Study of micropattern gaseous detectors for high rates of x-ray imaging Applications

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Studies of the operation of various micropattern gaseous detectors (MICROMEGAS, GEM, capillary plates, microgap PPAC, microgap RPC) at very high x-ray fluxes will be presented. It will be shown that as a rule the maximum achievable gain (before breakdowns appear) for all micropattern detectors drops significantly with the counting rate. We investigated physical mechanisms involved in this phenomenon. At relatively low gains (~100) some micropattern detectors, GEM for example, can operate safely at rates of up to 10^6Hz/mm^2 in the case of a steady radiation, and up to 10^9Hz/mm^2 in the case of a pulsed radiation.

As a result of these studies we have developed spark-protected microgap RPCs capable of operating at gains of ~10^4 and at counting rates of 10^5Hz/mm^2. The other unique property of this microgap RPC is its high position resolution: better than 50 microns in digital mode at rates of 10^5Hz/mm^2. The breakthrough in achieving extraordinary rate characteristics and position resolutions was only possible after solving several serious problems: RPC's cleaning and assembling technology, aging, spurious pulses and after-pulses and discharges in the amplification gap and along the spacers. High-rate, high-position resolution RPCs can find a wide range of applications in many different fields, for example in synchrotron radiation or medical imaging. Several images obtained with this detector will be demonstrated.