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CONCERNING THE MEASUREMENT OF THE MAGNETIC MOMENT OF THE Λ^0 HYPERON

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In [1], the authors of the present article described an experiment on the measurement of the magnetic moment of the Λ^0 hyperon and presented the preliminary experimental results. In this experiment, the magnetic moment of the hyperon was determined from the angle of rotation of the hyperon spin in a strong plused magnetic field of 220 kG intensity. The polarized hyperons were produced in a polyethylene target in the reaction $\pi^+ + p \to \Lambda^0 + K^0$ at an incident π^--meson momentum 1.07 GeV/c. The hyperons produced in the polyethylene target traveled in a strong longitudinal magnetic field and decayed on reaching the emulsion stack. The initial position of the hyperon spin was determined from the direction of the polarization vector at production, and the final position was determined from the angular distribution of the π^- mesons of the $\Lambda^0 \to p + \pi^-$ decay. Owing to violation of spatial parity in Λ^0 decay, this angular distribution is given by

$$f(\Theta) = \frac{1 + \alpha P\cos\Theta}{2},$$

where Θ is the c.m.s. angle between the direction of the polarization vector at the instant of decay and the momentum of the decay π^- meson, α is the asymmetry coefficient, and P is the degree of polarization of the hyperons.

Different variants of experiments on the measurement of the magnetic moment of the Λ^0 hyperon were realized in [1 - 7]. As a rule these are laborious experiments that require the efforts of a large staff for many years.

The accuracy with which the magnetic moment of the Λ^0 hyperon is determined is $\Delta\mu \sim (1/H_{av}\ell\sqrt{N})$, where H_{av} is the average value of the magnetic field along the flight trajectory, ℓ is the flight distance, and N is the number of decays recorded in the track detector. In the authors' opinion the use of magnetic fields of high intensity is the most promising from the point of view of decreasing the error in the determination of the magnetic moments of the hyperons. Whereas a few yeara ago this meant magnetic fields of several hundred kilogause, now, following a 1971 study by the CERN group [7], in which the accuracy of determination of the magnetic moment of the Λ^0 hyperon was greatly increased, one should speak of megagauss fields. This pertains primarily to experiments in which the track detector is a nuclear emulsion, for which there is no automatic processing method. In experiments in which spark and bubble chambers are used as detectors, a direct increase of the statistics when working with magnetic fields $\sim$100 kG can still give a higher accuracy within a conceivable time of 2 - 3 years.

The reduction of the entire material obtained in our study [1] would require a few more years. The accuracy with which the magnetic moment of the Λ^0 hyperon was measured would then be comparable with but not higher than the accuracy of [7]. The authors have therefore deemed it advisable to terminate the experiments in magnetic fields of 220 kG and report the final result.

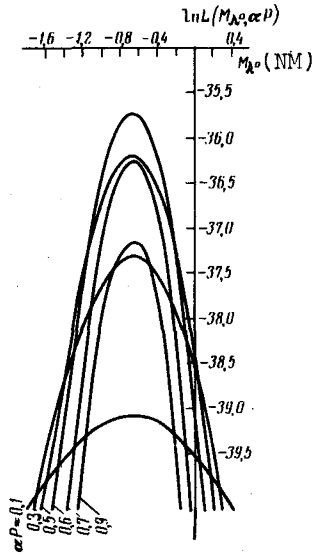
We have thus processed 25% of the obtained experimental material. From 57 events of the $\Lambda^0 \to p + \pi^-$ decay, satisfying all the selection criteria of [1], we determined by the maximum-likelihood method the value of the magnetic moment of the Λ^0 hyperon. The likelihood function is written in the form

$$L(\mu, aP) = \prod_i \left\{ \frac{1 + aP\cos\Theta_i(\mu)}{2} \right\},$$

where $\Theta_i(\mu)$ is the angle in the c.m.s. of the Λ^0 hyperon between the direction of the emission of the π^- meson of the decay and the direction of the polarization vector at the instant of the decay, calculated under the assumption that the magnetic moment of the Λ^0 hyperon is equal to μ. It follows from the figure that

$$\mu_{\Lambda^0} = (-0.65 \pm 0.28)\ \text{NM}$$

The indicated error corresponds to a decrease of the logarithm of the likelihood function by 0.5.



Logarithm of the maximum-likelihood function.

In conclusion, the authors are grateful to A.O. Vaisenberg, L.L. Gol'din, and V.A. Smirnitskii for help and useful discussions, to the crew of the accelerator of the Institute of Theoretical and Experimental Physics for help in performing this work, and also to A.M. Alpers, Z.S. Galkina, M.I. Ovsyannikova, and the laboratory group of the Moscow Engineering Physics Institute for help with scanning the experimental material.

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STIMULATED RAMAN SCATTERING OF MICROWAVES IN A LAYER OF COLLISIONLESS PLASMA

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An important role can be played in the interaction of microwave radiation with a plasma even at sufficiently low field intensities (compared with the plasma field), by nonlinear processes and particularly by parametric instability [1, 2]. The occurrence of instability leads to an increase in the field dissipation, since the oscillating electrons begin to be scattered by density pulsations; this mechanism is important also when it comes to explaining why the plasma layer becomes transparent at relatively small field intensities [3]. Parametric excitation of Langmuir and acoustic waves were first observed by Stern and Tzoar [4]. They have shown, however, that in order for the effect to occur it is necessary to direct the electric field of the wave perpendicular to the generatrix of the plasma cylinder. As a result it can be assumed that an