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Options for gain elements and gas mixtures in a high rate EIC Time Projection Chamber

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☒ In order to investigate options for a future high rate TPC we have tested various gas gain structures and gas mixtures. Our goal was to focus on crucial TPC parameters: ion back flow, energy resolution (dE/dx), electron and ion drift speed, electron diffusion (in E- and B-fields), and stability. We concentrated on two options for the gain structure: 4 GEMs and MMG+2GEMs. For the hybrid option we achieve simultaneously an ion back flow below 0.3% and an energy resolution better than 12% for 55Fe X-rays at a gain of ≈ 2000 in a variety of gas mixtures. A few gas mixtures that we studied haven't typically been used in a TPC, but appear promising, and further testing is recommended. Additionally, we investigated a potential instability (especially for MMGs) that occurs primarily from a high voltage (HV) power supply (PS) voltage drop in reaction to a discharge. It was demonstrated that a resistive protection layer on a pad / strip readout structure reduces the HV PS voltage drop after a spark to practically negligible levels. The hybrid micro-pattern gas amplification stage allows for a TPC design that can operate in a continuous mode, serves as a viable option to limit space charge distortions in high-rate TPCs, and guarantees that dE/dx , ionization cluster space reconstruction resolution, drift parameters and detector stability will not be compromised.

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