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Decelerating beamline design of an ECR ion source at Avalanche Energy

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Avalanche Energy's fusion system, the Orbitron, requires the transport of low-energy, positive ion beams into extremely low-pressure environments. As the fusion systems mature, the need for beam current increases rapidly. To match development pace of the Orbitron system, we have acquired a D-Pace ECR ion source that can produce 30 mA of D+ beam current at 50 keV of energy. While this source produces sufficient beam current for the next generation of Orbitron machines, the energy at which this beam is produced is too high. To accommodate a 10 keV ion beam requirement, a deceleration scheme has been designed and tested. First, a series of IBSimu simulations were conducted to design a lensing and deceleration system to convert the higher energy beam into an adjustable, 10 keV beam as required by the Orbitron. Surrogate optimization is employed to optimize the geometry and biasing based on beam current and spot size. Next, the system was designed mechanically to support the voltage and cooling requirements inherent to the system. Finally, tests were conducted on this design, and emittance measurements were taken to ensure that the beam is matched to the Orbitron's requirements. This work presents each step of this process and discusses its relevance to Orbitron fusion.

Primary author: HEPNER, Shadrach (Avalanche Energy)

Co-authors: LANGTRY, Robin (Avalanche Energy); VALENTEEN, Samantha (Avalanche Energy); SCHIPMANN, Scott (Avalanche Energy)

Presenter: HEPNER, Shadrach (Avalanche Energy)

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