The ANU Heavy Ion Accelerator Facility External Beam Line

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The ANU Heavy Ion Accelerator Facility provides important infrastructure for various ion-beam research opportunities. Proton therapy and other radiotherapies using massive particles, such as carbon-12 are emerging as an alternative to traditional photon radiotherapies [1]. Such particles have an energy deposition-depth profile that results in high dosage near the end of their track, with a relatively low dose elsewhere [1, 2]. The biological effect of protons and heavy ions are less well understood than those of photons. In order to study the effect of radiation on cell cultures an external beam is required as the cells cannot be placed in vacuum.

Here, we present an initial design for an external beam apparatus at the ANU heavy ion accelerator facility (HIAF). System engineering methods were used to develop the architecture of the apparatus (Figure 1) and dictated the development of a simulation framework. This framework consists of a GISCOSY beam optics simulation coupled to a Geant4 simulation that simulates the beam transition through a thin window into the air.

The spread, energy and intensity distributions of proton and carbon-12 beams were studied as a function of distance from the window, as well as the effects of alternative window materials and thicknesses. Finite element analysis is recommended to optimize the window mechanical and thermal properties. The cost of the new hardware was estimated to be approximately $12,000.

Overall, this work aims to lay the foundations of an external beam design, a simulation test framework, and the basis for a grant application for an external beam at the ANU HIAF.

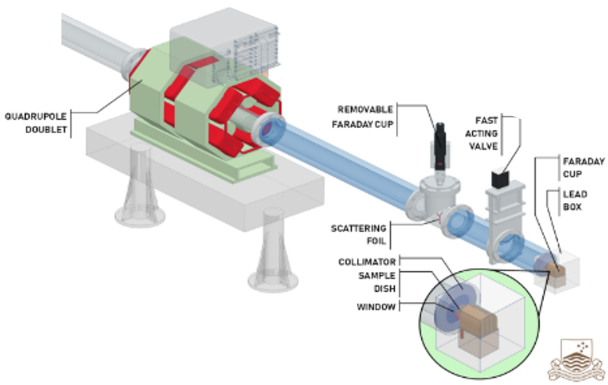

FIG. 1: The Mechanical design of the external beam apparatus, integrated with the existing beam pipe.

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