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A HANDBOOK OF THE BEHAVIOUR OF STREAMER TUBES AS A FUNCTION OF THE HIGH VOLTAGE AND OF THE GAS MIXTURE

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The streamer tubes are now widely used in many experiments in high energy physics, so that we thought useful to systematically investigate their behaviour as a function of the high voltage for different isobutane content in an argon-isobutane mixture.

The tested chamber was composed of 48 tubes, 9x6 mm^2 in cross section, equipped with 60 μm wires. The tubes were constituted, following a common technique, by a plastic comb-like profile and a cover. The inner surfaces were painted with high resistivity graphite (> 100 k$\Omega/\square$). The high voltage was applied to the graphited surfaces and the 48 wires were OR-ed and grounded through a 10 kΩ resistor.

The chamber was tested using a Fe^{55} source, giving X rays of low enough energy (5.9 keV) to produce a single cluster in the gas. The charge collected on the wires was sent to a LeCroy QVt multichannel analyzer. The high voltage was varied from proportional mode region through streamer mode to the discharge limit for different argon-isobutane mixture (10/90 to 50/50). The peak positions of the charge distributions are given in Figs. 1-5 for the different gas mixtures and compared in Fig. 6. All the figures present three regions; in the low voltage range we have the typical exponential trend of proportional mode, which begins to sa-

turate before entering a second region were streamer mode appears. Going up with high voltage only streamer mode remains with a lower slope in the exponential trend of amplification. The transition region is more accentuated for higher content of argon. Some examples of charge distributions are reported in Figs. 7 and 8. Fig. 7 shows the coexistence of proportional and streamer peaks, with the first one slowly disappearing going up with high voltage. Fig. 8 points out the arising of the tail due to multi streamer production in the streamer mode region.

All these results are intended as a handbook valid for tubes with cross sections in the range 5x5 to 10x10 mm^2 and wire diameter 1/100 of the average cell side. We controlled in a complementary test that the general behaviour of smaller tubes (brass and copper tubes, 4x4 mm^2 and 3.5x4.5 mm^2 in cross section) is analog. In Fig. 9 the charge distribution peak versus high voltage is given for 90% and 100% isobutane content. Examples of charge distributions are given in Fig. 10. In Fig. 11 we compare the behaviour of the charge distribution peak for 4x4 mm^2 and 6x6 mm^2 tubes with the same gas mixture (33/77 argon-isobutane).

