THEORETICAL PHYSICS CONFERENCE PREMIERE

By J. M. Eisenberg and L. J. Weigert

THE first annual Eastern Theoretical Physics Conference was held at the University of Virginia in Charlottesville, on October 26 and 27, 1962. Such a conference was first proposed by M. E. Rose in the spring of 1961, and the decision to organize the first meeting was made at an informal gathering of physicists from Duke University and the University of North Carolina with Dr. Rose. It was thought that this conference should be arranged on a regional basis, somewhat along the lines of the Mid-Western Theoretical Physics Conference which had been meeting for several years. Under the chairmanship of Dr. Rose, a committee was formed, consisting of E. Merzbacher of the University of North Carolina, J. Sucher of the University of Maryland, and C. N. Yang of the Institute for Advanced Study. In the fall of 1961, a formal proposal was submitted to the National Science Foundation, which agreed to support the first conference.

It was intended that the annual conferences last for two days, with no simultaneous sessions. The Charlottesville conference was concerned with nuclear physics, particle physics, and gravitation. It is assumed that other areas, for example solid-state physics, will be discussed at future meetings.

About 125 theorists from universities, government laboratories, and private research laboratories attended the conference, coming from points as distant as Massachusetts and Florida. The program consisted of eight invited papers and fifteen contributed papers distributed over four sessions. Of the invited papers, three were in nuclear physics, three in particle physics, and two in gravitation. For the contributed papers, the numbers were four, nine, and two, respectively.

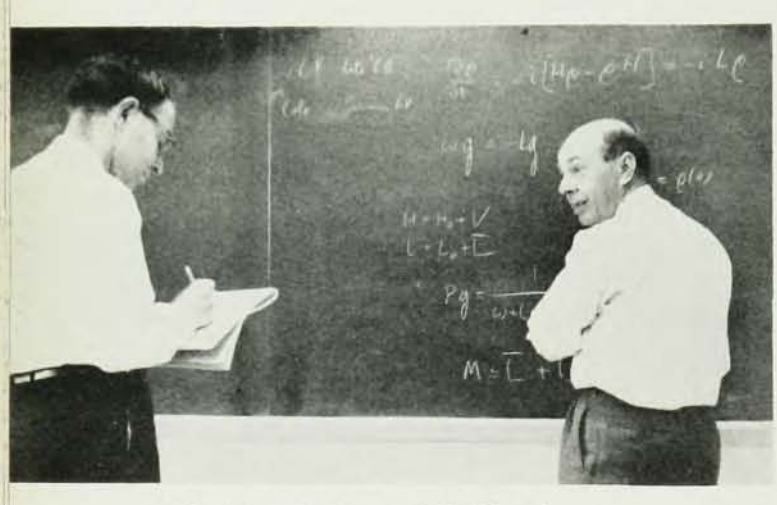
The conference was opened on Friday morning with some words of welcome by Dr. Rose. G. Breit then called the morning session to order. This session dealt with nuclear physics and began with a paper on vibrations and single-particle excitations in nuclei by G. E. Brown of MIT. Dr. Brown pointed out that only in a very few cases can nuclear excitations be explained by a single-particle mechanism. A more successful explanation is provided by introducing particle correlations to describe nuclear states. It is important that these correlations be introduced in the ground state as well as in excited states. They produce a collective behavior (vibration), and this in turn results in a state well separated from the single-particle states. It is this state which is responsible for transitions of a particular multipolarity, in the energy range between 10 and 25 MeV. Dr. Brown's paper was followed by two contributed papers relating to questions of nuclear pairing correlations, delivered by M. Baranger and by R. A. Sorensen, both from the Carnegie Institute of Technology.

Questions relating to single-nucleon damping of collective oscillations were discussed in an invited paper by R. A. Ferrell of the University of Maryland. It should be pointed out that Dr. Ferrell graciously agreed on very short notice to deliver his paper in place of a speaker who was unable to attend the conference due to illness. In the work reported by Dr. Ferrell, the widths of giant dipole resonances were calculated, using the fact that the wave functions describing these resonances overlap with the continuum. Thus, there is a certain transition probability to states with an unbound nucleon; this gives rise to a resonance width. The morning session closed with a contributed paper by B. Bayman of Princeton University on exterior wave functions for the triton ground state.

The afternoon session, under the chairmanship of C. N. Yang, dealt with two separate topics. The first of these is best described by the title of the invited paper delivered by L. C. Biedenharn of Duke University: "Nuclear Structure Information from Inelastic Electron Scattering". Dr. Biedenharn first gave a short but comprehensive review of this subject. Traditionally, in calculations relating electron-scattering experiments to nuclear structure, various approximations have been used. The speaker discussed their validity in detail, and illustrated his remarks by comparing the results of

Both authors are from the Physics Department of the University of Virginia, where the conference was held. Arrangements were made for the publication of the proceedings of that conference by Gordon and Breach.

C. N. Yang, J. R. Oppenheimer, M. E. Rose, and J. Sucher.



J. Levinger, U. Fano, and blackboard.

A few of the 12 theorists present.

