31

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V.D.Laptev, Yu.N.Pestov and N.V.Petrovykh

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Institute of Nuclear Physics
Novosibirsk 90,USSR

The plane spark counters with a high counting rate are discribed. The counters area is 100 cm^2 and the gap is 0.2 mm. The accuracy of measuring the delay time between the counters is $2\tau_{1/2} = 155$ psec.

The known spark counters, having a high time resolution, are limited by a small area and a low counting rate [1,2]. It is necessary to quench the voltage applied to the counters plates for ~1 msec after the detection of each particle so that the electric strength of the gap can be recovered. It was shown in the works [3,4] that using a semiconductive material as one of the electrodes in combination with special absorbing photons gas mixture allow one to create the conditions for a local quenching the voltage at small region around the spark while the other area remains sensitive to the charged particles. The necessary voltage-recovery time of the discharged area was selected by a resistivity of the semiconductive electrode. Therefore the possible counting rate increases K times as compared with a usual spark counter where K is the ratio of detector's area to the local discharged area. Moreover, there is the possibility of constructing the plane spark counters practically with any area.

A principal design of the counter is shown in fig.1. The negative electrode was a 12 mm thick optical glass covered by a vacuum-deposited chromium layer of 200 Å and then by a vacuum deposited copper of 1μ. To obtain a good copper layer a double deposition was used with intermediate standard treatment (see below) of the preceding layer. The electrode (2) is a semiconductive glass [5] $100\cdot100\cdot5$ mm^3 on which the copper strips 10 mm wide and 1 mm spaced were vacuum deposited. The thickness of semiconductive glass was chosen from a condition that a radiative attenuation

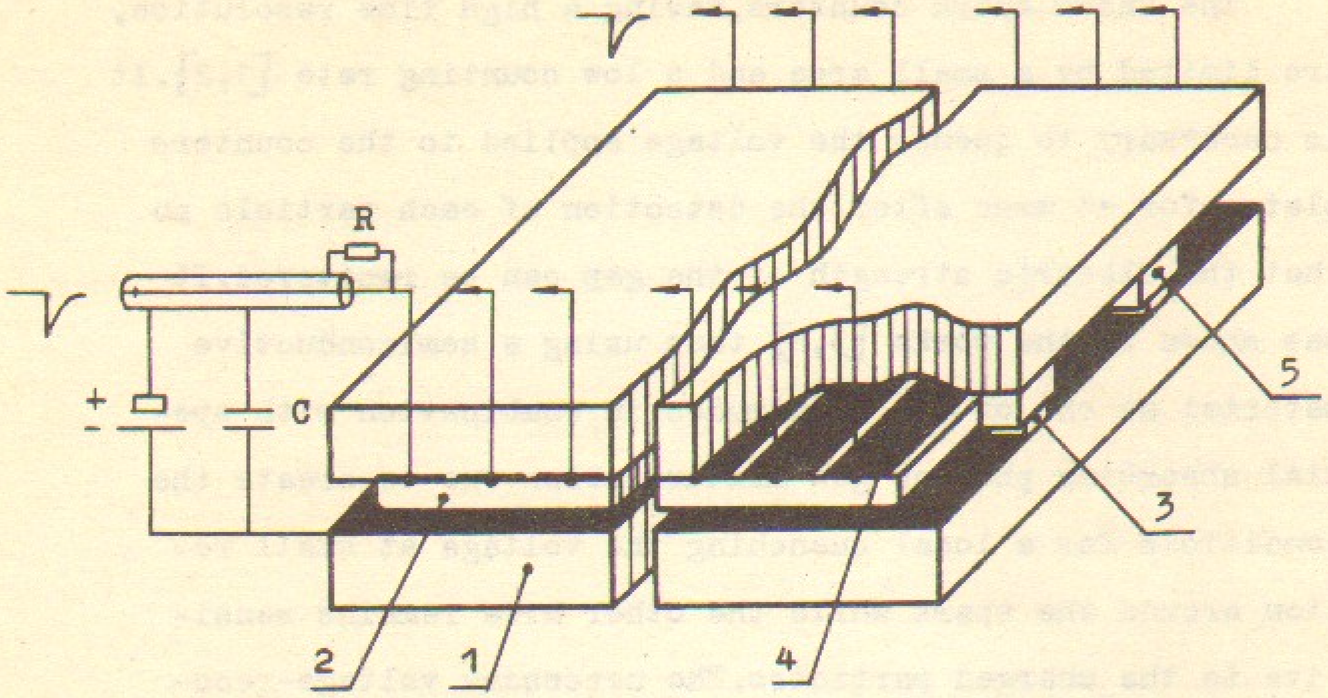

Fig. 1.