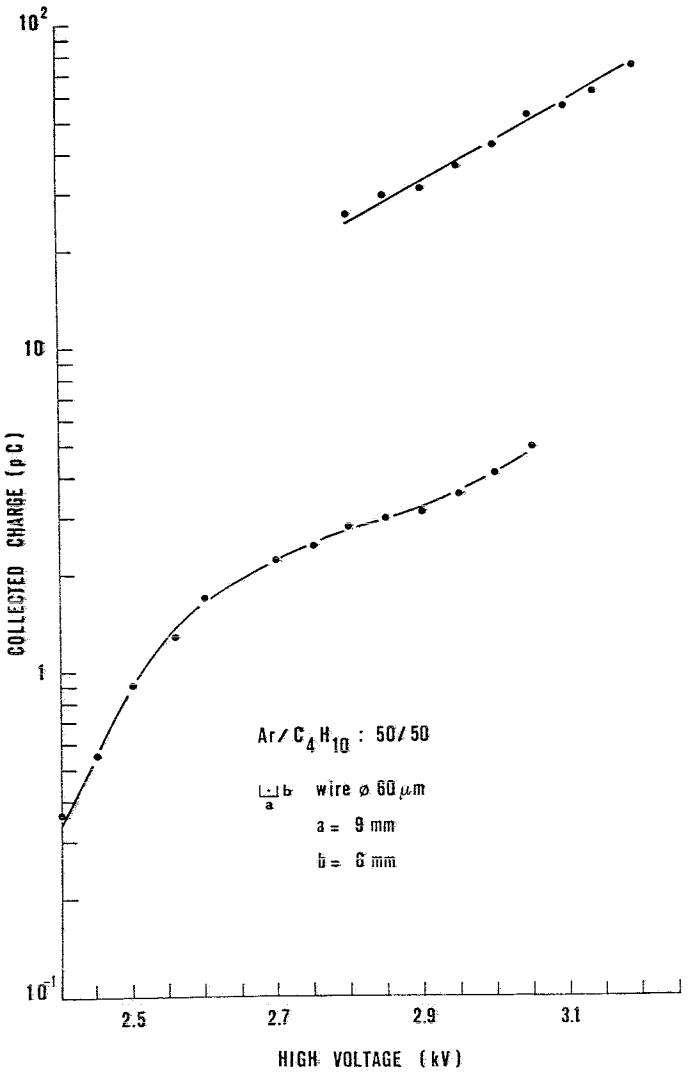

FIG. 1 - Charge distribution peak versus H.V. for Ar/C_4H_{10} = 50/50.

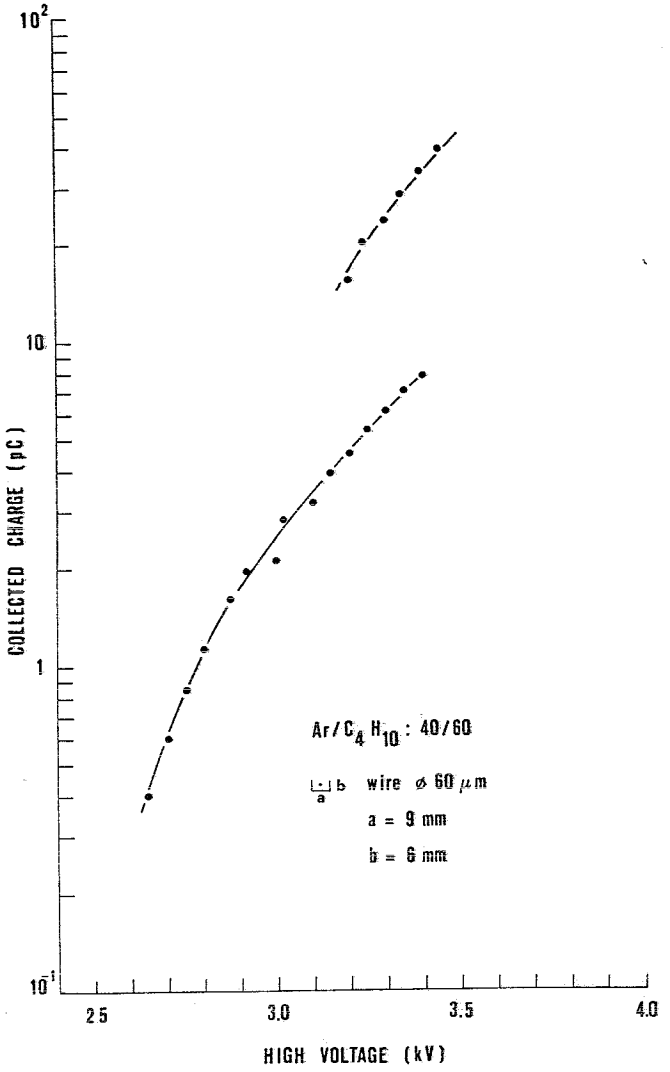

FIG. 2 - Charge distribution peak versus H.V. for Ar/C_4H_{10} = 40/60.

