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ANGULAR DEPENDENCE OF THE BRIGHTNESS OF STREAMER TRACKS

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Submitted 15 January 1967; resubmitted 16 June 1967
ZhETF Pis'ma 6, No. 6, 684-687 (15 September 1967)

It was shown in [1] that a streamer chamber can be used to measure the ionizing ability of charged particles, and that the most characteristic parameter defining the ionizing ability is the track brightness.

However, when particles having a definite ionizing ability pass through the chamber when the latter is in a fixed operating mode, the track brightness is a function of the angle α between the particle trajectory and the electric-field intensity vector $\vec{E}$. We have investigated the character of the variation of the brightness of streamer tracks varying the angle α, and also the dependence of the limiting angle α_n on the ionizing ability of the charged particles (α_n - angle at which the chamber operation goes over from the streamer mode to the tracking mode). To determine the influence of the duration of the high-voltage pulse on these characteristics, the measurements were made at two high-voltage pulse durations ($\tau_1 \approx 40$ nsec, $\tau_2 \approx 42$ nsec), and at electric field intensities $\vec{E} = 10$ kV/cm.

It is known that streamer development occurs during the last few nanoseconds of the total track-formation time τ. Taking furthermore account of the fact that the brightness of the track increases sharply with increasing streamer, it becomes clear that even as small a difference in the pulse duration as 2 nsec greatly affects the total brightness of the track. Protons of known energy were passed through a chamber filled with neon to a pressure of 1 atm at a definite angle α. The angle was varied by rotating the chamber relative to the beam. The photography was carried out in two projections, A and B (Fig. 1). The obtained images of the streamer tracks in the projection A were measured with a microphotometer (MF-4), after which the logarithmic density D was calculated.

At present there is no rigorous theory describing the mechanism of formation of inclined tracks in spark chambers. However, a semiqualitative analysis of these questions [2-5] indicates that the angle α_n depends on the operating mode of the spark chamber, namely, α_n increases with increasing amplitude and with decreasing duration of the leading front of the high-voltage pulse. In addition, it is noted in these papers that α_n should depend also on the ionizing ability of the particles.

Our experimental data are listed in the table. It is seen that with decreasing α the track brightness first increases relatively slowly, and then when $\alpha \sim \alpha_n$ the brightness increases sharply, although subsequently it reaches saturation at small angles. It is also seen from the table that α_n depends on the ionization, too. Indeed, $\alpha_n \sim 58°$ when $I = 1.2I_{min}$

and $\alpha_n \sim 63°$ when $I = 3.4I_{min}$. The rms error σ_α in the determination of the angle by measuring the lateral projection of the tracks does not exceed 0.6°. From the listed dependence of the brightness on α at $I/I_{min} = 5.4$ it is seen that α_n ceases to increase with further increase of ionization, in accord with [4].

Table

Duration	α, deg	$D(1.2\ I_{min})$	$D(3.4\ I_{min})$	$D(5.4\ I_{min})$
τ_1	58	0.40 ±0.13	0,66 ±0.19	–
	63	0.19 ±0.04	0.58 ±0.2	–
	67	0.19 ±0,07	0,35 ±0.11	0.47 ±0,11
	90	0.14 ±0.03	0.23 ±0.05	0.33 ±0.04
τ_2	58	–	–	2 ± 0.3
	61	0.62 ±0.15	–	1.7 ±0.3
	90	0.25 ±0.03	0.52 ±0.07	0.80 ±0.08

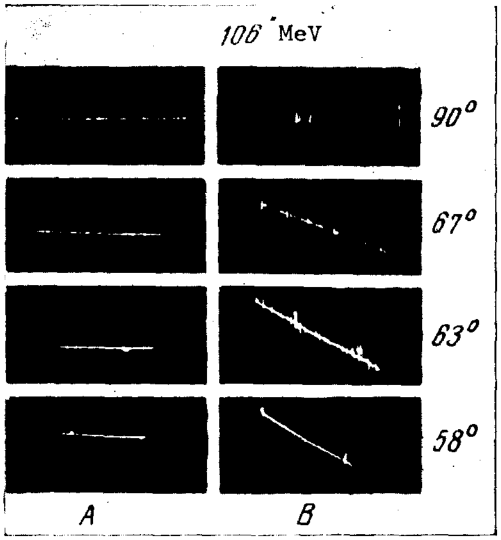

Fig. 1. Photographs of tracks of protons with $I = 3.4I_{min}$, traveling at different angles.