The principal design of the counter. 1) The negative electrode. 2) The semiconductive glass electrode. 3) The steel laying 0.185 mm. 4) The copper strips. 5) The optical glass laying.

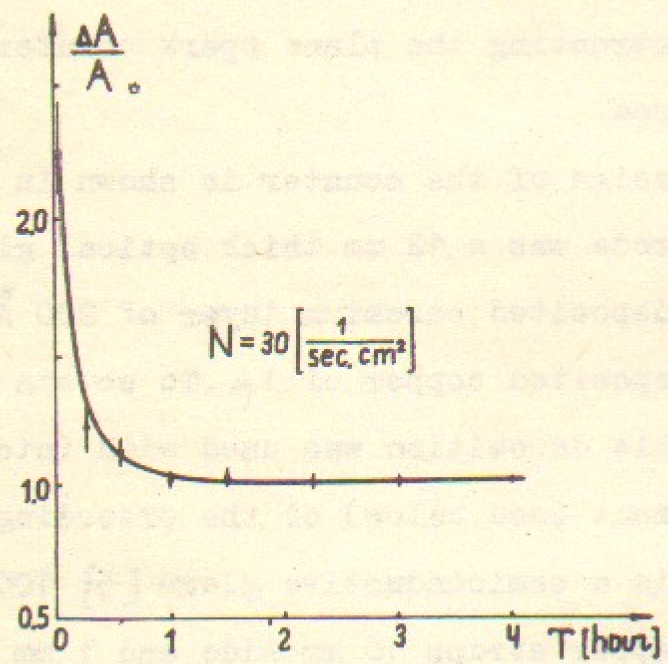

Fig. 2.

The dependence of the ratio $\Delta A/A_0$ (see fig.3) on working time of the counter with the radioactive souce Co^{60}.

of a spark signal in a strip transmission line, formed by copper strips and opposite electrode, was negligible up to 10^9 Hz. The semiconductive electrode was glued by the epoxy on the optical glass 12 mm thick. The glueing on the optical glass provided a mechanical hardness of the electrode which stood a high pressure of ~300 kv/cm electric field in the gap. Two spark counters were produced with a different resistivity of semiconductive electrodes. One counter had the electrode resistivity $7\cdot10^9$ om·cm and the other one $1\cdot10^9$ om·cm. The last resistivity provided after breakdown recovery time comparable with the gas deionization time. The semiconductive glass had the dielectric constant $\varepsilon=10$ for the both counters.

The electrodes were polished to an accuracy of 2 μ over the plane. The distance between electrodes was fixed by a steel laying $185\pm2\,\mu$ thick.

Preassemble treatment of electrode surfaces consisted in oil removal by cleaning with the fine polishing powder "Polyrit" on the felt and subsequent rinsing with big quantity usual water and then distilled one. A boiling of the electrodes in distilled water were necessary if the surfaces were polluted by some organic matters. The control for the readiness of the surface was performed by interference strips. These strips appeared on the thin layer of the water when it avaporated from the clean surface of the electrode. The counter assembling place was fenced against a dust by a good electrifying film "Astrolon". This method of preparing electrode surfaces and assembling allowed one to

