The Performance of a Wire Chamber with a Light-Sensitive Methane/TMAE Gas Mixture at High Counting Rates

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A multiwire photon detector with the addition of TMAE vapor to achieve photo-sensitivity was tested as a possible candidate for the HERA–B RICH detector. The main obstacle for use of such a methane/TMAE filled gas detector in a high rate experiment, appears to be prohibitive aging in the form of rapid loss of chamber gas gain and thus of efficiency. The lower efficiency in turn reduces the number of detected photons per Cherenkov ring and thus the velocity resolution. The gain reduction is attributed to polymer deposits on the anode wires. In order to remove these deposits, a special circuit was constructed, which enabled heating of the anode wires in-situ with elevated currents. An almost complete recovery of the gain was achieved. Unfortunately, this recovery is not of long duration, but is followed by a quick drop in gain. With periodic short heat treatments, an average gain considerably higher than for the non-heated wires could be achieved. Although this rejuvenation of the aged wires does not seem to be sufficient for HERA–B, it could hopefully be useful in experiments with somewhat lower rates.

Summary of Poster: One of the candidates considered as a photon detector for the HERA–B RICH was a multiwire proportional detector with the addition of TMAE vapor to achieve photo-sensitivity. The test module, inspired by the JETSET chamber, consisted of 64 (8×8) cells with 8×8 mm^2 cross section and 10 cm length. It was made of 0.2 mm thick slotted, gold-plated bronze plates. A 50 μm diameter gold-plated tungsten anode wire was stretched along the axis of each cell, being soldered to an end-plate on one end and to a ceramic bridge on the other. The module was closed on the top and bottom by the end-plate and by a quartz window respectively. Such a design ensured short drift times, required by the 96 ns bunch crossing time in HERA. It also permitted operation with the TMAE vapor pressure below saturation, thus avoiding condensation, while conserving high quantum efficiency. The signals were read out by charge sensitive preamplifiers. They were then led through amplifiers (EG&G Mod.574) to CAMAC discriminators (Philips Mod.7106) and to CAMAC scalers (CAEN, Mod.$C_2$57). The discrimination threshold could be set by the computer programme, which enabled quick scans of the individual cell count rates versus their threshold voltage setting. With -2650 V on the cathodes and the anodes at ground potential, an exponential pulse height distribution, due to single photons from a UV lamp, was obtained. Thus, the distribution of count rate versus threshold voltage should also be exponential, with the logarithmic derivative inversely proportional to the average pulse height and thus to the chamber gas gain. A small UV light source and a spherical mirror gave a parallel beam with which 8 cells were illuminated resulting in an event rate of about 2.5 MHz per cell. As may be seen from the threshold scans of cells at the beginning and towards the end of illumination, the gain has been considerably reduced which is indicated by the increased slope. On the other hand, the rate extrapolated to zero threshold, has not changed, indicating no change in quantum efficiency. The gain reduction is attributed to polymer deposits on the anode wires. The ratio of average responses of illuminated and non-illuminated cells showing a gain reduction to about 30% of the initial value in 300 hours of illumination. This illumination corresponds to $\sim$ 55 mC of accumulated charge per cm^2 of the detector surface. In order to remove these deposits, a special circuit was constructed, which enabled heating of the anode wires with elevated currents. A mass-spectrometric analysis showed no changes in composition of evaporated components above a temperature of 200^0C, which was the limit set also by possible loosening of the solder bonds. The threshold scan immediately after heating shows that the gain has increased to approximately the value it had at the beginning of illumination. In other words, the rejuvenation with heating almost compensates the aging due to illumination. Unfortunately, this rejuvenation is of short duration. The gain falls more quickly after heating. Nevertheless, the heating of anode wires has an overall beneficial effect. With periodic short heat treatments, an average gain considerably higher than for the non-heated wires could be achieved. Although this rejuvenation of the aged wires does not seem to be sufficient for HERA–B, it could hopefully be useful in experiments with somewhat lower rates.