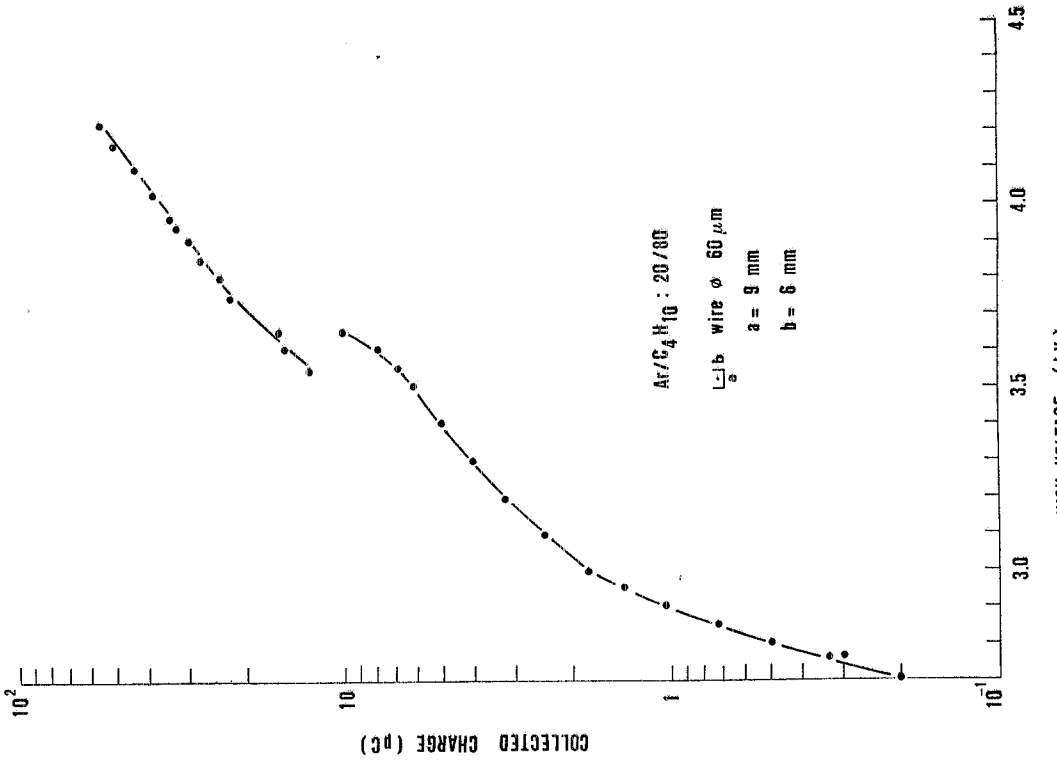

FIG. 4 - Charge distribution peak versus H.V. for Ar/C_4H_{10} = 20/80.

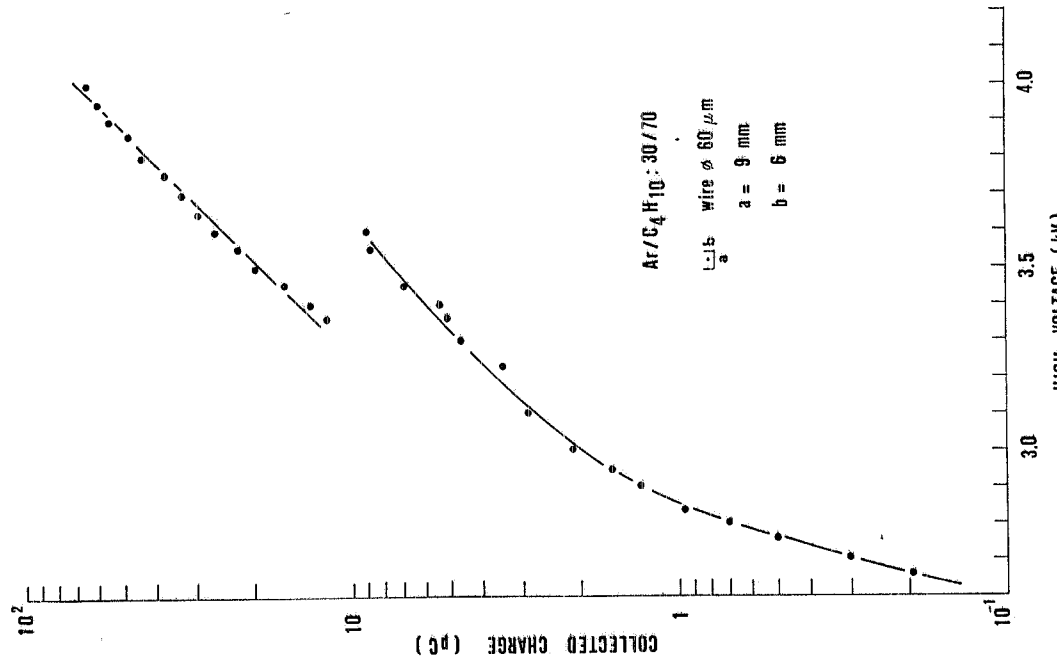

FIG. 3 - Charge distribution peak versus H.V. for Ar/C_4H_{10} = 30/70.

