Update on the He-LIG and LSTAR projects to produce RIB for TAMUTRAP

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We continue to develop a ^{3}**He**-based **l**ight-**i**on **g**uide (He-LIG) system, complementing the existing (proton-driven) *p*-LIG system, to increase RIB production at the CI using the high intensity of the K150 cyclotron. The **l**ight-ion guide **s**eparator for **T**exas **A**&M's K150 **r**are isotope beams (LSTAR) will transport and purify the RIBs produced by the He-LIG.

Most of our effort continues to be on the construction of LSTAR as the new graduate student, M. Holloway, gets caught up on his thesis project, the He-LIG gas cell and transport to the separator. In April of 2024, we ordered the two dipoles and electrostatic elements from Danfysik. After iterating with their technical staff, they have come up with the concept design, shown in Fig. 1. Field calculations of the quadrupoles (*Q*), quad-plus-octupoles (*Q*+oct), sextupoles (*S*), 24-rod mulitpole (*M*) and dipoles (*B*) they designed all meet our specifications. With the concept design milestone reached, they are now proceeding with the final design as they begin procuring the raw material (particularly the iron for the dipoles) and subcontract production of the electrostatic elements. If all goes well, Danfysik expects to ship the separator components to TAMU by the summer of 2025.

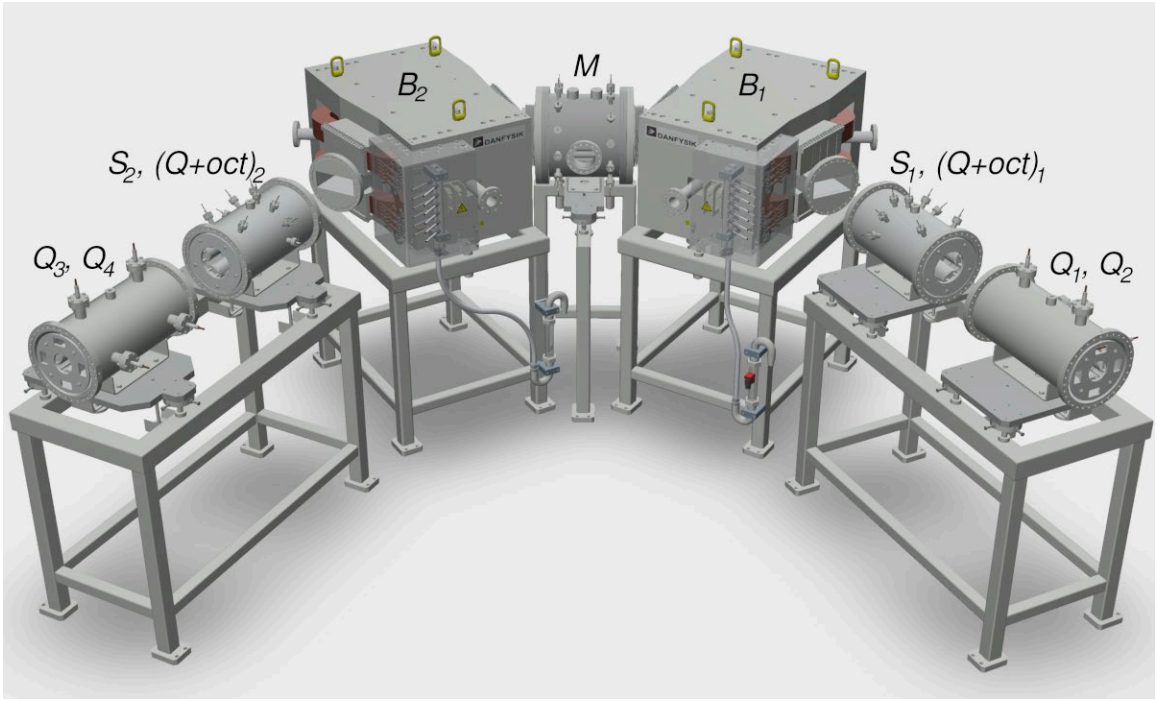

FIG. 1. Danfysik's CAD drawing of their concept design of LSTAR.

In addition to working on the concept design with Danfysik, we have submitted a paper to Nuclear Instrumentation and Methods A, "*LSTAR – An isotope separator for expanding radioactive ion beam production at the Cyclotron Institute, Texas A&M University,*" which describes the layout, ion-

optical design, and specifications of LSTAR. We are in the process of addressing comments from the referees and expect it to be published by the end of summer.