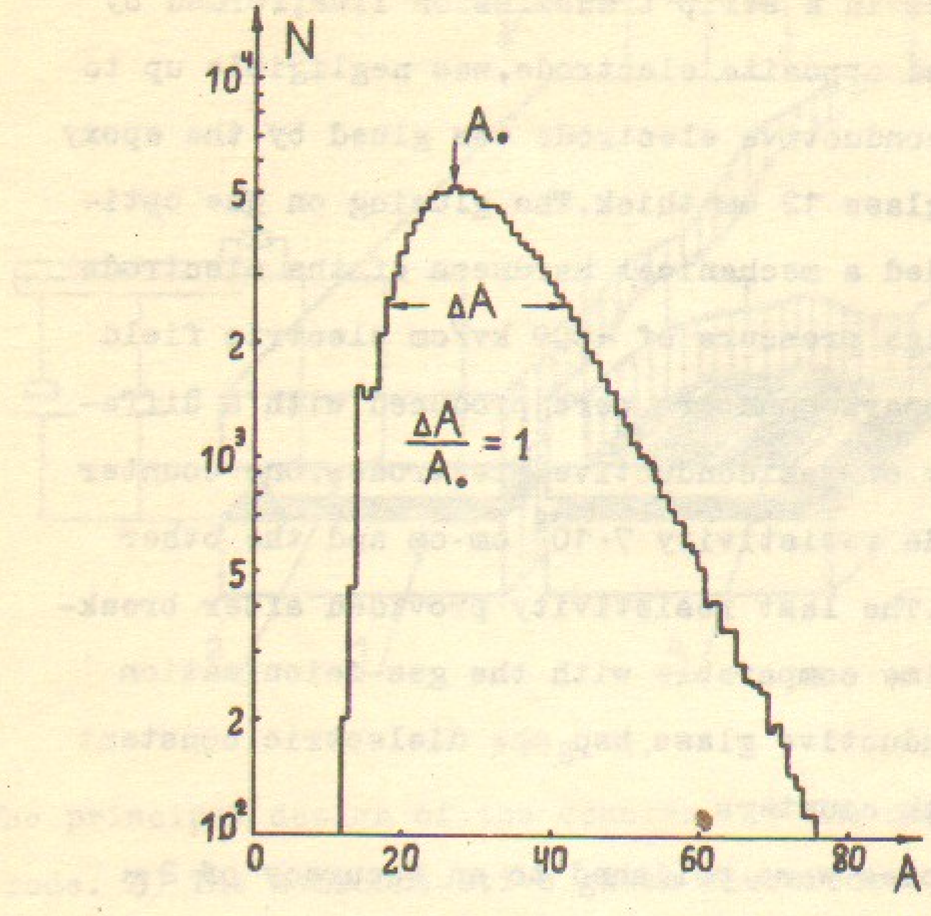

Fig. 3.

The amplitude distribution of the pulses.

