A new Fast Gas Stopper for Intense and Energetic Rare Isotope Beams

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The demonstration of the conversion of intense beams of fast projectile fragments into high-quality low-energy beams will allow the full range of rare isotope beams from projectile fragmentation to be used in precision experiments like laser spectroscopy or ion and atom trapping. Thus, the gas-stopping scenario is an integral part of all new radioactive beam facilities presently under construction or planning. The first complete demonstration that rare isotopes produced by projectile fragmentation of relativistic heavy-ion beams can be thermalized and used for Penning trap mass measurements at the NSCL [1]. While successful, the linear gas stoppers presently in operation are limited in terms of maximum beam intensities. Furthermore, the observed ion-extraction times that range from tens to hundreds of milliseconds do not match the benefits of fast-beam ion production. The development of a more robust concept is therefore critical.

Recent beam simulation studies performed at the NSCL [2] show that the stopping of heavy ions in a weakly focusing gas-filled magnetic field can overcome the intensity limitation of present systems while simultaneously providing a much faster ion extraction. The results are very encouraging; the cyclotron gas stopping scheme promises efficient stopping of beams with energies of >100 MeV/u at rates $>10^8$/s and extraction times of less than 5 milliseconds. The simulation results will be discussed and the ongoing design work towards the realization of a cyclotron gas stopper at the NSCL will be presented.

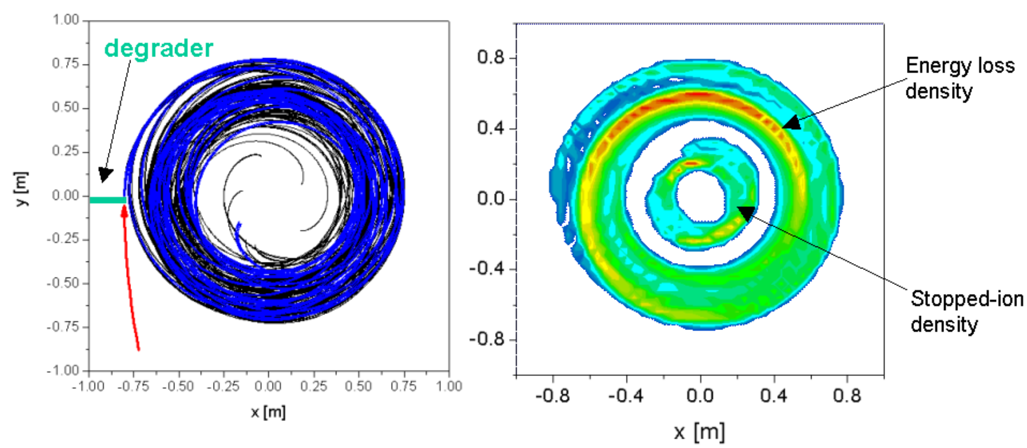

Figure 1*: Sample trajectories of 100 MeV/u ^{78}Br ions in a 2-T cyclotron gas stopper with 10 mbar He pressure (left). Energy loss density and stopped-ion distribution (right).*

[1] G. Bollen et al., Phys. Rev. Lett. in press (2006) .
[2] G. Bollen, D.J. Morrissey, S. Schwarz, Nucl. Instr. Meth. A550 (2005) 27