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Possible Options for Gain Elements in a High Rate Time Projection Chamber.

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Abstract—A brief overview will be presented of the performance of Time Projection Chamber (TPC) gas amplification elements that have been utilized and proposed for next generation central tracking detectors, including an option with continuous readout at high luminosity. The presentation will concentrate on issues critical for high rate detector operation, such as the positive ion backflow (IBF) and energy resolution of these structures, but will not include track finding and momentum reconstruction performance. Both single- and multi-stage Gating Grid (MGG) structures and use of various combinations of micro-pattern gas detectors will be considered as an approach to minimize IBF and the resultant space charge build-up in the main TPC drift volume. A MGG+MWPC structure has been proposed* as an option to minimize TPC dead time. Our first preliminary results will be presented on measurements of the positive ions collection timing, with a comparison to simulations. We have proposed, simulated, and measured the properties of a combination of a MicroMeGas (MMG) detector with two Gas Electron Multipliers (GEM) for TPC application. We have measured the positive ion backflow (IBF) and energy resolution of this structure at various settings of the gains of the elements and the electric field between the elements with different chamber gases. At a gain of 2000, this configuration allows achievement of both an IBF below 0.4% and an energy resolution better than 12% (standard deviation) for 55Fe x-rays. Spark rates were measured for a variety of conditions and will also be presented, including a setup with a resistive layer for protection with a TPC application in mind.
Index Terms—TPC, Gating Grid, MicroMegas, GEM.

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