reliable computations. This type of information is practically usefull as it can be applied to any type of geometry. It should be stressed that the model fails if the cylindrical symmetry is lost, and this happens in the RD detector as soon as the streamer starts to be seen, on the regions of 1 or 2%.

References

[1] C. C. Bueno et al., to be published in Nucl. Instr. Meth. A.
[2] M. Margarida Fraga et al., IV International Workshop on Resistive Plate Chambers and Related Detectors, Naples, Italy, October 1997.
[3] E. Cerron et al., Nucl. Instr. Meth. A373(1996)35.

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Study on Avalanche Gain and Charge Collection in Microgap Detectors at High Pressure

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Introduction

Microstrip and microgap gaseous detectors operated at high pressure have been considered for the development of 2D devices with low granularity, efficient in an energy range of up to 25 keV in detectors for medical applications and synchrotron radiation [1-3]. We have reported that even when using microgaps with narrow anodes (4 μm) the safe maximum gain at 6 bar at high rates is low (under 200) [4] and that in order to be used in practical detectors these devices should be used, with a preamplification structure such as the recently developed gas electron multiplier (GEM) [5]. It is known that space charge effects are important to proper GEM operation and that, in order to avoid recombination at high pressure, the typical drift fields are much higher than at atmospheric pressure. Considering the great interest of those preamplifying structures, we decided to study the dependence of the charge collection on the drift electrode at several pressures using gaseous mixtures containing heavy gases, such as krypton, at various counting-rates and gains. Since our previous work has shown that the anode and insulator width is of great importance for high-pressure operation of microgaps, their influence on the drift current is also considered.

System Description

A stainless-steel chamber and a clean gas system were used. Special care was taken to keep the gas impurities to a minimum. Two series connected picoammeters (Keithley 602 and 414s) were used for simultaneous measurement of the anode and cathode currents. The drift electrode current was computed from the difference between these two values. The distance between the microgap surface and the drift electrode was 5 mm. The electrodes were made of aluminum and the insulator is silicon oxide of 3 μm thickness. The anode pitch is 100 μm and several anode and insulator widths were used. The measurements were performed with a beam energy of 12 keV using an X-ray generator. The gain was calibrated either by the pulse amplitudes or by the current and count rate measurements.

Experimental Measurements

During all the measurements the gas mixture was Kr-10%CO_2 and the gain was set at 150 within an error of less than 10% at a drift voltage of 1000 V. As expected, the drift current also depends on the value of the drift voltage. The ratio of the drift and anode currents for two count rates and two different anode layouts versus applied drift voltage shown that when using the wider anodes and insulators the anode voltage is higher than with the narrower ones, and this can explain the observed difference in drift currents. At high counting, the variation of the ratio between the drift and anode current with the counting rate, for several drift voltages, is such that the reduction of this ratio at the maximum counting rate (about 5%) seems almost independent of drift voltage. The variation of the ratio between the drift and anode current versus counting rate using four different microgap layouts were studied. The general trend of the preceding results appears again, wider insulators yield higher drift currents and the reduction in drift current is not significantly dependent on the anode layout. The fraction of the avalanche charge which is collected at the drift electrode versus counting rate for different values of pressure is shown that at 3 bar the reduction in the ratios between drift and anode currents seems less evident than at 6 bar, but, taking into account the associated measuring errors, this reduction cannot be considered significantly different. At 1 bar the variation is smaller, being almost non-existent.

Conclusions

Our study of the drift current has shown that its value is strongly dependent on the value of the drift field and counting rate and that with the typical drift fields used at high-pressure operation the amount of positive ions that is collected by the drift electrode is important. While we could not see effects that could be easily associated exclusively with the influence of the layout on the avalanche development in the studied microgaps, it was shown that microgaps with wider insulating widths feature higher drift currents. Considering the importance of the pulse speed in high count rate applications, we have shown that microgap detectors at 6 bar should be operated with a sufficiently high drift field to have a fast rise time. However, in these conditions, as much as 20% of the avalanche ions are collected in the drift electrode. The influence of this charge on the proper operation of the GEM multiplying device at high pressure is still to be studied.

References

[1] S. E. Baru, V. V. Neusroev, A. Papanestis, G. A. Savinov, and L. I. Shekhtman, Proc. Int. Workshop on Micro-Strip Gas Chambers, Lyon, France, (1995), p. 27.
[2] F. Angelini, R. Bellazzini, A. Brez, M.M. Massai, G. Spandre, M. R. Torquati, Proc. European Workshop on X-Ray Detectors for Synchrotron Radiation Sources, Aussois, Frances, (1991), p. 96.
[3] F.A.F. Fraga, M.M.F.R. Fraga, R.F. Marques, L.M.S. Margato, J.R. Gonçalo, A.J.P.L. Policarpo, C.W.E. van Eijk, R.W. Hollander, J. van der Marel, Nucl. Instr. and Meth. (1997).
[4] F.A.F. Fraga, R. Ferreira Marques, I. Ivaniouchenkov, L.M.S. Margato, J.R. Gonçalo, A.J.P.L Policarpo, C.W.E. van Eijk, R.W. Hollander, J.van der Marel, presented at the IEEE 97 Nuclear Science Symp.
[5] R. Bouclier, W. Dominik, M. Hoch, J. C. Labbé, G. Million, L. Ropelewski, F. Sauli, CERN-PPE/97-32.

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Medida do Espectro de Energia dos Nêutrons Emitidos na Linha de Produção de radioisótopos do Ciclotron do IEN com o uso de Detectores de "Threshold"

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Desde março de 1999 o Instituto de Engenharia Nuclear (IEN), vem comercializando o ^{123}I ultrapuro, usado no radiodiagnóstico da tireóide. Sua produção é feita empregando-se o Ciclotron do IEN em conjunto com o sistema KIPROS, recentemente adquirido do Forschungszentrum Karlsruhe (FZK) da Alemnha, que possibilita a produção do iodo-123 à partir da irradiação de gás xenônio enriquecido a 99% no isótopo de número de massa 124. Nas condições atuais de irradiação, tem-se empregado uma corrente de 20 μA de prótons de 24 MeV em feixes de três horas de duração, realizados durante a madrugada. Com o aumento da demanda pelo iodo-123 teremos, num futuro próximo, que elevar a corrente e aumentar o tempo de irradiação de forma a atender às necessidades do mercado. Para garantir que as doses a que os técnicos envolvidos no processo de produção permaneçam em níveis aceitáveis, torna-se necessária uma otimização da blindagem de concreto e polietileno que confina a linha de irradiação. O primeiro passo nessa direção é a determinação do espectro de energia dos nêutrons emitidos no processo. A partir dos valores das seções de choque de reações do tipo (p,xn) nos diferentes materiais que são irradiados, calculou-se a fluência estimada dos nêutrons produzidos nas condições de feixe descritas ácima. Considerando-se o valor encontrado (10^{12} n/s), bem como a disponibilidade de alvos e equipamentos e a rapidez do método, optou-se pelo uso de detectores de "Threshold" na determinação do espectro de energia dos nêutrons. O levantamento do fluxo de nêutrons está sendo feito a 20 cm da superfície da câmara de irradiação do gás com lâminas metálicas de: ouro, (com e sem um invólucro de cádmio), alumínio, níquel e índio. As medidas das atividades induzidas nesses materiais são feitas com um detector do tipo HPGe que teve sua eficiência determinada para três diferentes geometrias de posicionamento das fontes, (5, 12 e 18 cm de distância), em função dos diferentes níveis de ativação dos materiais