In anticipation of the separator arriving by next summer, we are updating our design of the He-LIG and preparing to install the new (delayed by a year) *p*/He-LIG chamber (see Fig. 2 and Ref. [1]). Our prototype gas cell worked very well, however it leaked a lot of helium, so we are redesigning it to have indium seals; this will lead to better vacuum outside the gas cell for ion transport, and also be a more efficient use of helium. We also need to update the SPIG transport following the gas cell to be curved to accommodate the new design of LSTAR (2x62.5° horizontal instead of the original 2x45° vertical [2]). The new gas cell should be ready for testing this fall. We are also eagerly anticipating the arrival of a new post-doctoral researcher, Dr. Graeme Morgan, this summer who will help lead commissioning of the new gas cell. He will also lead the effort, in collaboration with the *p*-LIG and operations groups, to prepare Cave 5 for installation of the *p*/He-LIG chamber and LSTAR. This will be no easy task as large shielding blocks need to be removed, large roots blowers need to be repositioned, and the HV platform needs to be upgraded to reach 70 kV. Significant planning and organization are required to minimize the disruptions to the *p*-LIG re-accelerated RIB developments [3].

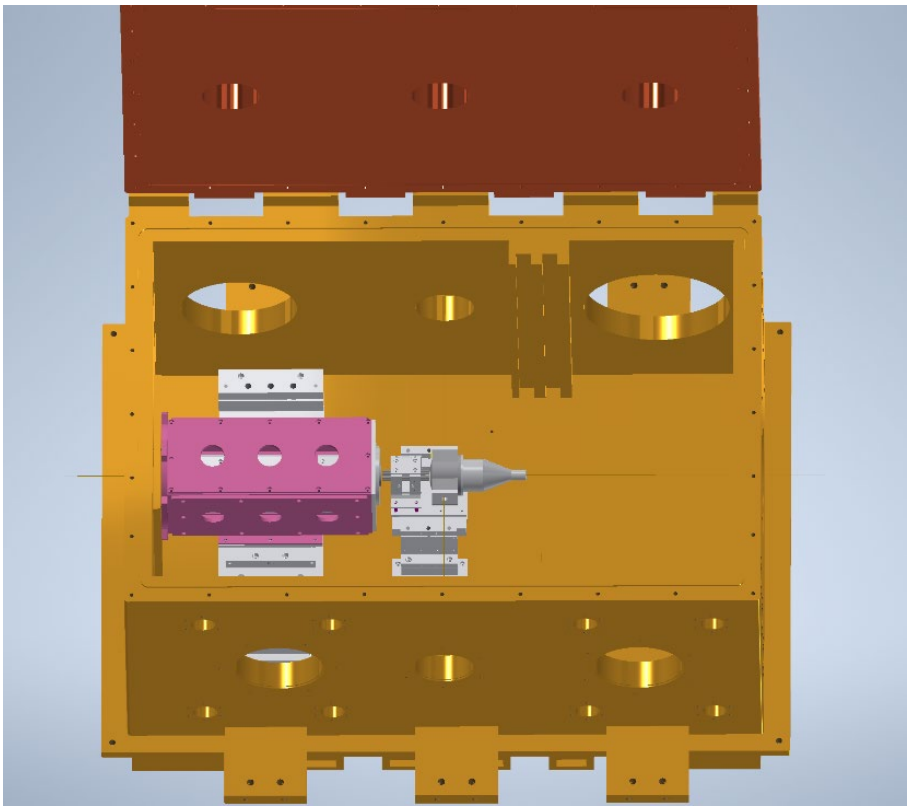

FIG. 2. p/He-LIG chamber in the He-LIG configuration. The required amendments to our prototype are indium seals to reduce gas leakage, and curved SPIGs outside of the box (to the left) to transport beam to the entrance of LSTAR.

[1] P.D. Shilding *et al.*, *Progress in Research*, Cyclotron Institute, Texas A&M University (2020-2021), p. V-68.

[2] G. Chubarian *et al.*, *Progress in Research*, Cyclotron Institute, Texas A&M University (2019-2020), p. IV-93.
[3] G. Tabacaru *et al.*, *Progress in Research*, Cyclotron Institute, Texas A&M University (2023-2024), p. IV-7.