[2] E. I. Kondorskii and L. N. Fedotov, Izv. Akad. Nauk SSSR, Ser. Fiz. **16**, 432 (1952).

[3] C. Kittel, Revs. Modern Phys. **21**, 541 (1949).

Translated by D. ter Haar
113

PARAMAGNETIC RESONANCE OF THE FREE RADICALS OBTAINED BY FREEZING A PLASMA OF H_2S

S. D. KAITMAZOV and A. M. PROKHOROV

P. N. Lebedev Physical Institute, Academy of Science, U.S.S.R.

Submitted to JETP editor May 31, 1958

J. Exptl. Theoret. Phys. (U.S.S.R.) **35**, 551 (August, 1958)

HYDROGEN sulfide, generated by the usual method and dried over calcium chloride under a pressure of 0.3 mm Hg, was passed into a quartz tube in which a high frequency electrodeless discharge was excited. The power in the discharge was 120 w and the frequency was 40 Mcs. The discharge tube was joined to a quartz trap cooled by liquid nitrogen. The dissociation products of the H_2S were frozen out on the inner surface of the trap. The electron paramagnetic resonance spectrum was observed for the material condensed below the nitrogen level. The substance had a dark green color and a snow-like structure.

Observations were carried out at 1300 and 9400 Mcs. For observation at 1300 Mcs, the frozen material was placed in a previously cooled through-type quarter-wave coaxial resonator connected to a vacuum pump. The absorption spectrum was observed on the screen of an oscillograph. Observations were made at 77°K. The line observed was 16 ± 1 gauss wide at half intensity and had a nearly Gaussian shape.

The dependence of the absorption line on preliminary warming of the specimen was qualitatively investigated. It was found that keeping the specimen for an hour at 120 to 130°K is not accompanied by an essential change in the intensity and shape of the line. Keeping the specimen at 170°K for an hour causes a several-fold drop in intensity and a narrowing of the line to 12 gauss. A very weak line continued to be observed after 30 min at dry-ice temperature. Let us note that storing the specimen at 77°K for two months did not give rise to a noticeable change of intensity of the line.

Observations at 9400 Mcs were carried out on a superheterodyne spectroscope[1] in a cylindrical resonator in an H_{011} mode. The shape of the line differed radically from Gaussian. The line breadth was 85 ± 5 gauss, and the spectroscopic splitting factor $g \approx 2.03$. On warming the specimen, the peak of the line deformed asymmetrically. The change of shape of the line on warming indicates that the condensed material contains two radicals with different stability to warming.

A comparison of the line breadths at 1300 and 9400 Mcs, as well as the asymmetry of the line at 9400 Mcs, are evidence of a strong anisotropy of broadening $(g_{\parallel} > g_{\perp})$.

The authors express their thanks to G. Ia. Vzenkova for her part in the work.

---

[1] A. A. Manenkov and A. M. Prokhorov, Радиотехника и электроника (Radio Engg. and Electronics) **1**, 469 (1956).

Translated by R. Eisner
114

ON THE PROBLEM OF ANGULAR CORRELATION OF SECONDARY PARTICLES PRODUCED IN HIGH-ENERGY NUCLEAR COLLISIONS

I. M. GRAMENITSKII, M. Ia. DANYSH, V. B. LIUBIMOV, M. I. PODGORETSKII, and D. TUVDENDORZH

Joint Institute for Nuclear Research

Submitted to JETP editor May 31, 1958

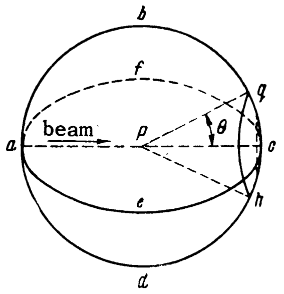
J. Exptl. Theoret. Phys. (U.S.S.R.) **35**, 552-553 (August, 1958)

WE report here the results of a study of the correlation between the emission angles of secondary relativistic particles produced in interactions between ~ 9-Bev protons and emulsion nuclei. The coefficient of correlation between the number of particles emitted within various solid angles was measured for that purpose.