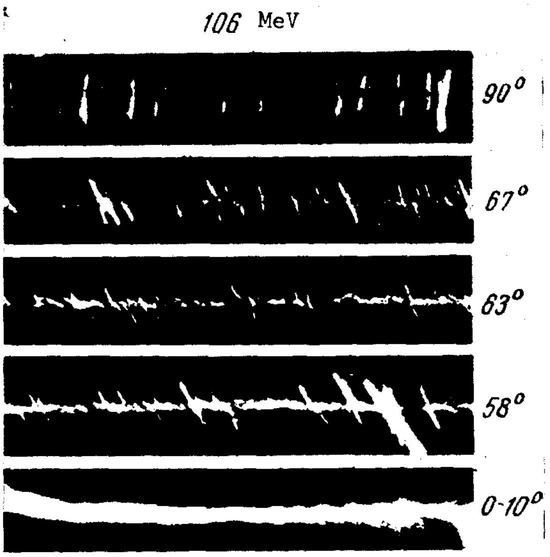

Fig. 2. Side projection B of proton tracks for different angles α ($I = 3.4I_{min}$).

Figure 2 shows how the streamer-development process depends on the particle angle, and also how the streamers rotate and gradually coalesce along the electric field (at small angles) into a single spark channel. From the obtained dependence of the track brightness on the angle α it is clear that unless the chamber operation is made more isotropic from the point of view of brightness, calibration curves will have to be plotted for each operating regime in order to be able to measure the ionizing ability of particles. It is seen from

Fig. 3 that for the first series of measurements the dependence of D on I/I_{min} has the same character within the angle range 67 - 90°, whereas at smaller angles the change in the brightness, due to the change in the limiting angle, is superimposed on the dependence of the track brightness on the ionization.

In conclusion, the authors consider it their pleasant duty to thank A. I. Alikhanyan for interest and collaboration, A. A. Tyapkin for proposing the measurement of the angles, and E. M. Matevosyan for help with the data reduction.

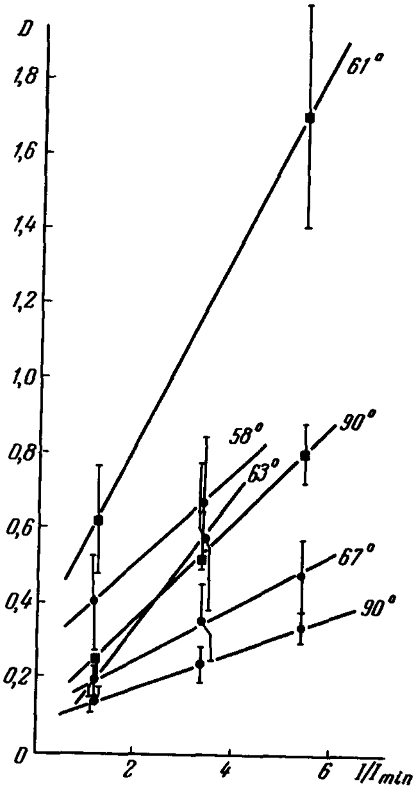

Fig. 3. Calibration curves of density D vs. I/I_{min} for different angles α. ● - τ_1; ■ - τ_2.

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INVESTIGATION OF THE KINETICS OF SELF-FOCUSING IN LIQUIDS

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ZhETF Pis'ma 6, No. 6, 687-690 (15 September 1967)

Self-focusing of light, predicted by Askar'yan in [1], has lately attracted much attention. In particular, very interesting results were obtained by the authors of [2,3], who observed filaments with transverse dimension up to 2 μ and with a lifetime $\sim 10^{-9}$ sec. It was also noted [4] that in nonlinear reflection of light from a liquid, the lifetime of the Stokes component of Raman scattering is $\sim 3 \times 10^{-11}$ sec, which apparently is also connected with self-focusing. So far, however, the kinetics of the self-focusing process and its cor-