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Development of gaseous photomutipliers with Micro Pattern Gas Detectors

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In the last few years, considerable effort has been devoted to the development of gaseous photomultiplier tubes (PMTs) with micro-pattern gas detectors (MPGD) which are sensitive to visible light. The potential advantage of such a gaseous PMT is that it can achieve a very large effective area with moderate position and timing resolutions. Besides it can be easily operated under a very high magnetic field (˜1.5 Tesla).
Since photon and ion feedbacks cause faster degradation for the bi-alkali photocathode, the maximum achievable gain might be limited at a level 100. Several recent developments, however, have successfully achieved a long term high sensitivity for a photon detection by using hole-type MPGDs such as a gas electron multiplier (GEM) and a glass capillary plate (CP).
We constructed a double Micromegas detector with a bi-alkali photocathode. The gain of this device was studied by measuring the signal currents at the anode, first mesh, second mesh and the photocathode while varying the applied voltage of the first and second meshes. The gain reached 2×10ˆ3 without a large deviation from the exponential curve. However, at a gain above 2×10ˆ3 we observed a rapid gain rise due to secondary effects. In order to develop a gaseous PMT having no substantial secondary effects up to 10ˆ5 with a bi-alkali photocathode we tried some combinations of a hole-type MPGD and a Micromegas.
We developed a hole-type MPGD with Pyrex glass by using a micro-blasting method, which allows the problem-free production of bi-alkali photocathode while a kapton GEM reacts with the photocathode materials. Basic performance tests of the Pyrex CP gas detector were carried out with a gas mixture of Ne (90%) + CF4 (10%) at 1 atm. We successfully obtained a gain of up to 1.5×10ˆ4 and an energy resolution of 23% for 5.9 keV X-rays.
In the development of gaseous PMTs with less ion-feedbacks we made simulation studies by using Garfield and Maxwell 3D, which can simulates the motion of electrons and ions in MPGDs.
We will present a current status of the development of gaseous PMTs and simulation results.

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