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Design and Simulation of the IsoDAR RFQ Direct Injection System and Spiral Inflector

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The IsoDAR (Isotope Decay-At-Rest) experiment aims to explore physics beyond the standard model by searching for anomalous neutrino oscillations indicative of sterile neutrinos. The experiment requires a primary beam of H2+ ions to be accelerated to an energy of 60 MeV/amu at a current of 5 mA, which will be accomplished by using a high-power compact cyclotron. One of the challenges in this scheme is the injection into the cyclotron, where space-charge forces are strong and acceptance into a small RF phase window is desired. We aim to achieve this by using a Radio-Frequency Quadrupole (RFQ) injector, brought very close to the center of the cyclotron, which is capable of efficiently transporting and bunching the beam before an electrostatic deflector - called a spiral inflector - turns the beam onto the mid-plane of the cyclotron for acceleration. Careful design and simulation of this process is necessary. To this end, electric and magnetic field maps are generated in OPERA and loaded into the accelerator simulation code OPAL to run start-to-end simulations of the injection system and first few turns in the cyclotron. Several iterations between RFQ design and spiral inflector simulations will be necessary to optimize the geometry of the spiral inflector, i.e. to minimize the number of ions lost during injection and maximize beam current. I will present the development and latest results of the particle simulations and design optimizations for the IsoDAR RFQ direct injection project, particularly the spiral inflector.

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