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Garfield Simulation of the SpiRIT TPC Field Cage

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The SAMURAI Pion-Reconstruction and Ion-Tracker (SpiRIT), a Time Projection Chamber (TPC), is designed to measure the density dependence of the nuclear symmetry energy around twice the saturation density. The heart of the TPC is a field cage designed to measure the momentum distributions of pions and light particles emitted in heavy ion collisions. The interior of the field cage is 145 cm long x 97 cm wide x 52 cm high. The side and front walls are constructed of 1.6 mm thick halogen-free G10 printed circuit boards (PCBs) with 6 mm wide copper strips and 4 mm gaps between strips corresponding to a 1 cm pitch on both the interior and exterior sides of each PCB. The exterior strips are offset by 5 mm from the interior strips to expel electrons from the insulating gap. The top of the field cage is open to the wire and pad plane region and the cathode is located at the bottom. This rigid and gas tight structure has a thin (4 micrometer) PPTA upstream beam entrance window (6 cm wide x 7 cm high), and a larger (39cm x 81cm) and thicker (125 micrometer) polyamide exit window that allows passage of light charged particles and heavy ions with minimal energy loss to ancillary detectors downstream. Aluminum electrode surfaces were evaporated on the entrance and exit windows. These and the copper electrodes on the PCBs provide the electric field that drifts the ionized electrons to the wire planes.

We use GARFIELD simulations to study the uniformity of the electric field within the field cage geometry, the transmission properties through the gating grids and their dependence on the voltages set, and to investigate ExB drift effects in the avalanche wire region. Garfield is used because of its predictive power of optimizing drift properties of electrons, and ions, through the gas volume. In this talk, I will present the important simulations related to the design and operation of SpiRIT and the strengths and limitations of these calculations.

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