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Design of Gating grid driver for SπRIT Time Projection Chamber

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The SAMURAI Pion-Reconstruction and Ion-Tracker (SπRIT), a Time Projection Chamber (TPC) is part of an international effort to constrain the nuclear symmetry energy around twice the saturation density [1]. The field cage of the SπRIT TPC is designed to measure the momentum distribution of pions and isotopically resolved light particles emitted in heavy ion collisions. The field cage consists of a drift volume and three wire (gating grid, ground and anode) planes located just below the pad plane at the top. Positive ions produced in an electron avalanche near the anode wires can distort the electric field in the drift volume of a Time Projection Chamber. A gating grid is designed to prevent these ions from going back into the drift volume and to block electrons ionized by unreacted beam particles from entering the multiplication region. In the "open" mode, all the gating grid wires are set to have the same potentials (nominally -110 V). This condition allows drifting electrons to pass into the multiplication region consisting of the ground wire and anode wire planes. When the gating grid is "closed", alternate wires are biased up or down by about 70 V (-40 V and -180 V). The electric field created between the wires assures that no electrons pass through the gating grid wire plane to the anode plane. The gating grid has a dead region in which ionization electrons drift to the grid before it is opened. The size of this dead region is governed by the electron drift time and the time needed to open the gate. It is also related to the properties of the detector gas, pressure, and the electric field. We have investigated how to minimize the dead region by matching impedance of the driving circuit, estimate the inductance of the system and tune resistance, capacitance and inductance values so that the gating grid runs slightly underdamped. The designs, properties and operation of different gating grid drivers and the time each takes for the gating grid to open will be discussed.

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[1] R. Shane et al., Nucl. Instrum. and Meth. A (accept for publication)

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