monitored.
- The nature of the detected beam - it is radioactive!

Low-intensity beam detection is mostly addressed by employing single particle counting devices. Good timing and position resolution of these detector systems must be maintained sometimes while operating at high rates (up to 10^7 ions/sec). Since the detected ions are radioactive, detection methods that minimize deposition of the beam in or near the detector are preferred.

Several years of experience performing nuclear physics experiments at HRIBF, and at other radioactive beam facilities, have resulted in an impressive arsenal of diagnostic devices and methods addressing all aspects of beam diagnostics. This presentation will review some of the methods and instruments developed at different radioactive beam facilities.

Detectors used for beam counting, profile, and emittance measurements come in different varieties among which we count:

- Direct counting devices - a large variety of gas-filled particle detectors.
- Detectors based on detection of secondary electrons ejected from a thin foil by the passing ion.
- Residual gas-beam profile monitors based on the coincident detection of ions and electrons produced by the beam ionizing residual gas molecules.

Significant effort has been devoted also to analyze the composition of beam delivered both at the source level and for the accelerated beam. The methods mentioned in this review will include:

- Beam assays - a time analysis of the decay of deposited beam.
- In line X-Ray excitation of the beam.
- In line separation of isobars in the beam using a combination of energy loss and subsequent time of flight or magnetic separation.

Efforts aimed at improving the performance of existing devices and the development of new devices will be outlined.

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