Texas A&M cyclotron K150 radiation effects facility
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Several improvements have been made to the radiation effects facility K150 beamline. A backscatter detection system has been implemented to accommodate high intensity proton dosimetry. The beam shutter control box has been modified to ease the transition between high-intensity and low-intensity set-ups. Also, beamline hardware has been modified and reconfigured to help minimize residual radioactivity.

The backscatter detection system is mounted inside an ISO250 six-way cross (Fig. 1). The system consists of a set of four tantalum foils and four detectors aligned to measure backscattered protons from the foils (Fig. 2). The detectors are mounted on an aluminum ring and are angled to face the foils. The foils are mounted on a separate aluminum ring and are placed perpendicular to the beam path at 90° intervals radially about the beam line center. On average, approximately 10% of the beam is backscattered into the detectors.

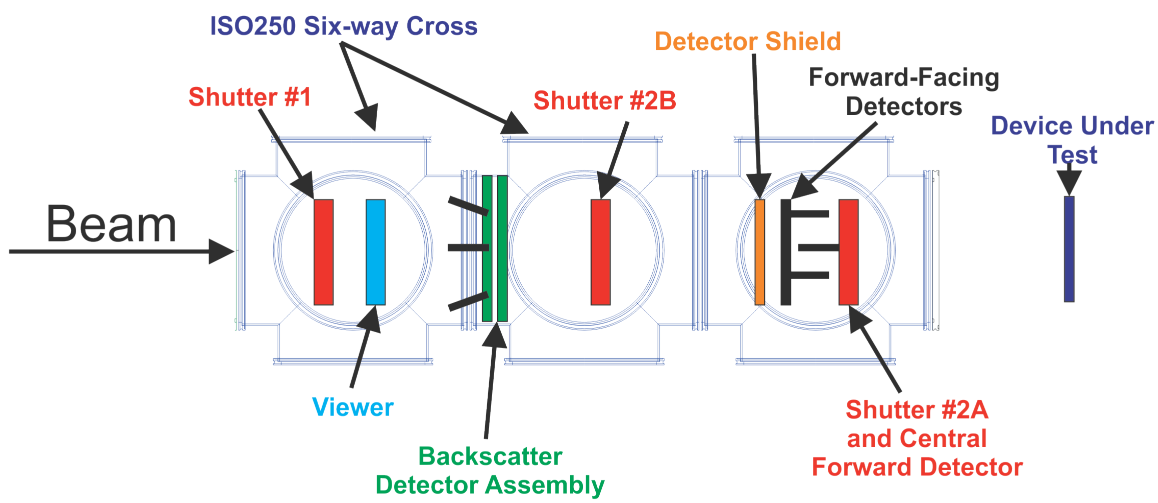
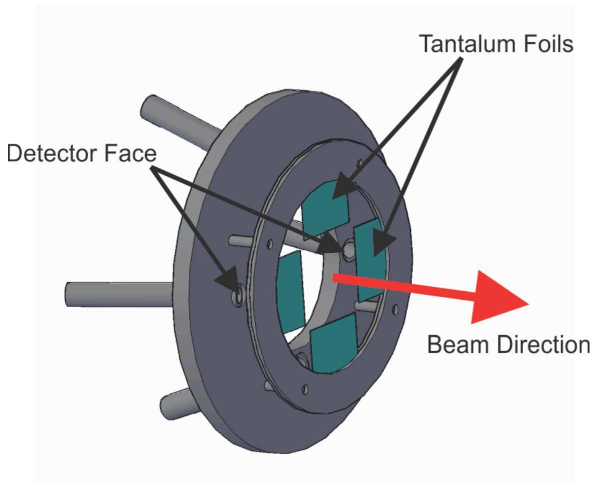


FIG. 1. Radiation effects facility K150 beamline layout.

For high intensity dosimetry (beam flux > 3e7 particles/cm^2/sec), beam uniformity is first confirmed at a lower intensity with the forward-facing detectors (Fig. 1). Then, an aluminum detector shield is positioned in front of the forward-facing detectors to protect them during high intensity irradiations. Next, a calibration measurement is made using the central forward facing detector and the four backscatter detectors. Our custom SEUSS software determines the ratio of the count in the central detector to the average of the counts in the four backscatter detectors. Once this ratio is determined, the central detector is removed from the beam path and disabled. A second beam shutter (Shutter 2B) is then used to block the beam from the device under test (DUT). Finally, the beam intensity is increased and beam flux is determined by multiplying the average of the counts from the backscatter detectors and the calibration ratio.



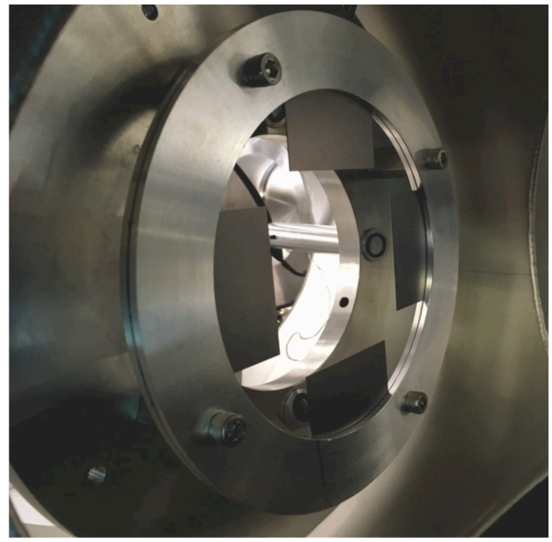


FIG. 2. (Left) CAD 3D model of backscatter detector system. (Right) Backscatter detector system installed in six-way cross.

The transition from low intensity operation and high intensity operation has been made more efficient with modifications to the beamline and the beam shutter control box. A third six-way ISO250 cross was added to the beamline and an additional beam shutter was put in place to block the DUT during high intensity testing (Fig 1). This shutter has been designated as "shutter 2B", with the original shutter 2 now referred to as "shutter 2A". Since the thruster with shutter 2A includes the central forward detector, it is removed from the beam path during high intensity beam exposure. A switch, added to the front of the shutter control box, is used to change between the two testing configurations. Control from the SEUSS software is transparent between the 2A/2B switch.

New input and output signals have also been added to the beam shutter control box. The box has now been wired to receive confirmation of detector shield position. Based on detector shield position, signals are provided to veto detector signals. An inhibit signal for non-operational beamline vacuum is now supplied for the high voltage power supplies.

Beamline hardware changes have been made to help reduce residual radioactivity. The standard 4" diameter beam pipe has been replaced with an 8" diameter beam pipe has been installed in front of the six-way crosses. A new 8" diameter beamline valve has also been installed. In order to reduce the stainless-steel valve's beam exposure, an aluminum collimator has been placed directly in front of the valve. The collimator has a 4" diameter opening and is 2" thick.

These improvements should help increase the ease and safety of operation of the K150 radiation effects facility beamline as we look to increase its use in the future.