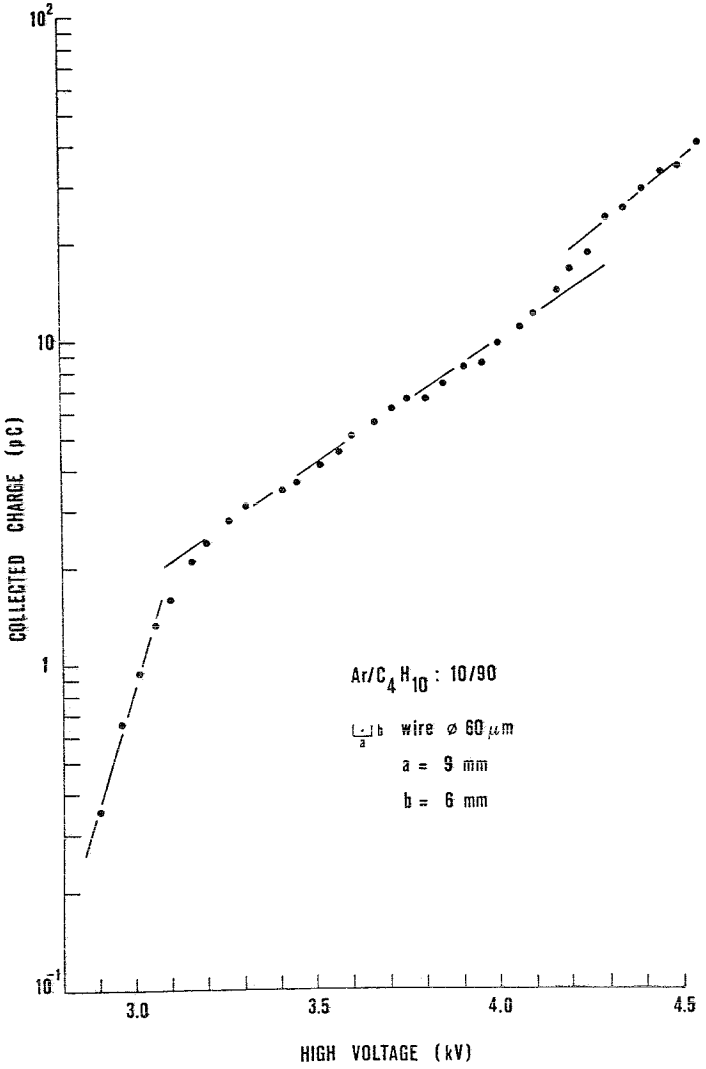

FIG. 5 - Charge distribution peak versus H.V. for Ar/C_4H_{10} = 10/80.

