RESULTS OF INVESTIGATION OF A WIDE-GAP SPARK CHAMBER WITH COMPENSATION OF THE PARTICLE-TRACK DRIFT

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When spark chambers are fed with high-voltage pulses of unipolar form, the drift of the cascades causes the tracks to be shifted parallel by a distance a relative to the true particle trajectories. This drift is proportional to the angle α of entry of the particle into the chamber. At the same time, in view of the distorted character of the electric field in the working volume of the chamber, the tracks are rotated through a certain angle ϕ. This is illustrated in Fig. 1. Both these factors reduce greatly the reliability of a wide-gap spark chamber as a tracking instrument. It is natural to expect such distortions of spark tracks to be completely absent or to be greatly reduced if an alternating electric field of sufficiently high frequency is produced in the volume of the chamber.

We checked the spatial accuracy of a two-gap spark chamber fed with radio pulses having a carrier frequency from 3.0 to 8.0 MHz. For comparison, analogous measurements were made also with unipolar pulses. The chamber had gaps of 15 cm each and a working area 25 × 25 cm. The high-voltage pulse was applied to the central electrodes. The chamber was filled with pure neon at atmospheric pressure. The photographed tracks of cosmic muons with energy above 0.3 GeV in the angle interval from 0 to 30 deg. The data reduction was by means of a computer using the semi-automatic measuring apparatus working in line with the "Razdan-2" computer.

Figure 2 shows the average and rms displacements of the spark tracks in a direction normal to the real particle trajectory. We see that at a frequency

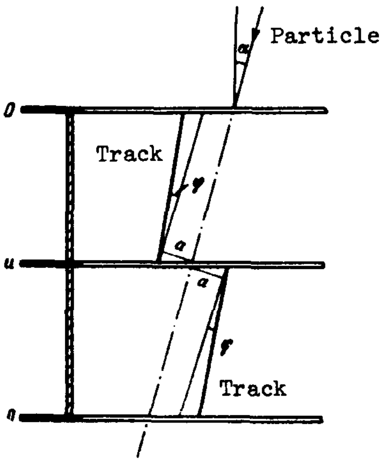

Fig. 1

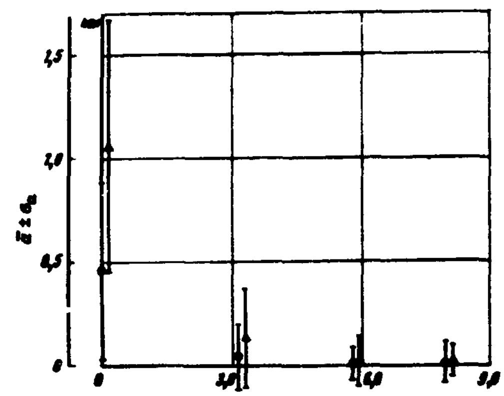

Fig. 2

Fig. 1. Character of reproduction of the trajectory of a charged particle by the spark track in a wide-gap chamber in an electric field from a high-voltage pulse of unipolar form.

Fig. 2. Dependence of the shift of the spark tracks relative to the true charged-particle trajectory on the frequency of the electric field applied to the chamber. ● and ▲ correspond to results obtained in the angle interval 0 - 10° and 10 - 30°.

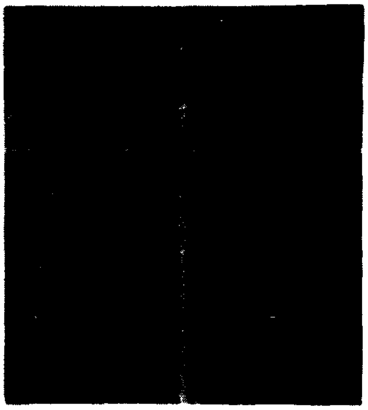

Fig. 3

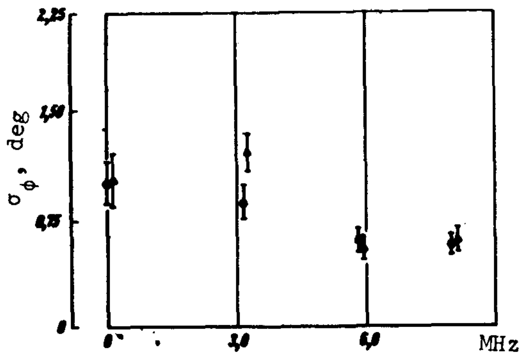

Fig. 4

Fig. 3. Exterior view of tracks obtained by applying to the chamber a unipolar pulse (case a) and a radio pulse with carrier frequency 8.0 MHz (case b). In both cases the high-voltage pulse was applied to the central electrode of the chamber. The frequency of the reference oscillations on the oscillograms is 10 MHz.

Fig. 4. Dependence of the rms false angle between the track and particle trajectory on the frequency of the electric field applied to the chamber. ● and ▲ correspond to results obtained in the angle intervals 0 - 10° and 10 - 30°, respectively.

6 - 8 MHz there is practically no displacement, and σ_a is of the order of 80-90 μ, i.e., it does not exceed the usual amplitude of the "convolutions" of the tracks. For clarity, Fig. 3 shows the tracks and the high-voltage pulses corresponding to them. Track a was formed by a uniform pulse, brack b by a radio pulse with f = 8.0 MHz. It should be pointed out that the experimentally obtained number of radio-pulse periods beyond which the displacement is no longer observed is 6 - 7, regardless of the frequency.

Figure 4 shows the results of the measurement of the angular accuracies. We see at 6 - 8 MHz the rms false angle σ_ϕ between the track and the true trajectory is almost half as large as in the case when a unipolar high-voltage pulse is applied to the chamber. This indicates that the influence of the distorted character of the electric field in the chamber is also greatly reduced in an alternating field.

We wish to note here that the foregoing data are not the last word, since ordinary glass was used in the spark chamber, and the photography was by means of the RFK-5 camera.

Thus, it can be stated on the basis of the obtained data that a wide gap-spark chamber fed with a high-voltage radio pulse makes it possible to measure tracks that coincide in space with the particle trajectories, thus permitting, in physical experiments, the reconstruction of the kinematics of the investigated processes with a larger spatial accuracy.

In conclusion, the authors thank K. Amroyan for help in the reduction of the results.