be inspection. Some applications to wave equations in higher dimensional spaces are indicated.

* N. Kemmer, Phys. Rev. 56, 491 (1940).
* A. Klein, Phys. Rev. 56, 491 (1940).

TA6. The Nonrelativistic Limit of Spin \( \frac{1}{2} \) Particle Wave Equations. P. A. M. Dirac and K. M. Case, University of Michigan.—The Dirac-Pauli-Fierz theory for half-integral spin particles is investigated in the nonrelativistic limit. Starting from the Dirac-Schwinger formulation of the theory, the wave function \( \psi(k) \) which describes a particle of spin \( \frac{1}{2} \) is reduced with respect to the three-dimensional rotation group and the superpositions of components are eliminated. The Hamiltonian is calculated to order \( \frac{1}{\hbar} \) and the intrinsic magnetic dipole and electric quadrupole moments are found. In addition the spin-orbit coupling and Darwin terms are obtained.

* Dirac and Schwinger, Phys. Rev. 56, 491 (1940).

TA7. Joint Probabilities and Transition Probabilities in Differential-Space Quantum Theory. Norbert Wiener, Massachusetts Institute of Technology, and Armand Siegel, Harvard University.—In our theory of quantum systems, the statistical predictions ordinarily obtained from the wave function are obtained from an ensemble of deterministic systems each of which has a sharp value for every observable. The values over this ensemble for two observables corresponding to two commuting operators in ordinary quantum mechanics are, necessarily, imperfectly correlated, and it is of interest to find their joint probability distribution. Suppose two operators \( R \) and \( S \) correspond to two quantum-mechanical operators \( \hat{R} \) and \( \hat{S} \) respectively. Then for the ensemble corresponding to \( \psi(x) \), prob \( |R=\hat{R}, S=\hat{S}| = |\langle a|a||1\rangle^2 - |\langle a||1\rangle^2 | \langle a|a||1\rangle^2 | \langle a||1\rangle^2 | \rangle \), for \( \psi \) real, means the positive part of the quantity inside brackets. If \( \hat{K} \) is the Hamiltonian and \( \lambda \) the time, this expression is \( |\langle a|\hat{a}||1\rangle^2 \) times the probability that a system of the ensemble corresponding to \( \psi \) has \( R=\hat{R}, S=\hat{S} \) at time zero will make a transition after a small interval \( \lambda \) to \( R=\hat{R} ; S=\hat{S} \).

* Work of this author supported by Office of Naval Research.

TA8. The Determination of the Scattering Potential from the Spectral Weight Function. I. Kay and H. E. Moses, New York University.—By generalizing the method of Gelfand and Levitan it is shown that in many cases the potential can be obtained uniquely from the spectral measure function, if we specify the asymptotic behavior in some representation of the eigenstates of the total Hamiltonian \( H \) associated with the measure function. In contrast to earlier treatments where one restricts oneself to an unperturbed Hamiltonian \( H_0 \) and a representation such that the \( H_0 \) is a second derivative operator and the potential is diagonal, the procedure described is quite general: \( H_0 \) may have almost any character, and the potential need not be diagonal in the representation in which the asymptotic description of the eigenfunctions is specified. The transformation \( U \) which maps the eigenfunctions of \( H_0 \) into those of \( H \) and \( U^{-1} \) are given triangular matrices in the specified representation. \( U \) and \( U^{-1} \) then satisfy a Wiener-Hopf equation which involves the spectral measure function. In many cases the solution for \( U, U^{-1} \) can be obtained explicitly in terms of the spectral measure function. The potential can then be obtained from these operators.

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TA9. Vacuum Polarization and Proton-Proton Scattering. L. L. Foldy, Columbia University, and E. Eriksen, University of Oslo.—An attempt has been made to determine the presence of effects of vacuum polarization in colliding proton-proton experiments. If available experimental data on proton-proton scattering is in spite of the smallness of these effects and relatively large errors in the data, it appears that the data substantiate the predicted vacuum polarization effects. The electromagnetic interaction of heavy charged particles, if one assumes the nuclear potential has a Yukawa shape. By correcting the available data for these effects, new values are available for the zero energy scattering length and effective range of the specifically nuclear interaction between two protons.

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TA10. A Covariant Formalism Describing the Polarization of Spin One-Half Particles. I. Michel, Institute for Advanced Study, and A. S. Wightman, Princeton University.—We denote by \( p(p) \), the state of a spin \( \frac{1}{2} \) particle of four momentum \( p \) and mass \( m \), whose spin is polarized along a space like four-vector \( \mu \), such that \( \cdot p < 0, \cdot \mu - 1 \). Then the projection operator onto the \( \mu \)-vector may be written \( P_{\mu} = \frac{1}{2}(1 + \gamma_5 \gamma_{\mu}) \).

* We use Feynman notation. \( P \), the generalization of the Stokes pseudo-vector and is the expectation value of \( P_{\mu} \) for a mixture, the degree of polarization is \( \langle \gamma_5 P_{\mu} \rangle \).

* For another \( m > 0 \), we have \( P_{\mu}'' = \gamma_5 \gamma_{\mu} \gamma_5 \gamma_{\mu} \).

TA11. A Problem in Shower Theory.—Approximation A. R. C. O’Rourke, Naval Research Laboratory.—The Blabha-Heitler method of solving the shower equations in “approximation A” has been applied to the situation in which a beam of photons with a prescribed spectrum is incident upon a thick target. The mathematical aspects of the work are an immediate and direct extension of the classical work of Blabha-Heitler and N. Arley, who treated primary monoenergetic electrons and photons respectively. The contribution of the present work lies perhaps more in the numerical results which have been obtained at the Naval Research Laboratory electronic digital computer. The numerical work completed so far is for the ideal primary spectrum \( \kappa_{n,0}(k) \) equals a constant, i.e., the high energy Bremsstrahlung shape. The results can be usefully employed in the calculation of photoneutron yields and other targets.


TA12. Wave Functions and Transition Probabilities for Light Atoms. H. S. J. Yilmaz, M. I. T..—Introductory by Philip M. Morse.—A new method of taking electron configurations into account is presented. This method differs from conventional configuration methods in a general simplicity and interpretation. However, due to the particular choice of perturbation series, there are substantial similarities. The computation is based on a function, which is calculated beforehand. This function is a bilinear Laplace transform of the Green’s function and has various useful properties. The method is applied to the \( 1 S_0, 2 S_0, 2 P_1 \) configuration of \( Cs, N_1, O_{1S}, \) and \( F_1 \). A few significant terms are identified which take care of 60-80 percent of the discrepancy between experimental and theoretical values of multiple separations. The spin-orbit separations and nebu-structure are calculated. With a slight modification of the 2p wave function can be calculated.

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