A FOCAL PLANE DETECTOR FOR MEASURING EVAPORATION RESIDUES IN INVERSE KINEMATICS USING THE GAS-FILLED ENGE SPECTROGRAPH

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Medium-mass, proton-rich radioactive ion beams have been developed and produced in the past two years at HRIBF. Neutron-rich beams produced from the fission of uranium is under development. In many cases, experiments will have to be performed in inverse kinematics.

There is an ongoing program to study fusion mechanisms near the Coulomb barrier for a chain of isotopes extending from proton-rich nuclei to neutron-rich nuclei. The measurements are carried out using the Enge split-pole spectrograph filled with gas to increase the efficiency for detecting evaporation residues (ERs). For inverse kinematic reactions, the energy and charge state distribution of the ERs are very similar to those of the elastically scattered particles, making the identification of ERs and projectile-like particles very difficult.

A focal plane detector system which provides position, timing and energy information has been constructed and used in experiments. The focal plane detector consists of a position sensitive avalanche counter (PSAC) and a plastic scintillator. The PSAC is of the same design as that used in the RMS focal plane[1]. The active area of this PSAC is 36×7.5 cm^2. There are five wire planes which provide position and timing signals: anode, x-position, cathode, y-position and anode planes. The plastic scintillator measures the energy of particles. The scintillation photons are directed by an acrylic light guide, shaped into a square cylinder, to the two horizontal ends on the side. Photomultiplier tubes mounted at the end of the light guides are used to collect the photons. The photomultiplier tubes are sealed in cylindrical cans to isolate the tubes from the low pressure gas in the spectrograph preventing the tubes from discharging.

The focal plane detector was used to measure ERs from the ^{75}As beam incident on Ti targets. A typical histogram of energy as function of time-of-flight measured by the focal plane detector is shown in Figure 1**a**. By applying a gate on the energy axis to exclude the elastic scattering events, the ERs can be clearly identified in the time-of-flight as function of position spectrum, as shown in Figure 1**b**.

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[1]C. J. Gross *et al.*, ORNL Physics Division Progress Report, ORNL-6916 (1996).

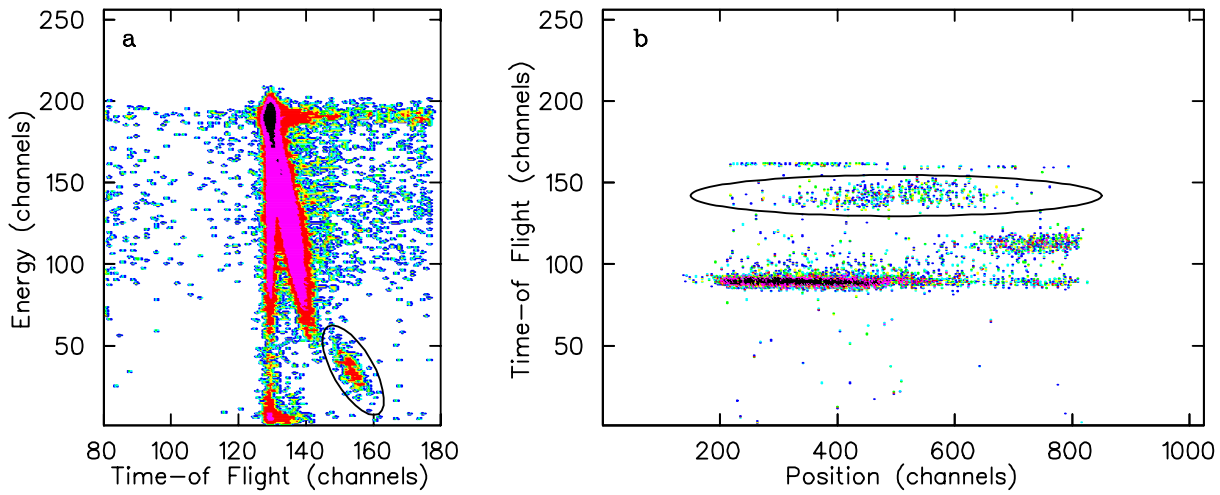

Figure 1: **a**. Histogram of energy vs. time-of-flight for 265 MeV ^{75}As+^{46}Ti. **b**. Histogram of time-of-flight vs. position gated on energy of **a**. ERs are shown in the gated area.