Progress on the GOLIATH upgrade for the He6-CRES experiment

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The Gas Operated Large Ion-Bunch Atomic Trap for He6CRES (GOLIATH) radiofrequency quadrupole (RFQ) was designed to be a large throughput ion trap to supply ion bunches to the He6CRES experiment in order to combat energy dependent losses without sacrificing statistics. Following the design [1], extensive simulation [2-3], and construction of GOLIATH and the GOLIATH test bench [4], GOLIATH has been placed under vacuum for ongoing commissioning tests. With the introduction of the 1 kW radiofrequency power supply, the transformer and GOLIATH were impedance matched to provide maximum power to the RFQ. After studying the injection into the box in which GOLIATH is housed, GOLIATH supplied the first signal of ^{7}Li to our microchannel plate detector as seen in Fig. 1.

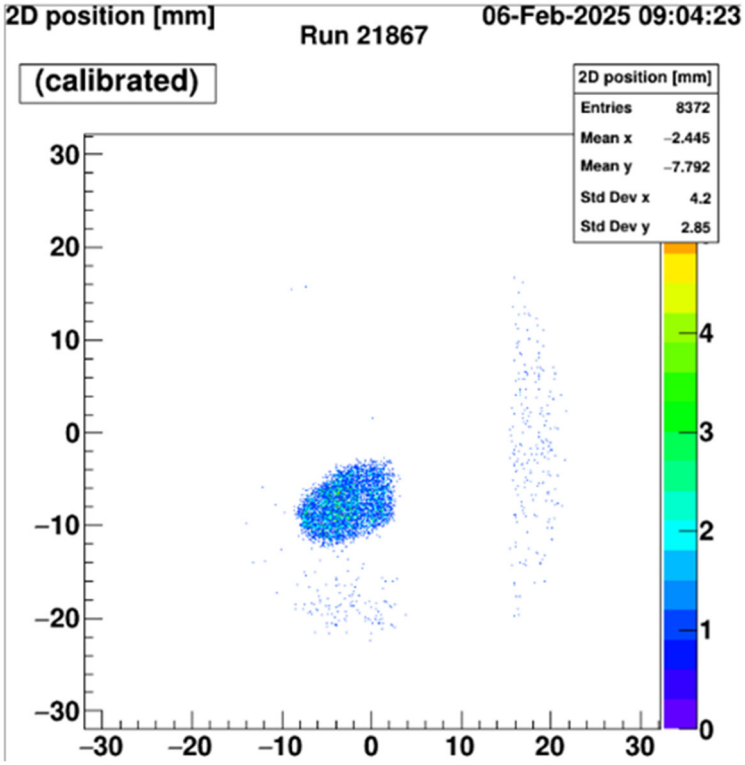

Fig. 1. A 2D plot read from the delay-line anode attached to the microchannel plate that shows us the positional image of the first beam through GOLIATH.

After the first signal was detected while GOLIATH was at ground, injection was optimized at increasing potentials until the high voltage platform reached 9.985(5) kV, which when compared to the 10 kV excitation potential of the source, results in a beam energy of ~15eV within the RFQ. With the introduction of a 4He buffer gas, these particles will be stochastically cooled, lowering the energy and energy spread further. The cooled beam will then flow toward the end of the RFQ into the bunching region

where they will be held for a fixed time before they are released toward our detector with the help of two timing switches. A representation of this process can be found in Fig. 2.

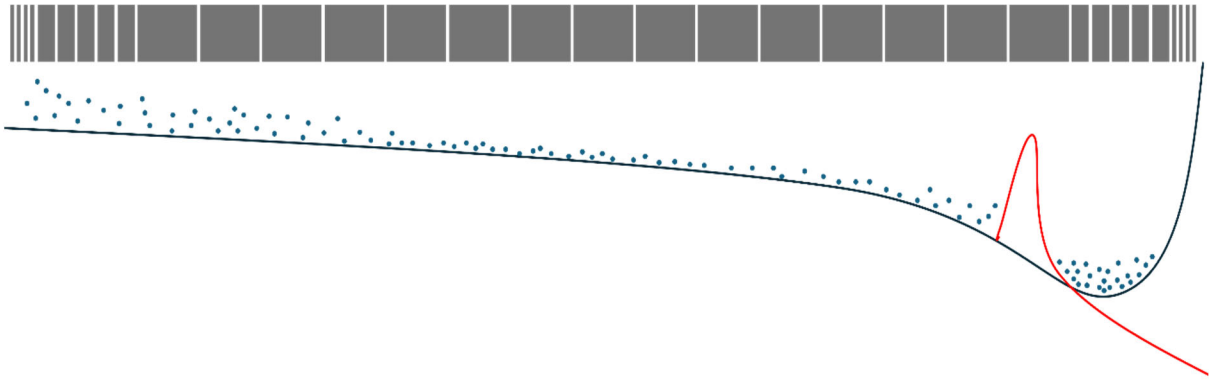

Fig. 2. A graphical representation of the cooling and bunching within GOLIATH as the beam of (blue) particles progresses from the left, losing energy to the buffer gas and is coaxed toward the bunching region via a potential gradient (black) that is applied to the electrodes of GOLIATH (grey), before being released by the dropping of the potential on the last electrode and raising of a kicking electrode (red).

With GOLIATH in place, commissioning tests are underway and are looking to be completed throughout the summer of this year. Studies into the potential gradient, trapping region shape, cooling time, gas pressure, and kicking electrode will be completed with the goals of the maximization of ion number per bunch and overall transport efficiency, with the minimization of time and positional spread. Following commissioning tests of GOLIATH at Texas A&M, it will be delivered to the University of Washington. Once there, the results of the tests will be crucial in the development of the beamline as we transition from a gaseous source to an ion source.

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

[2] D. McClain, *et al.*, Progress in Research, Cyclotron Institute, Texas A&M University (2021-2022), p. IV-31.

[3] D. McClain, *et al.*, Progress in Research, Cyclotron Institute, Texas A&M University (2022-2023), p. IV-33.

[4] D. McClain, *et al.*, Progress in Research, Cyclotron Institute, Texas A&M University (2023-2024), p. IV-17.