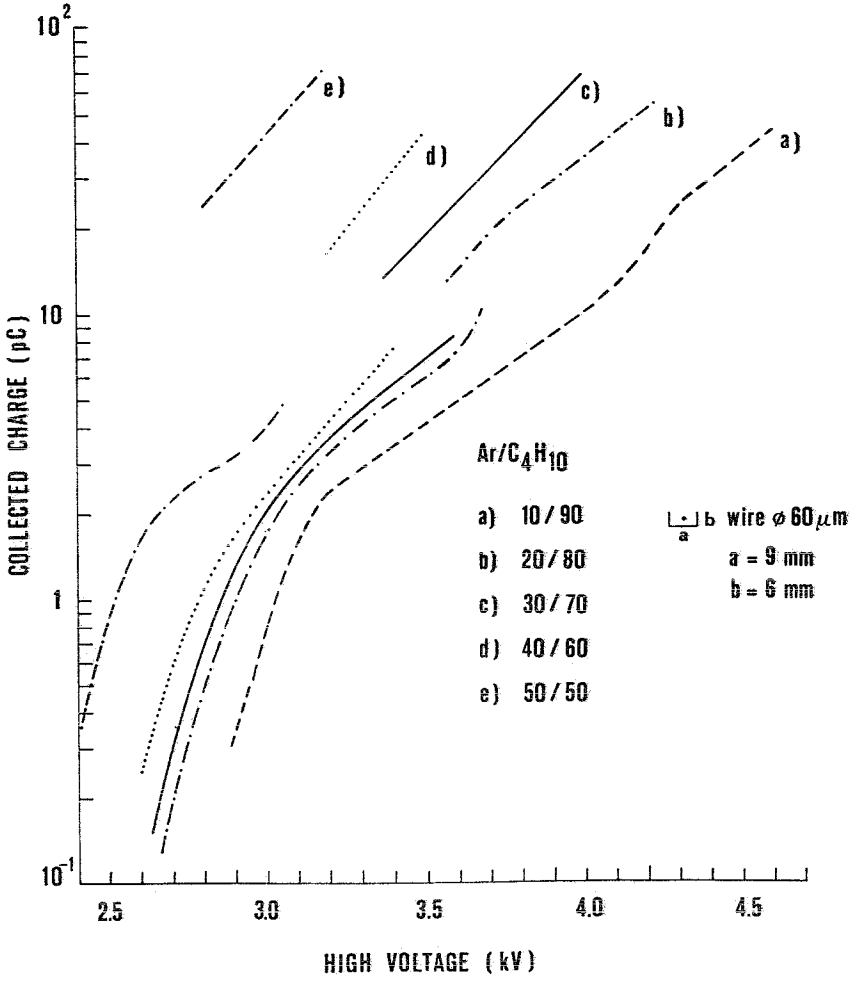

FIG. 6 - Comparison of charge distribution peaks versus H.V. for different gas mixtures.

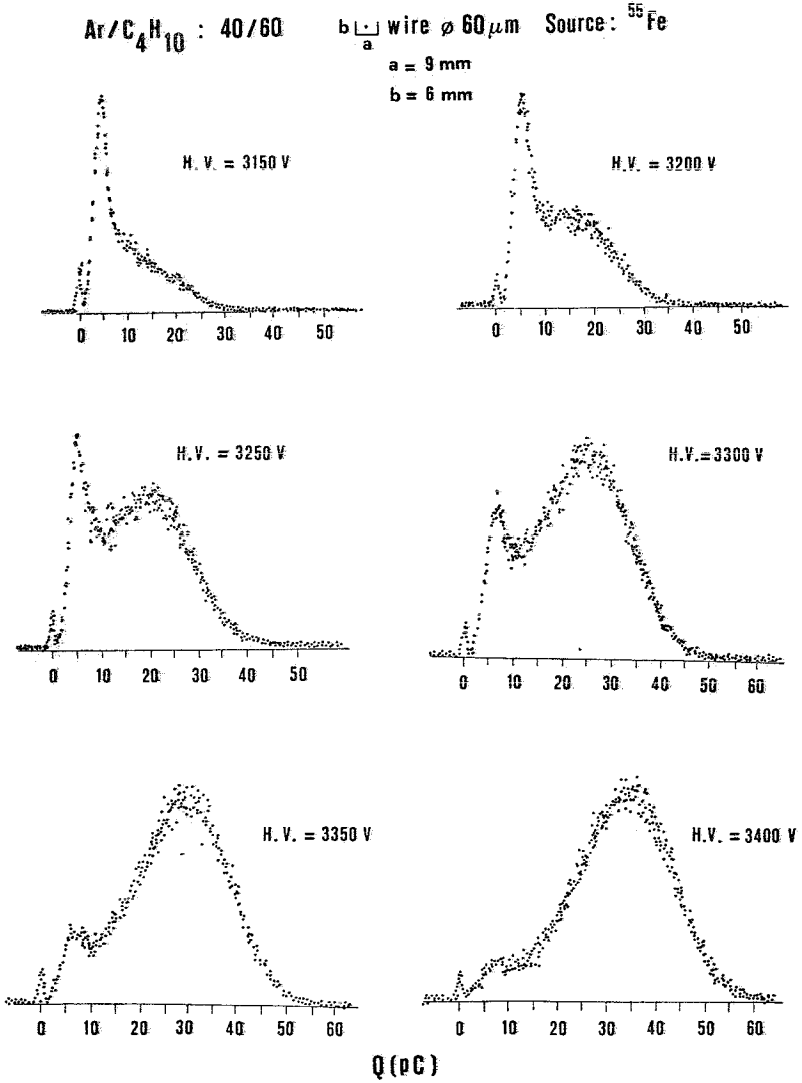

FIG. 7 - Examples of charge distributions for 9x6 mm^2 tubes with Ar/C_4H_{10} = 40/60.