Born-approximation calculations with his own work, using a partial wave expansion of relativistic Coulomb wave functions. By artificially adjusting the nuclear radius, the results of the Born approximation can be brought into close agreement with those of the exact calculation, except for the case of large-angle scattering, where they differ qualitatively. In a contributed paper by M. E. Rose and L. J. Weigert, both of the University of Virginia, the point was made that by orienting the beam and the target in these scattering experiments, observable effects are produced which yield additional information on nuclear structure.

Recent advances in theoretical particle physics occupied the second half of the Friday afternoon session. S. Treiman of Princeton University gave an invited talk on analyticity in particle physics. His paper was in large measure a critical review of the use of analyticity properties of scattering amplitudes, beginning with the original dispersion-theoretic conjecture of M. Goldberger. Dr. Treiman led us through the subsequent development of that field, including the applications of the Mandelstam representation, and ending with a discussion of Regge poles and their experimental implications. With wry wit, he exposed the conjectural basis of many of the analyticity arguments. At the same time, he showed their great value in leading to certain theoretical conclusions, such as Pomeranchuk's theorem, and in sugesting experimental work, such as that which resulted in the discovery of pion resonances. Applications of these techniques to electron-nucleon scattering and K^+-proton scattering were given in two contributed papers. The first of these was co-authored by J. S. Levinger and M. W. Kirson (Cornell), and the second by G. Costa, A. H. Zimerman (CERN), and R. L. Gluckstern (Yale). The session ended with a contributed paper by B. Zumino of New York University, in which the author showed that the existence of a massive vector boson is not inconsistent with gauge invariance. He did this by obtaining exact solutions for a two-dimensional model.

J. R. Oppenheimer was chairman of the Saturday morning session. Experimental data on pion resonances were presented in a survey by J. Steinberger of Columbia University. In his invited paper, Dr. Steinberger listed the properties of the ρ, ω, and η resonances, and discussed the experimental means by which these properties were determined. The review of recent experimental developments in particle physics was continued in an invited paper by G. A. Snow of the University of Maryland on K-meson and baryon resonances and on the various schemes for classifying these resonances from a group-theoretical point of view. Strong interactions were further treated in three contributed papers. S. Barshay of Brandeis University presented a method for determining the spins and parities of excited baryons by means of an extension of Adair's analysis. G. Breit of Yale University discussed the influence of vector mesons on nucleon-nucleon spin-orbit interactions. A paper by E. L. Lomon, H. Goldberg, W. W. S. Au, and C. N. Yen-Liu of MIT on

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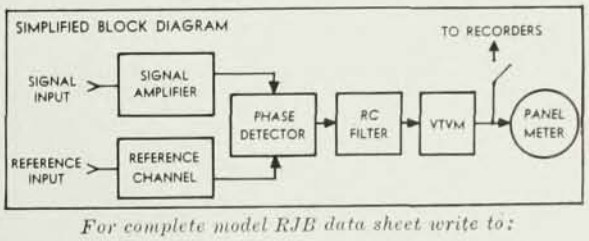

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applications of the boundary-condition model for strong interactions concluded the discussion of strong interactions.

An invited paper on weak interactions could not be delivered because of the ill health of the speaker. In compensation, Dr. Oppenheimer, as chairman, called for general discussion on weak interactions, and C. N. Yang gave a very stimulating impromptu talk on problems of current interest in that field. He discussed such questions as the detection of a possible mass difference between the neutrinos associated with the electron and with the muon, the detection of intermediate bosons, and the selection rules operating in particle decay. This provided the framework for further discussion from the floor. Two contributed papers, one by S. A. Bludman of the University of Pennsylvania and the other by E. J. Schremp of the US Naval Research Laboratory, were concerned with schemes for treating the two neutrinos on a unified basis.

The Saturday afternoon session (J. Weber chairman) was almost completely devoted to general relativity, in particular to quantization effects. B. DeWitt delivered an invited paper entitled, "The Quantization of Geometry", in which he showed by Gedanken-experiment analysis that a logical contradiction results if the gravitational field is not quantized. The only alternative to quantizing the gravitational field would be the introduction of a new principle in quantum mechanics. Dr. DeWitt also discussed recent work on developing a formalism for calculating quantum gravidynamic effects. A contributed paper on Q-number coordinate transformations and the ordering problem in general relativity was delivered by J. L. Anderson of Stevens Institute of Technology. R. Arnowitt of Northeastern University gave an invited paper describing recent work which shows that the gravitational field can be treated in a manner closely analogous to that used for the electromagnetic field. Methods have been developed for defining canonical variables and constructing energy-momentum tensors, as well as the other well-known quantities that appear in field theory. P. J. Westervelt of Brown University contributed a paper on the radiation of gravitation waves resulting from the emission and absorption of electromagnetic waves. The conference was closed with a paper by H. Jehle, W. C. Parks, and C. E. Rossi on the decomposition of Lorentz transformations and Foldy-Wouthuysen transformations into a two-by-two representation.

The large program covered in the two days of the Charlottesville conference left only Friday night for a social gathering. This took the form of a banquet at which J. R. Oppenheimer presided and J. A. Wheeler gave a very absorbing talk entitled, "A Few Links in the Charismatic Chain". Dr. Wheeler was concerned with tracing the subtle connections between successive generations of physicists which provide the inspiration for renewed efforts in understanding the laws of nature.

It is planned to hold the next Eastern Theoretical Physics Conference at the University of North Carolina in Chapel Hill, N. C.