An aging study of a MICROMEGAS + GEM detector

J. May, S. Kane, J. Miyamoto, I. Shipsey

presented by **Jun Miyamoto**

Dept. of Physics, Purdue University, W. Lafayette, IN 47906, USA

We are studying the aging behavior of a micromegas detector with GEM preamplification. Because of minimal insulation materials and its inherent parallel E-field in the amplification gap, superior radiation hardness was previously reported in Ar-Isobutane gas mixture in a micromegas detector with no preamplification. It is expected to tolerate even a larger amount of radiation in cleaner gas mixture like Ar/CO_2. However, using it as a stand-alone device in this mixture (low gas gain) could increase its discharge probability and it could lead to faster degradation of detector performance. To circumvent this problem, small preamplification with a GEM was added to extend the life time of the main detector. It is well known that the GEM itself tends to age if too much gain requirement is imposed on it, thus a good balance of gain sharing between the micromegas and the GEM should make it possible to build a very radiation-hard gas detector. We will report on the aging behaviors of both devices when the two devices are combined to achieve high gas gain and operated under safe conditions.

Summary of Talk: A micromegas detector consists of an anode plate and micro-mesh separated by only 50 – 100 microns [1]. Unlike typical micro-patterned gaseous devices, its electric field is similar to that in a parallel plate chamber. This parallel structure may have distinct advantage in terms of radiation hardness. From our experience, trying to achieve high gas gain in an extremely narrow gap with an insulator in-between (e.g. near anodes of MSGC and MGC) could accelerate aging and its effect is more pronounced in the form of dark deposit accumulated on the strips of these devices [2]. Accumulation of deposits on very thin strips could change the detector properties irreversively. The parallel structure of the micromegas allows the use of anode strips on the electron collector that are wider by an order of magnitude so that very fragile thin anode strips are not needed to achieve the same gas gain. The elimination of the thin strips can minimize aging effects significantly even if some deposit is formed on the metal surface because some surface will be always available for charge collection.

A Micromegas detector has another advantage in that it has very little insulating materials between the anode and the cathode. The only insulating material near the avalanche region is the small pillars made of Kapton separated by a few millimeter pitch and the area obstructing the active detector area is almost negligible. This feature was not available in the MSGC and a large insulator often becomes an origin of discharge.

For the reasons above, the first aging study of the detector was very encouraging and 16 mC/mm^2 was accumulated in an Ar/Isobutane mixture by the Saclay group [3]. Because of the high gas gain that such a gas mixture allows, the micromegas was used as a stand-alone detector with no preamplification. In order to build a more radiation-hard detector, cleaner gas like Ar/CO_2 must be used but this gas mixture does not yield gas gain high enough to be of practical use and preamplification is necessary. In our work a GEM (gas electron multiplier) was used to add preamplification and the gain was shared by both the GEM and the micromegas. This gain sharing mechanism usually works favorably assuming that both devices are quite radiation hard but the radiation hardness of GEM's was already confirmed by our previous work [4]. We will report on the radiation hardness of the combined system in our talk.

References:

1. Y. Giomataris et al, Nucl. Instr. and Meth. A 376(1996)29.
2. E. Gerndt et al, Nucl. Instr. and Meth. A422 (1999)282.
3. Private communication with Y. Giomataris, 2000
4. J. Miyamoto and I. Shipsey, IEEE Nuclear Science, Vol 46, No 3,1999, 312-316