Abstracts of Contributed Papers in Session D

Meson–Nucleon Coupling Constants from Forward Dispersion Relations. D. V. BUGG (introduced by G. M. Stafford), *Rutherford Laboratory.*—Phase-shift analyses of nucleon–nucleon scattering up to 660 MeV have been used to calculate the real and imaginary parts of the five Wolfenstein amplitudes at $t=0$. Various combinations of these are selected to isolate in turn contributions from exchange of 0^+, 0^-, and 1^- mesons in the u channel. The contributions are well fitted by pole terms, and permit a determination of most of the coupling constants to 20% accuracy. In particular, the pp amplitudes, after removal of the pion pole term, show a significant contribution from exchange of a 0^- (or 1^+) state with a mass of about 600 MeV and with $g^2=10\pm2$. The pn data are not good, but suggest that most, if not all, of this originates not from η exchange but from a 0^- state with $I=1$. It is suggested that this comes from the 3π cut, in the same way that large parts of the "σ" and "ρ" exchange contributions are believed to come from exchange of two uncorrelated pions. Improved pn data at 50, 95, and 210 MeV would help greatly in sharpening this conclusion. The parameters of the deuteron are also discussed.

Coupling Constants of the One-Boson Exchange Model. T. UEDA* (introduced by A. E. S. Green), *Osaka University,* S. SAWADA, *Nagoya University,* W. WATARI, *Osaka City University,* AND M. YONEZAWA, *Hiroshima University.*—A large number of sets have been obtained for coupling constants of the one-boson exchange model which includes the π, α, ρ, and scalar meson (s) exchange. A considerable difference among these coupling constants comes from the following. (1) The scalar meson mass is assumed variously. The coupling constant of the s vs mass plot falls on a rather smooth curve extending from $g_s^2\sim1$ at $M_s\sim2.5\ M_\pi$ to $g_s^2\sim40$ at $M_s\sim5\ M_\pi$. The effect of mass variation of the s can be replaced by that of renormalization of its coupling constant to some extent. (2) There is some cancellation between the contributions of vector meson and the s. So the larger contribution of s results in the larger vector meson contribution. (3) Rescattering effects are assumed variously. (Schrödinger equation K-matrix model. N/D method, etc.) (4) Experimental data to which coupling constants are adjusted differ.

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Two-Pion Exchange Potential for Nucleon–Nucleon Scattering.* W. A. WILSON (introduced by M. MacGregor), *University of Florida.*—The effects of the exchange of two pions on nucleon–nucleon scattering is studied. The problem is approached by means of a set of coupled equations obtained by Green[1] based on the functional formalism of Fock. The amplitude arising from the two-pion exchange is examined in the t channel ($N-\bar{N}$ scattering) and is shown to be large only for $I=0$ and $J=0$, or $J=2$. The effect due to the exchange of two pions can then be approximated largely by the exchange of an $I=0$, $J=0$, and an $I=0$, $J=2$ mesons. The results are discussed in relation to the dispersion theoretical calculations of two-pion exchange effects of Furuichi and Waturi,[2] Furuichi and Watanabe,[3] and Durso.[4]

* Work supported in part by the U. S. Air Force Office of Scientific Research.

[1] A. E. S. Green, Phys. Rev. **77**, 719 (1950).
[2] S. Furuichi and W. Watari, Progr. Theoret. Phys. (Kyoto) **34**, 594 (1965); **36**, 348 (1966).
[3] S. Furuichi and K. Watanabe, Progr. Theoret. Phys. (Kyoto) **35**, 408 (1966).
[4] J. W. Durso, Phys. Rev. **149**, 1234 (1966).

Vector Meson Interactions and Auxiliary Conditions.* E. ROCHLEDER (introduced by M. MacGregor) AND A. E. S. GREEN, *University of Florida.*—The fact that successful meson field descriptions of the nucleon–nucleon interaction introduce both scalar and vector fields whose major terms almost cancel makes the details of the relativistic terms matters of some importance. In this work we derive nucleon–nucleon interactions from vector and scalar meson fields which have direct and derivative-type couplings to nucleons. We first let the field consist of a four vector and an independent scalar without auxiliary conditions. We next consider a Proca field in which the auxiliary condition is a field equation. Finally, we consider the case in which the auxiliary condition serves as a constraint on the state vector. The nucleon–nucleon interactions implicit in each of these three types of treatments are derived in the one-boson-exchange approximation and are compared. They differ in their relativistic terms. The general objective of this study is to clarify which type of vector field might best describe nature.

* Work supported in part by the U. S. Air Force Office of Scientific Research Grant No. 902–65.

Vector Mesons and the Nucleon–Nucleon Interaction.* R. D. SHARMA† AND A. E. S. GREEN, *University of Florida.*—We examine three distinct OBEP which follow from different treatments of the vector meson field. A Breit-like reduction shows that the relativistic terms of the nucleon–nucleon interactions differ substantially. The Born phase shifts for $l\geq1$ are calculated and are found to be quite similar except for the $^1P_1$ state. The implications of these results are discussed.

* Work supported in part by the U. S. Air Force Office of Scientific Research Grant 902–65.
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Realistic Nuclear Forces. LESTER INGBER* (introduced by Keith Brueckner), *University of California, San Diego.*—The total Lagrangian interaction describing nucleons and their interaction via one-meson exchanges is nonrelativisitically reduced, corresponding to a Schrödinger equation with a momentum-dependent (not energy-dependent) potential of the form described by Scotti–Wong (modified to interpret cutoffs and momentum dependence). This potential, so "uniquely" defined, and giving analytic functions throughout coordinate space is used to calculate nucleon–nucleon scattering for incident laboratory energies of 25–350 MeV. With the meson masses and coupling constants "fit," low-energy scattering properties, the deuteron problem, and nuclear matter calculations are solved. Highlights of this analysis are: (1) Importance of the σ meson in determining the central/tensor ratio of nuclear forces; (2) importance of momentum-dependence; (3) importance of "nonlocality." This potential with only eight parameters (themselves reasonable physical quantities) proves itself to be the best over-all description of nuclear forces to date, and can be taken to be a valid physical description to be used in other nuclear calculations.

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