Current status of the LSTAR project

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The purpose of the Light-ion guide Separator for Texas A&M's Radioactive ion beams (LSTAR) is to, in conjunction with the Helium Light-Ion Guide (He-LIG), utilize high intensity ^{3}He beams from the K150 cyclotron and produce secondary radioactive ion beams of interest to TAMUTRAP's research program investigating β–delayed proton decays of neutron deficient nuclei (Fig. [1]). The separator itself consists of nine electrostatic elements comprising two quadrupoles, two quad-plus-octopoles, two sextupoles, and a 24-rod multipole working alongside two magnetic dipoles (see Ref. [1]). These components were designed and built by Danfysik according to the specifications outlined in a paper recently published in Nuclear Instruments and Methods A (Ref. [2]) and have recently arrived at the Cyclotron Institute.

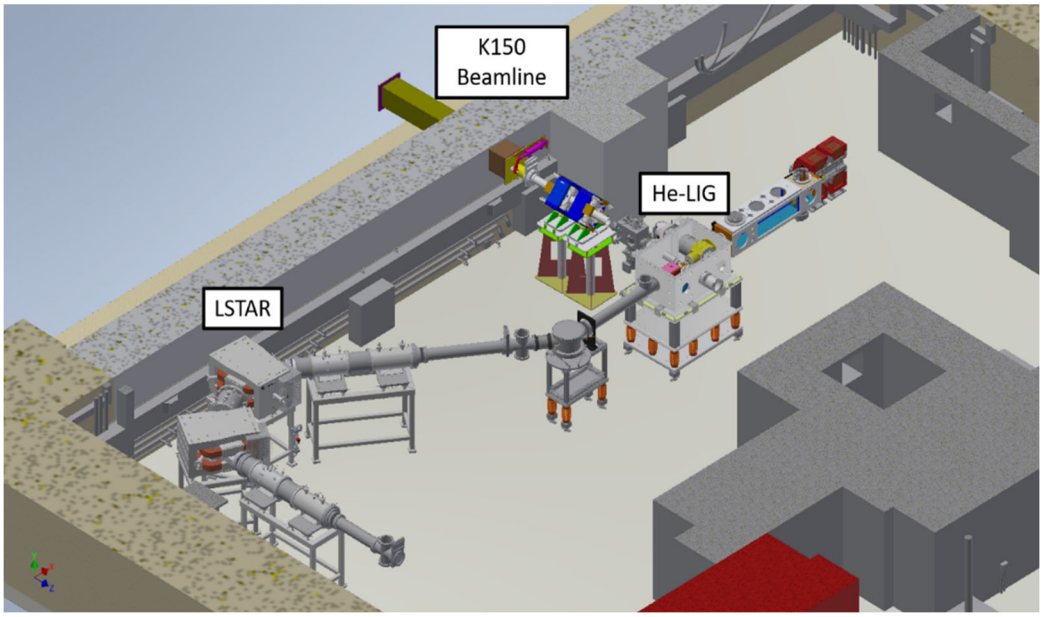

Fig. 1. The planned location of LSTAR in Cave 5 in relation to the He-LIG and the K150 beamline.

In order to deliver the radioactive beam from the He-LIG to LSTAR, the extracted ions must be sufficiently cooled through collisions with helium gas and radially confined. To this end, a differential pumping system combined with a number of sextuple ion guides (SPIGs) have been designed. The SPIGs, including a bending SPIG (Fig. [2]) required to deflect the beam 36° to be in alignment with the LSTAR entrance, have been designed and demonstrated through repeated SIMION simulations to maintain the low beam emittance and high transmission required for injection into LSTAR (Fig. [3]).