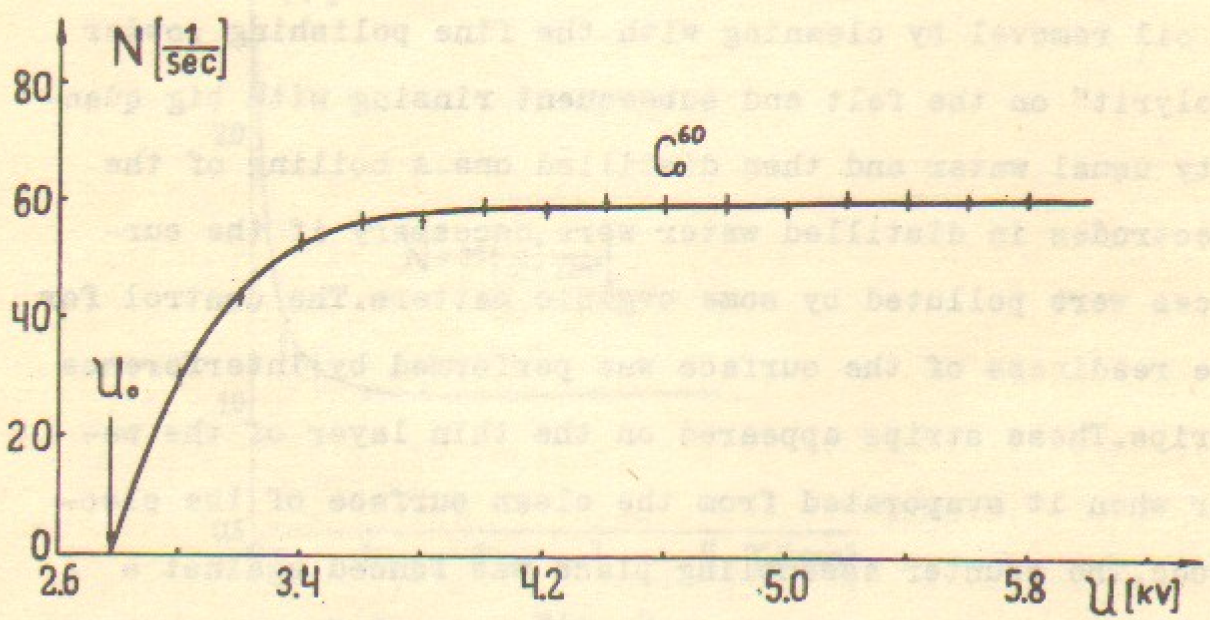

Fig. 4.

The counting characteristic.

get usually the counters of a high quality.

The counter was placed in a volume of a stainless steel,pumped out and filled with a following gas mixture: 2% divinyl, 5% ethylene, 20% propane, 10% hydrogen and 63% argon at full pressure of 6 atmosphere.The main admixtures, absorbing photons and locating a discharge,were divinyl, ethylene and propan.Argon provided a high efficiency for charged particles,hydrogen increased the life time of the counter.The gas was made by a centrifugal pump to circulate in the closed system of counter and gas dust clearing filter at a velocity of 1 m/sec.Such a high gas velocity reduced strongly chemical reactions in the gas mixture.

The width of amplitude distribution was large at the first counter switching because the used gas mixture absorbed photons insufficiently.However,the amplitude distribution width decreased to $\Delta A/A_o=1$ (fig.2,3) after the detection of 10^5 pulses per cm^2 of the counter surface from the radioactive souce Co^{60} .After that the width did not practically depend on the working voltage,on the increasing of the content of the absorbing admixtures,on the repeated filling by the gas mixture and on the working time.This effect can be explained by the change of the conditions on the electrodes surfaces due to the covering them by a thin polymeric film.It is possible to attain the same width of the amplitude distribution at first switching by increasing of the absorbing admixtures's amount.However,the life time of the counter decreased in this case.

The counting characteristics are shown in fig.4.The plateau slope does not exceed 0.5% per 100 v.The dependence of

