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STATISTICAL INTERPRETATION OF EXPERIMENTAL DATA ON MULTIPLE PRODUCTION OF PARTICLES AT 1 TO 20 Bev

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Submitted to JETP editor July 10, 1958

J. Exptl. Theoret. Phys. (U.S.S.R.) **35**, 1302-1304 (November, 1958)

THIS communication presents a comparison of experimental data on multiple particle production in nucleon-nucleon and pion-nucleon collisions at a few Bev with Fermi's statistical theory.[1] In the calculations two forms of this statistical theory were employed (for details see the review paper, Ref. 2), — with and without account being taken of resonant nucleon-pion interactions through the introduction of isobaric states.[3] The radius of the effective volume is taken to be $\hbar/\mu c = 1.4 \times 10^{-13}$ cm. The methods developed in Ref. 4 were used to calculate the statistical weights.

The table gives the experimental[5,6] and theoretical distributions of p-p collisions at different energies according to the number of generated pions (W_n is the percentage of cases with the production of n pions).

Maenchen et al.[7] investigated interactions between negative pions and protons at 4.5 to 5 Bev and detected 61 2-prong events, 43 4-prong events and 2 6-prong events. The "isobaric" version of the statistical theory gives 64, 39, and 3 as the corresponding numbers, while the "nonisobaric" version gives 70, 35 and 1.

The momentum spectra in the center-of-mass system which are given in Ref. 7 are also in good agreement with the isobaric version (Figs. 1 and 2).

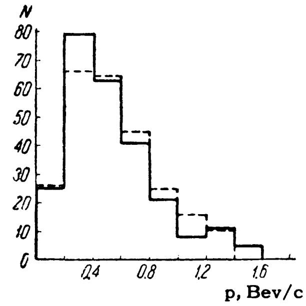

FIG. 1. Experimental[7] (solid line) and theoretical (dashed line) momentum spectra of secondary charged pions in the c. m. system from π^-–p collisions at 4.5 to 5 Bev.

$\bar{p}_{exp} = 0.54$ Bev/c; $\bar{p}_{theor} = 0.55$ Bev/c; $N_{tot} = 253$

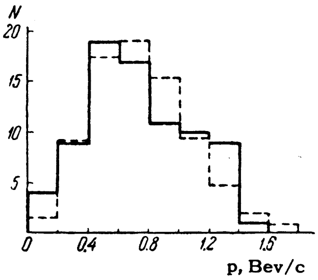

FIG. 2. Experimental[7] (solid line) and theoretical (dashed line) momentum spectra of secondary protons in the c. m. system from π^- – p collisions at 4.5 to 5 Bev.

$\bar{p}_{exp} = 0.74$ Bev/c; $\bar{p}_{theor} = 0.75$ Bev/c; $N_{tot} = 80$

We also calculated the distributions according to the number of secondary particles and the momentum spectra for nucleon-nucleon collisions at an average energy of 20 Bev, for comparison with experimental results[8] on nuclear interactions between cosmic-ray protons and Be, which in most cases can be regarded as nucleon-nucleon interactions. Unfortunately the experimental material does not permit a sufficiently reliable comparison of the experimental and theoretical secondary-particle distributions. However the momentum spectra for the experimentally observed multiplicities agree within statistical errors.

Our calculations confirm an earlier conclusion[2] (from an analysis of data on p-p, n-p and π-p collisions at energies different from those used here) that the Fermi theory including isobaric states gives a satisfactory description of multi-

Energy (lab. system), Bev	$W_1 : W_2 : W_3 : W_4$		
	Experimental	Theoretical (with isobaric states)	Theoretical (without isobaric states)
0.8 [5]	100 : 0 : 0 : 0	100 : 0 : 0 : 0	100 : 0 : 0 : 0
1.5 [5]	80 : 20 : 0 : 0	69 : 30 : 1 : 0	94 : 6 : 0 : 0
2.75 [5]	36 : 48 : 16 : 0	31 : 49 : 17 : 3	78 : 20 : 2 : 0
3.0 [6]	$(42^{+27}_{-25}) : (45^{+25}_{-29}) : (12^{+8}_{-5}) : (1^{+4}_{-0})$	25 : 46 : 25 : 4	68 : 31 : 1 : 0

plicities and momentum distributions of nucleon-nucleon and pion-nucleon collisions at a few Bev. The Fermi theory neglecting isobaric states gives poorer agreement with experiment. It must be noted, however, that angular distributions of particles in the given experiments do not agree with predictions from the Fermi theory.

In conclusion I wish to thank I. L. Rozental' and E. L. Feinberg for their interest in this work, and N. G. Birger and S. A. Slavatinskii for a discussion of the cosmic-ray data.

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Translated by I. Emin
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PARAMAGNETIC ABSORPTION IN PARALLEL FIELDS AT 9.3 × 10⁹ cps IN THE SALTS $Fe(NH_4)(SO_4)_2 . 12H_2O$ *AND* $Fe(NO_3)_3 . 9H_2O$

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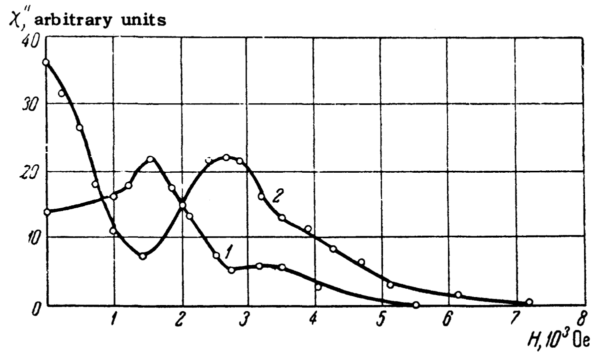
Submitted to JETP editor July 9, 1958

J. Exptl. Theoret. Phys. (U.S.S.R.) **35**, 1304 (November, 1958)

FOR the case of paramagnetic absorption in parallel fields there exists a phenomenological theory due to Shaposhnikov.[1] Experimental curves obtained by Garif'ianov[2] and Sitnikov[3] support this theory. However, Smits et al.[4] have experimentally found a more complicated dependence of the absorption on the field at 10^6 to 10^7 cps and at 20°K. Kurushin[5] obtained similar curves for $Mn(NH_4)_2(SO_4)_2 \cdot 6H_2O$ and $Mn(NO_3)_2 \cdot 6H_2O$ at 9.3×10^9 cps and room temperature. In this note we report the results of measurements of the paramagnetic absorption in parallel fields in powdered salts $Fe(NH_4)(SO_4)_2 \cdot 12H_2O$ and $Fe(NO_3)_3 \cdot 9H_2O$ at 9.3×10^9 cps and 295°K. The measurements were made with a radiospectroscope consisting of a klystron generator connected by a waveguide to a reflecting rectangular resonator operating in the H_{01} mode.

The absorption curves of $\chi''(H)$ have the following maxima: in the case of $Fe(NH_4)(SO_4)_2 \cdot 12H_2O$ (curve 1 in the figure) at a constant field



of 1600 Oe, and in the case of $Fe(NO_3)_3 \cdot 9H_2O$ (curve 2) at a constant field of 2600 Oe. To explain this shape of these curves, it is apparently necessary to develop further the theory of spin-spin relaxation.

The investigation was suggested and directed by K. P. Sitnikov.

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Translated by G. Volkoff
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