1 Annual Report 1998 of Theoretical Particle and High Energy Group

Subjects: The Unification of Elementary Particles and Fundamental Interactions

Member: Kazuo Fujikawa, Tohru Eguchi, Tsutomu Yanagida, Yutaka Matsuo, Atsushi Yamada, Ken-Ichi Izawa, Yuji Sugawara, Teruhiko Kawano

The main research interests at our institute are in superstring theory, quantum theory of gravity and unification theories. Superstring theory, supersymmetric field theories, topological field theories and conformal field theories are analyzed relating to the fundamental problems of interactions. In the field of high energy phenomenology, supersymmetric unified theories are extensively studied and cosmological problems are also investigated. In addition to these topics, we also study various problems in quantum field theory, from the viewpoints of both continuum and lattice approaches, for example, fluctuation-dissipation theorem, quantum tunneling, and so on.

We list below the main subjects of our researches.

1. Superstring Theory.
    - 1.1 Topological String Theory [1]–[3]
    - 1.2 Brane Dynamics, M(atrix) theory and Supersymmetric Gauge Theory [4]–[9]
    - 1.3 AdS/CFT Duality. [10]–[12]
    - 1.4 String Field Theory. [13, 14]
2. Supersymmetric Unified Theories.
    - 2.1 Properties of Supersymmetric Models. [15]–[21]
    - 2.2 Cosmic Ray Physics and Unified Theories. [22]–[26]
    - 2.3 Particle Cosmology. [28]–[30]
3. Various Problems in Quantum Field Theory.
    - 3.1 Fluctuation-Dissipation Theorem. [38]–[40]
    - 3.2 Quantum Tunneling Effect and Valley Method. [41]
    - 3.3 Lattice Gauge Theory. [42]–[46]
    - 3.4 Finite-Temperature Field Theory. [47]–[49]
    - 3.5 Bohm-Aharonov Effect.

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