Lecture Notes in Physics

176

Gauge Theory and Gravitation

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on Gauge Theory and Gravitation (g & G)
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PREFACE

The history of gauge theory began with Weyl's pioneering attempt to unify the general theory of relativity and electromagnetic theory. After the establishment of quantum physics, however, the two theories proceeded along quite different routes. Whereas general relativity remained a classical theory and applied solely to phenomena of very large scales, electromagnetic theory brought a great triumph in quantum electrodynamics for microscopic phenomena.

Though quantum electrodynamics was a prototype of quantum field theory, the gauge principle itself was regarded as a special artifice realizing renormalizability in the 1950s. The extension of the gauge principle to a non-Abelian symmetry was proposed by C.N. Yang and R.L. Mills in 1954 and also by R. Utiyama in 1956, but the non-Abelian gauge theory seemed to have no physical reality at that time. This situation changed drastically in the 1970s, when the concept of spontaneous symmetry breakdown was incorporated into the theory. It is now firmly believed that both electroweak and strong interactions are described by non-Abelian theories.

In contrast to the rapid progress of particle physics, the development of the theory of gravitation was rather modest, and remained isolated from the rest of physics. In recent years, however, it has become an increasingly accepted view that gravity should be included in quantum physics, and that the theory of gravitation is indispensable in explaining cosmic phenomena around black-hole spacetime and in the universe itself. Thus, it is widely believed that particle physics and the theory of gravitation must be unified from the standpoint of the gauge principle in a generalized sense.

In Japan, research on theories of gravitation has long been supported by the General Relativity and Gravitation (GRG) Research Group, together

with a sub-group (relating relativistic astrophysics and cosmology) in the Nuclear Astrophysical Group. Because of the interest of particle physicists in gravity, the GRG group recently expanded to include such scientists, and a new GRG Research Group was organized in 1981.

Professor Ryoyu Utiyama, President of Tezukayama University, is one of the most distinguished theoretical physicists in Japan. As early as 1956, he made a pioneering contribution to gauge theory and gravitation by showing that the general theory of relativity and the non-Abelian gauge theory could be understood on the same footing. Since then, Professor Utiyama has done a lot of important work on the gauge-theoretical formulation of quantum field theory. He served as an organizer of the GRG group and was professor at Osaka University until 1980.

The International Symposium on Gauge Theory and Gravitation was held at Tezukayama University, Nara, Japan, on 20-24 August 1982 to pay tribute to Professor Utiyama's brilliant research and to foster the development of gauge theory and gravitation. The symposium was supported by the Physical Society of Japan and the International Committee of the GRG, and sponsored by Tezukayama University, the Japan Society for the Promotion of Science, the Yamada Science Foundation, the Nishina Memorial Foundation, the JEC Fund and the Kinki Nippon Rail Line Company. The success of the symposium was made possible by the cordial cooperation of all participants and organizers. Many thanks are due to Mrs. Y. Tsuji and to the graduate students of Osaka University for their secretarial assistance.

December 20, 1982

Editors Keiji Kikkawa
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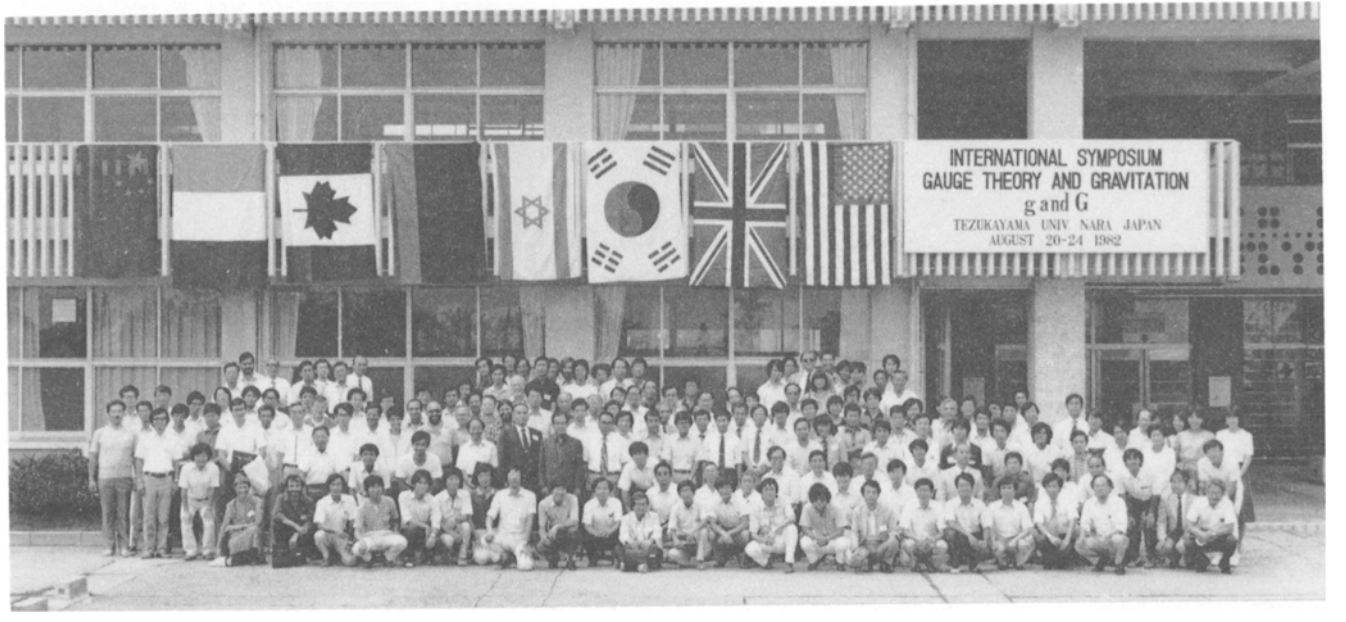

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