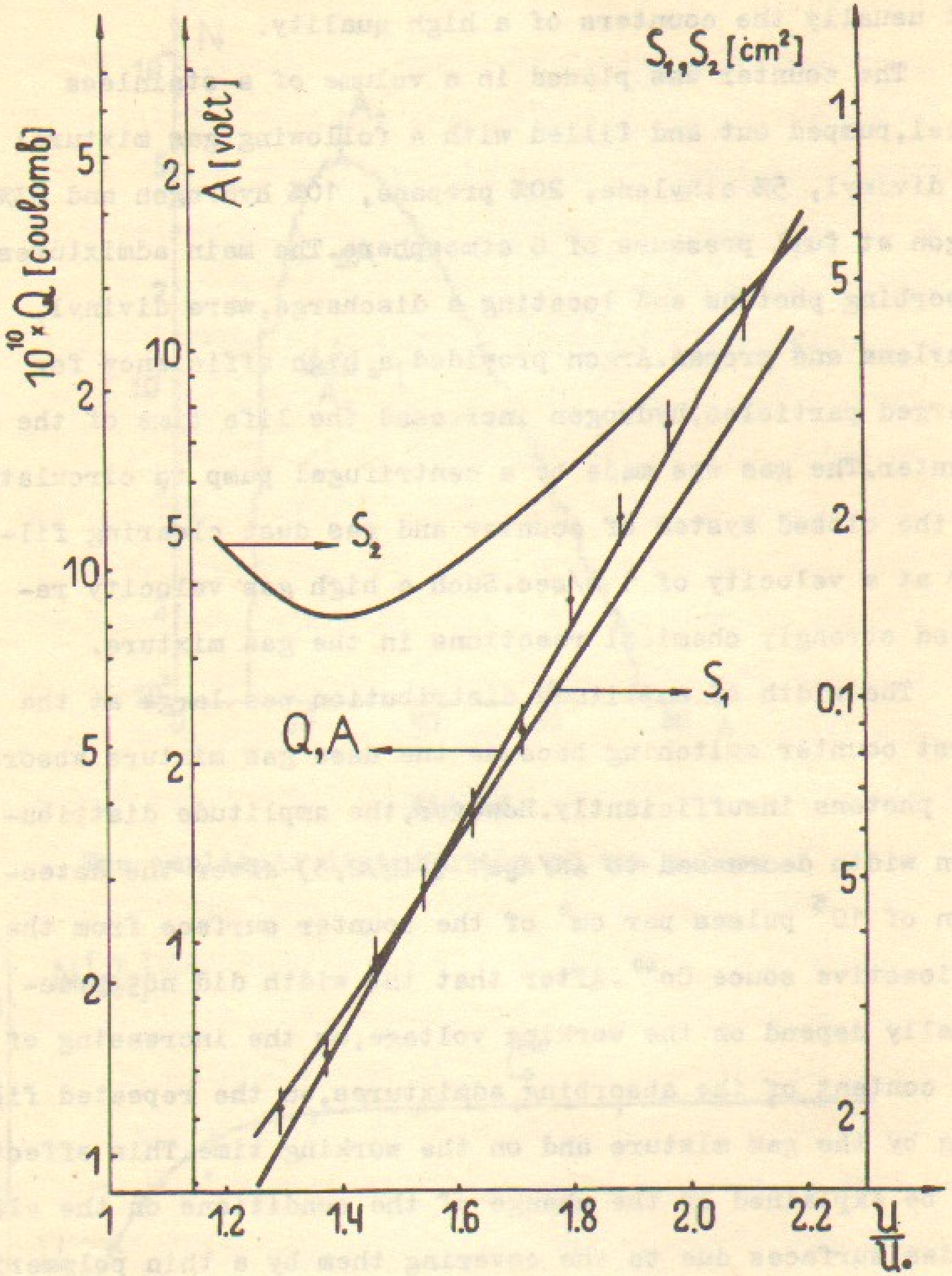

Fig. 5.

Some characteristics of the counter at the maximum of the amplitude distribution. Q is the charge induced on the electrodes at the breakdown. A is the pulse amplitude on a 50 om load. S is the area,losing the charge at the breakdown. S is the area insensitive to particles after the breakdown.

some characteristics of the counter on voltage are shown in fig.5.These characteristics correspond to the maximum of the amplitude distributon (fig.3).The pulse amplitude from each copper strip of the counter was 12 v on a 50 om load,if the applied voltage was 2.1 times higher than the threshold value.The area which lost the charge at the breakdown was 0.35 cm^2.This area was calculated at the assumption that the removal of the charge from the breakdown area is uniform.The area which was insensitive to particles just after the breakdown was 0.5 cm^2.This region consists of the area losing the charges at the breakdown and the surrounding area were the voltage drops below the threshold value.The last area is determined mainly by the thickness of the semiconductive glass.

The ability of the counter to work for a long time was investigated by means of the radioactive source Co^{60}.More than 10^7 pulses per cm^2 of the counter surface were detected without changing counter's characteristics at a voltage 1.5 time higher than the threshold value.The thickness of the homogeneous polymeric film on the electrode surfaces turned out to be 0.2μ.The research of the ageing effect of the counter is continued.