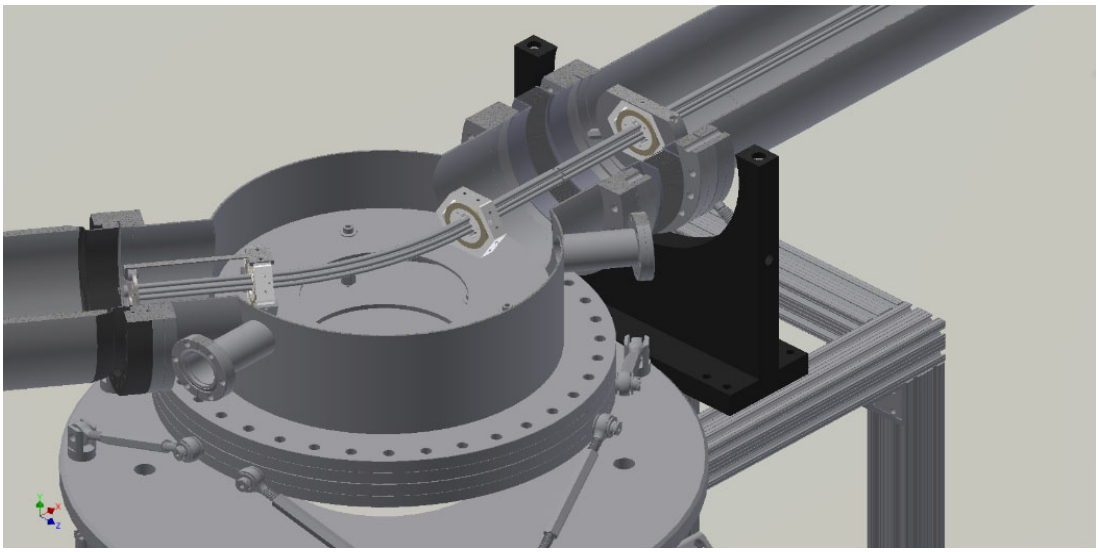

Fig. 2. A cross-sectional view of the bending SPIG and the end of the SPIG leaving the He-LIG box.

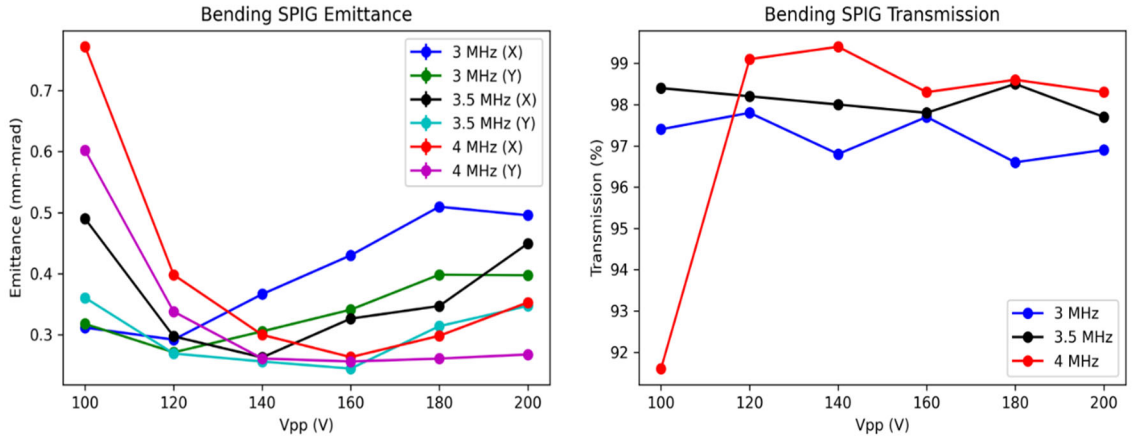

Fig. 3. Simion simulation results for the bending SPIG demonstrating emittance in both X and Y at the exit (left) and overall transmission (right) as a function of peak-to-peak RF voltage for multiple operating frequencies.

With the LSTAR components delivered and the removal of shielding blocks in Cave 5 to make room for the installation of the separator planned for the end of summer 2025, the first round of orders for necessary vacuum hardware have been made. The fabrication of parts necessary for the SPIGs are to be done in-house.

[1] D. Melconian *et al.*, *Progress in Research*, Cyclotron Institute, Texas A&M University (2023-2024), p. IV-24.

[2] G.P.A. Berg *et al.*, Nuclear Instrum Methods Phys. Res. **A1069**, 16994 (2024).