Certain features of the stopping power of gases for fission fragments

N. N. Demidovich, I. E. Nakhutin, and V. G. Shatunov

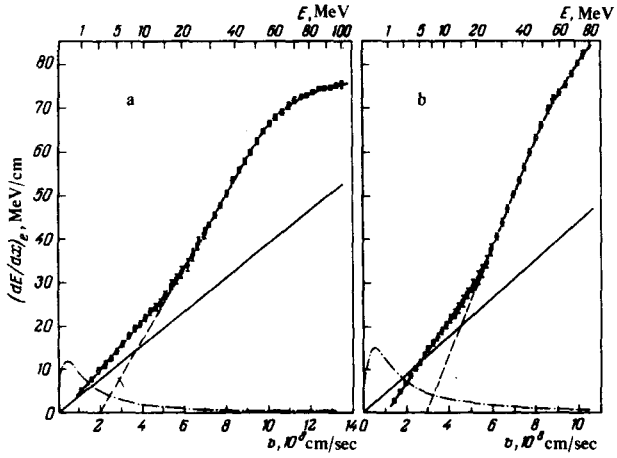
(Submitted October 10, 1975)
Pis'ma Zh. Eksp. Teor. Fiz. **22**, No. 10, 526–528 (20 November 1975)

We investigated the stopping power for the Cf^{252} spontaneous fission fragments in air down to energies ~0.8 MeV. The experimental dependence of the electronic stopping power of air for fission fragments differs from that predicted by the theory.

PACS numbers: 29.70.Gn

Most studies of the stopping power of various substances for heavy high-energy ions such as Br, I, U and fission fragments were carried out down to energies not lower than 10 MeV.[1–8] Only recently, Betz *et al.*[9] obtained experimentally the stopping powers of He, Kr, and air for uranium ions in the energy range 5–110 MeV.

We investigated the stopping power for fragments from spontaneous fission of Cf^{252} in air down to an energy ~0.8 MeV. We used in the experiment silicon surface-barrier detectors satisfying the Schmitt parameters.[10] The measurement procedure will be described in a separate article.



Plots of the electronic stopping power $(dE/dx)_e$ of air for average light (a) and average heavy (b) fragments of spontaneous fission of Cf^{252}. The experimental values are represented by circles with error bars, through which a continuous curve is drawn. The dashed line is the linear extrapolation into the low-energy region, while the dash-dot line is the stopping power due to nuclear scattering.[11] The theoretical plot of $(dE/dx)_e$ after Lindhard *et al.*[11] is shown by a solid thin line. All the data correspond to a pressure $P = 760$ mm Hg and $t = 15\,^\circ$C.

To obtain the electronic stopping power of air we subtracted from the experimental values of $(dE/dx)_e$ the values of the stopping power due to nuclear scattering.[11,12] The values of $(dE/dx)_e$ obtained in this manner for air in the case of average light ($M = 106$ a.m.u.) and average heavy ($M = 141.9$ a.m.u.) fragments of the spontaneous fission of Cf^{252} are shown in the figure together with the theoretical curves of Lindhard *et al.*[11] As seen from the figure, in contrast to the theoretical curve, the dependences of the electronic stopping powers are not linear functions of the fragment velocity.

The electronic stopping power for heavy ions such as Br, I, and U, having energies lower than ~30 MeV, were calculated heretofore by linear extrapolation[2] (see the dashed line in the figure). Our results, shown in the figure, differ greatly in the low-energy region from the values obtained by this extrapolation.

When the experimental data of[9] are examined, a certain analogy with our results can be noted in the behavior of the electronic stopping power of krypton for uranium ions.

We note in conclusion that our preliminary results show that the behavior of the electronic stopping power of CO_2 for fission fragments is similar in character to that described above for air.

[1] C. D. Moak and M. D. Brown, Phys. Rev. **149**, 244 (1966).
[2] M. D. Brown and C. D. Moak, *ibid.* **B6**, 90 (1972).
[3] P. M. Mulas and R. C. Axtmann, Phys. Rev. **146**, 296 (1966).
[4] G. B. Cumming and V. P. Crespo, Phys. Rev. **161**, 287 (1967).

[5]S. Kahn and V. Forgue, Phys. Rev. **163**, 290 (1967).
[6]H. Albrecht and H. Münzel, Z. Phys. **220**, 381 (1969).
[7]R. Müller and G. Gönnenwein, Nucl. Instrum. Methods **91**, 357 (1971).
[8]M. Forte, A. Bertin, M. Bruno, G. Vannini, and A. Vitale, Nucl. Instrum. Methods **108**, 525 (1973).
[9]G. Betz, H. G. Isele, and E. Rössle, Nucl. Instrum. Methods **123**, 83 (1975).
[10]H. W. Schmitt and F. Pleasonton, Nucl. Instrum. Methods **40**, 204 (1966).
[11]G. Lindhard, M. Scharff, and H. E. Schiott, K. Dan. Vidensk. Selsk. Mat.-Fys. Medd. **33**, No. 14 (1963).
[12]G. Lindhard, V. Nielsen, and M. Scharff, K. Dan. Vidensk. Selsk. Mat.-Fys. Medd. **36**, No. 10 (1968).