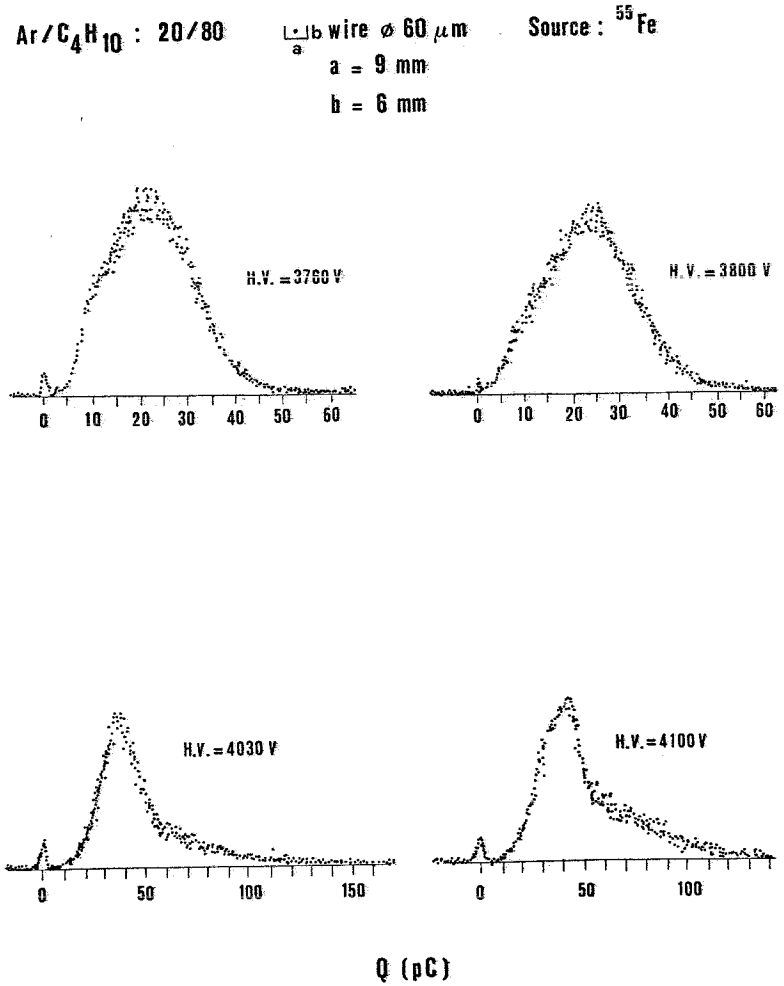

FIG. 8 - Examples of charge distributions for 9x6 mm^2 tubes with Ar/C_4H_{10} = 20/80.

