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Overview of Ion Beam Delivery Program at Avalanche Energy

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Avalanche Energy's fusion systems require the transport of low-energy ion beams into extremely low-pressure environments, often within the constraints of compact packages. Traditional vacuum pumping methods used on accelerator beamlines are infeasible at this scale, necessitating innovative designs. This work presents an overview of the beam transport solutions developed at Avalanche, including the implementation of a multiple-stage differential pumping section that minimizes gas load downstream. To reconcile the need for low final beam energy with the advantages of high-energy extraction, we have adopted a decelerated beam approach —extracting and transporting at higher voltages, then reducing energy at the entrance to the Orbitron. Additionally, we employ electrostatic focusing and steering techniques, including Sikler lenses, to finely tune the beam trajectory and spot size within tight spatial constraints. This poster outlines the design rationale, simulation results, and performance metrics of our current beamline systems, highlighting their relevance for compact fusion.

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