Consider two non-overlapping solid angles Ω_1 and Ω_2, and two random variables n_1 and n_2, equal to the number of secondary relativistic particles in a given star emitted within Ω_1 and Ω_2 respectively. We denote by p_1 and p_2 the emission probabilities of secondary particles within the angles Ω_1 and Ω_2, by $\bar{n}$ the mean number of particles in stars, and by D_n the dispersion of the number of particles. If we assume that the directions of emission of secondary particles are statistically independent, we obtain for the correlation coefficient $R = (\overline{n_1 n_2} - \overline{n_1}\,\overline{n_2})$ the relation $R = p_1 p_2 (D_n - \bar{n})$.

450 stars, found in scanning of an emulsion chamber consisting of layers of the NIKFI-R emulsion 400 μ thick, were used for the determination of R. The chamber was irradiated by the internal proton beam of the Joint Institute for Nuclear Research synchrophasotron. Scanning was carried out along the tracks produced by primary protons.

The measured values of D_n and $\bar{n}$ were found to be 3.64 ± 0.15 and 3.23 ± 0.09 respectively. The value of $Q = R - p_1 p_2 (D_n - n)$ was then measured for different angles Ω_1 and Ω_2.* The results are given below. The choice of the angles Ω_1 and Ω_2 is illustrated in the figure.



P – point of interaction; afcea – emulsion plane; I – angle between the planes afcPa and abcPa, II – angle between the planes abcPa and aPcea, III – angle between the planes aPcea and aPcfa, IV – angle between the planes aPcda and aPcfa, V – solid angle qPh ($\theta = 27°$), VI – solid angle (4π – qPh).

Ω_1	I + II or I + III	I + IV	V
Ω_2	III + IV or II + IV	II + III	VI
p_1	0.5	0.5	0.5
p_2	0.5	0.5	0.5
Q	0.10±0.03	–0.02±0.06	–0.17±0.06

The results indicate that the directions of emission of secondary particles are not entirely independent statistically.

In addition, we studied the problem of narrow particle pairs, the presence of which would indicate either the existence of intermediate rapidly-decaying particles[2] or a strong attraction between some secondary particles.[3] We selected particles pairs in stars with a difference in the angle of emission less than $\Delta = 3.5 \times 10^{-2}$. Six such pairs were observed in the analysis of 375 splittings, not counting, naturally, pairs due to π^0 decay according to the scheme $\pi^0 \rightarrow e^+ + e^- + \gamma$. The number of chance pairs, calculated under the assumption of statistical independence of the directions of emission of secondary particles, was found to be 5.9, which is in a good agreement with the observed value.

The study of correlations of the emission angles of secondary particles may prove useful as a check of the statistical theory of multiple-particle production.[4]

For this purpose it would be advantageous to investigate elementary collisions of nucleons and π mesons with nucleons. It is also necessary to account for possible angular correlations connected with conservation laws.

The authors thank E. V. Esin, T. V. Pokidov, L. I. Fedorov, and M. I. Filipov who took part in carrying out the measurements, and to D. S. Chernavskii for a discussion of the results.

---

*The dispersion D_m of the number of particles m in different fixed solid angles Ω was determined at the same time. It was found that in all cases $D_m \approx m$, i.e., $\alpha = D_m/\bar{m} \approx 1$. This result may be used in determination of the interaction energy from the angular distribution of secondary particles (cf., e.g., reference 1).

---

[1] A. I. Nikishov and I. L. Rozental', J. Exptl. Theoret. Phys. (U.S.S.R.) **35**, 165 (1958), Soviet Phys. JETP **8**, 115 (1959).

[2] Danysz, Lock, and Yekutieli, Nature **169**, 365 (1952).

[3] K. A. Brueckner and K. M. Watson, Phys. Rev. **87**, 621 (1952).

[4] E. Fermi, Usp. Fiz. Nauk **46**, 71 (1952).

Translated by H. Kasha
115

TRANSITION EFFECT FOR ELECTRONS IN WALLS OF AN IONIZATION CHAMBER

V. A. DMITRIEV

Moscow State University

Submitted to JETP editor April 25, 1958

J. Exptl. Theoret. Phys. (U.S.S.R.) **35**, 553-554 (August, 1958)

IONIZATION chambers have been used recently in a number of experiments[1] on the determination of the energy of nuclear active particles. A lead absorber is placed directly above the chamber, in which the electron-photon cascade, initiated by π^0 mesons produced in nuclear interactions, develops.