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The NSCL Cyclotron Gas Stopper - preparing to go 'online'

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Rare isotopes are produced at the NSCL by projectile fragmentation at energies of ~100 MeV/u. The NSCL has successfully used linear gas stopping cells for more than a decade to thermalize projectile fragments and extract them at 10's of keV energies; first for experiments at low energy and later for reacceleration to Coulomb barrier energies. In order to stop and rapidly extract light and medium-mass ions, which are difficult to efficiently thermalize in linear gas cells, a gas-filled, reverse cyclotron has been constructed [1]. The device uses a $\leq$2.6T field superconducting cyclotron-type magnet and helium gas in a LN-cooled stopping chamber to confine and slow down the injected beam. The thermalized beam is transported to the center of the magnet by a traveling-wave RF-carpet system [2], extracted through the central bore with an ion conveyor [3] and accelerated to <60 keV energy for delivery to the users.

For magnet commissioning and low-energy ion tests, the cyclotron gas stopper has been constructed in a location not connected to NSCL high-energy beamlines. The magnet has been energized to its nominal strength and the measured field is in excellent agreement with predictions. The RF ion-guiding components have been installed inside the magnet. Efficient ion transport has been demonstrated with ions from a movable alkali source with the magnet off. The tests are currently being repeated with the magnet energized and preparations are underway to cool the gas to LN temperature.

With offline tests coming to an end, an experimental vault is being prepared to allow connecting the cyclotron gas stopper to the NSCL beamline. The design for a dedicated momentum-compression beam line, similar to the ones feeding the linear gas cells, is essentially complete and the components are under construction. A summary of the offline tests, the layout of the cyc-stopper's new online location, the ion-optical design of the beamline and plans for the move of the device will be presented.
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[1] S.Schwarz et al., NIM B, 376, 2016, 256
[2] A.Gehring et al., NIM B, 376, 2016, 221
[3] M. Brodeur et al., NIM B, 317, 2013, 468

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