The time characteristics of the spark counter were studied by measuring a delay time between the signals from counters,placed one over another,from cosmic ray events.Fast electronics provided a compensation of the time spread connected with the particles passage through different points of counters.The histograms of pulse time distribution at the applied voltage 2.1 times higher than the threshold value

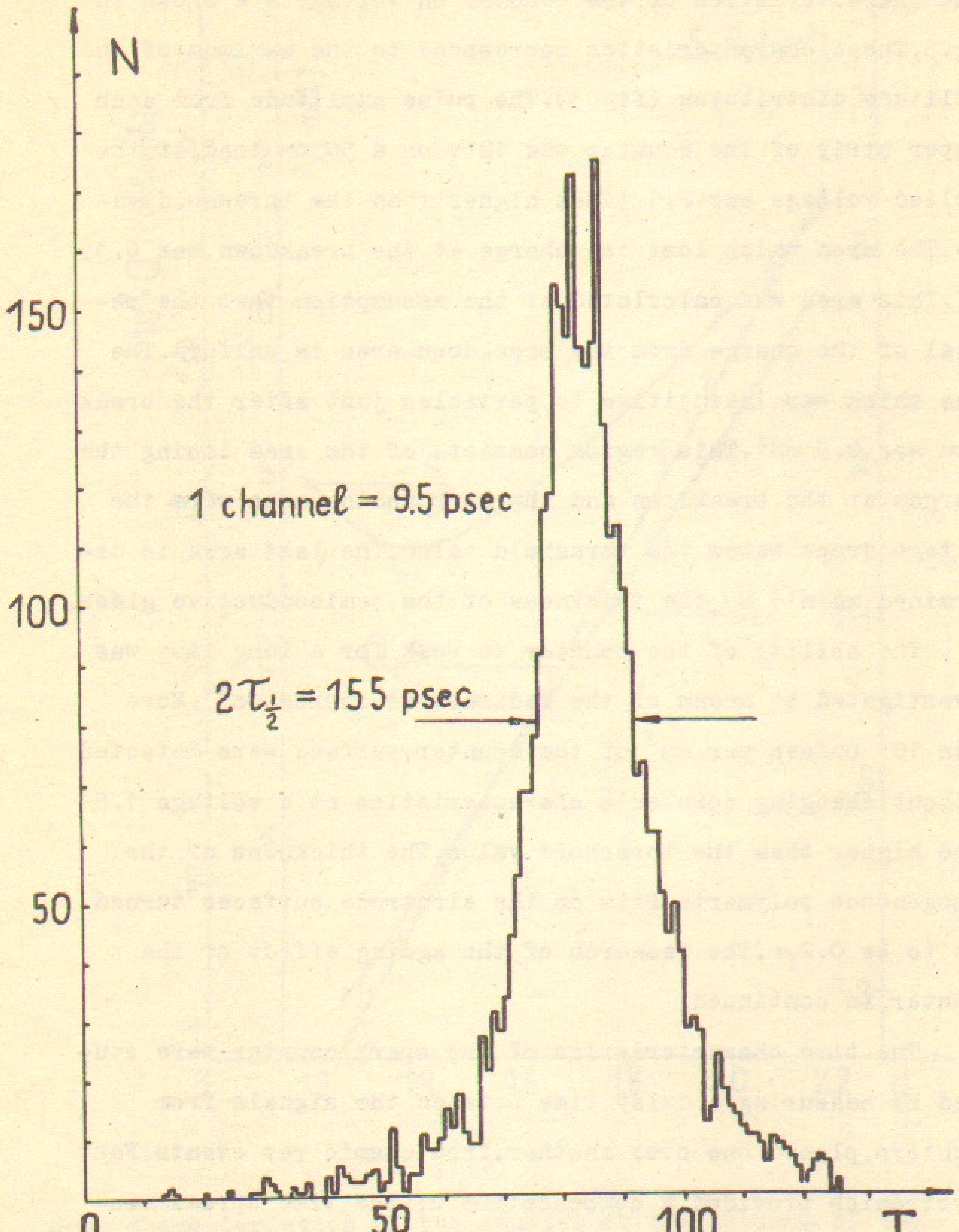

Fig. 6.

The histogram of pulse time distribution for two counters.

is shown in fig.6. The full width at half-maximum was equal to 155 psec. Under these conditions the measured efficiency was not less than 96%.

It is natural to use the good time properties of the pulses for a definition a particle coordinate in the counter by measuring a delay time between the signals coming from a spark at opposite ends of the copper strips. The preliminary experiments show the possibility of measuring coordinate with the accuracy better than 1 mm [6].

We think that the time resolution of the considered counters can be improved several times by means of increasing a overvoltage and decreasing counters gap.

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