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Efficient and time-encoded imaging detectors based on MPGDs

Gaseous detectors and in particular MicroPattern Gaseous Detectors (MPGDs) are widespread devices in High Energy Physics experiments. Recent technology developments have resulted in successful demonstrations of their usability for x-ray fluoroscopy and 3D imaging, energy resolved photon counting, and various other applications.

In certain conditions, MPGDs behave like scintillator plates with extraordinary scintillation yields. Thus, combining a low noise optical readout with the signal amplification inherent to MPGDs allows for excellent image qualities.

The anticipated technological advances in commercially available cameras, chiefly the increase of the sensor sensitivity and the recorded frame rate, will make time-stamping in images obtained from MPGDs competitive, which will enable not only time-resolved images, but also the mitigation of pileup in photon counting mode. Moreover, a dedicated amplification scheme will make time encoding in images on a tens of nanoseconds scale feasible, transforming the detector into a versatile 3D imaging device: a time projection chamber (TPC) where the time information is contained in the images themselves.

The full development picture foresees an increase of sensitivity to neutral particles - namely gammas and neutrons - on the detector side. Solid converters which maximise the performance (efficiency, position resolution, point spread function, etc.) are under study. Secondary electron emitters with embedded converters coupled to MPGDs will allow for fast, sharp and efficient imaging devices.

While the time scale for all these fields of research is several years, and it depends on the technological advances on the sensor performance and material science, the impact of the results from such activities, though uncertain, can be of extraordinary impact.

Summary

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