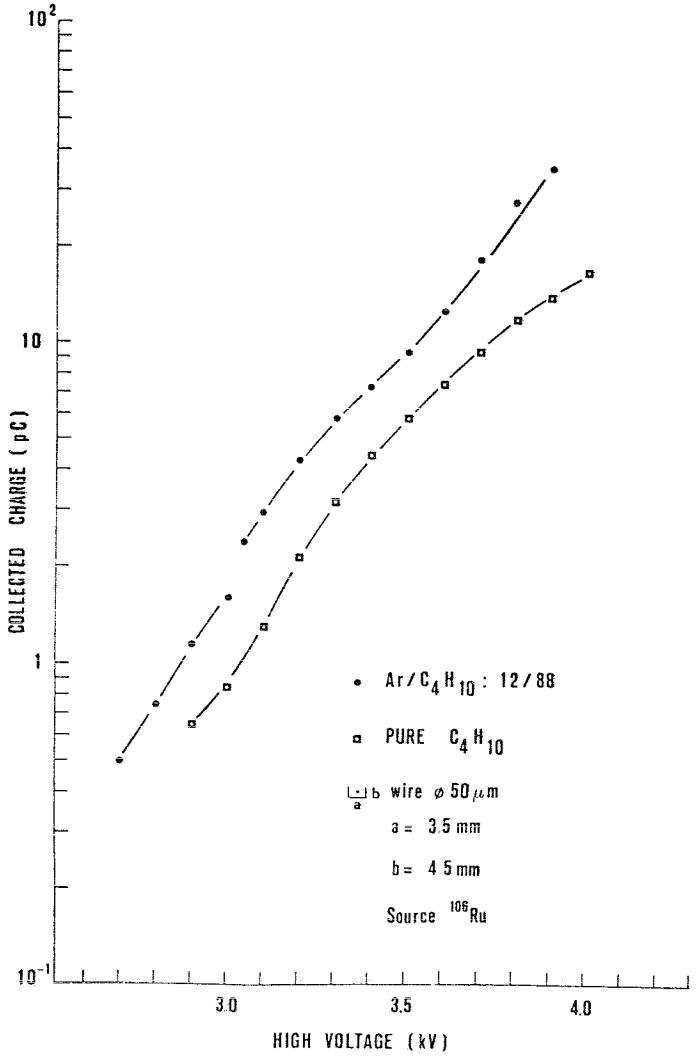

FIG. 9 - Charge distribution peak versus H.V. for Ar/C_4H_{10} = 12/88 and 0/100.

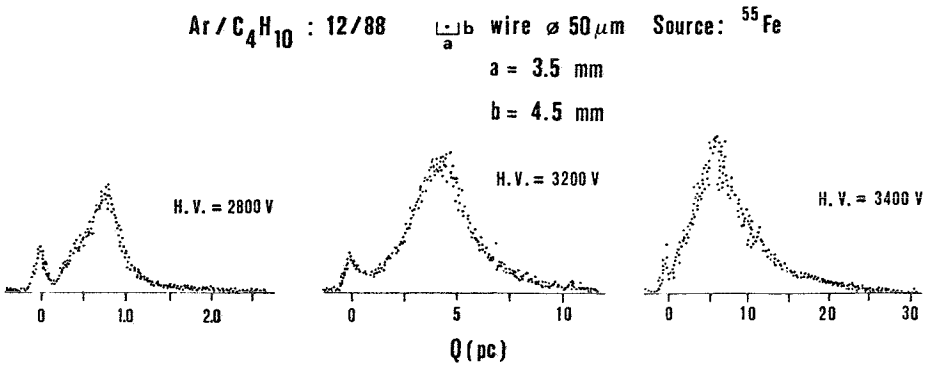

FIG. 10 - Examples of charge distributions for 3.5x4.5 mm^2 tubes with Ar/C_4H_{10} = 12/88.

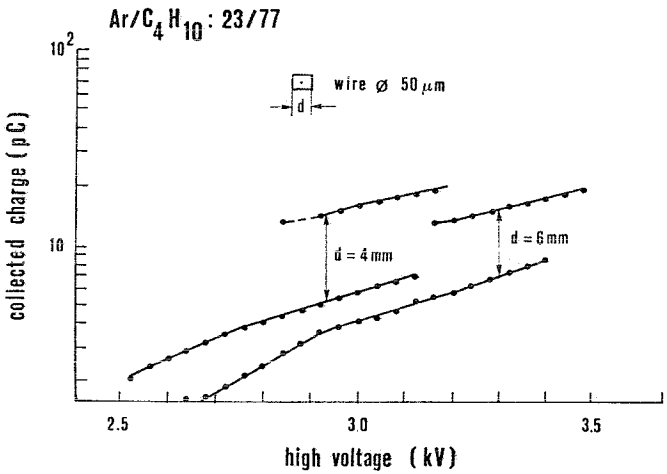

FIG. 11 - Comparison of charge distribution peaks versus H.V. for 4x4 mm^2 and 6x6 mm^2 tubes.