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Study on RPC signal attenuation and dispersion

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RPC Signal attenuation and dispersion are interesting topics and become more concerned since thin-gap RPC got popular and new readout methods proposed. Theoretical calculation indicates that attenuation and dispersion exist while signals propagating along the readout strips and both are relating to the surface resistivity of graphite layer and the propagation distance. In simulation we found the existence of signal attenuation and dispersion and verified that they are sensitive to the two factors mentioned above. To confirm and quantify, the measurements on thin-gap RPCs are performed. The lower limit of graphite surface resistivity of a certain RPC structure could be set which relates to the uniformity of electric field especially when the counting is high.

Gas gaps with different graphite surface resistivity are prepared for this study. To perform the propagation-distance-relating measurement, we manage to get two signals which are originally identical but have different propagation distance. While the charge induced on the readout strips by the avalanche, two signals would be generated and propagate towards both ends of the strip. In the far end the strip is kept floating i.e., connecting to an infinite resistor, to make the signal reflected back to the near end keeping the strength and polarity. Both signals would be terminated on the near end connecting to the matching resistors then observed and recorded by the oscilloscope. The difference of propagation distance could be given by the orthogonal readout strips or derived from the time difference of two signals'leading edges together with pre-measured signal propagation velocity. By this way two signals with different propagation distance are not only identical after induced but also are read from one readout strip oscilloscope channel, thus the systematical errors of this study would be suppressed.

Analysis of the waveforms would be performed offline. Charge, frequency and dispersion of each two signals would be studied and compared. Lowpass filter would be used to filter the high frequency noise. Influence of signal reflection would be studied using TDR (Time Domain Reflectometry) and would be calibrated.

Preliminary results show that the existence of both signal attenuation and dispersion, and the charge attenuation is about -2 dB/m with 120 kΩ/SQ graphite layer. The relationships between attenuation, dispersion and graphite surface resistivity, propagation distance would be discussed in details and counter measurements would be proposed.

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