1994 Fiscal Year Final Research Report Summary

Spontaneous Chiral Symmetry Breaking and Model of Elementary Particles

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04640297

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Kanazawa University

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Research Abstract

Spontaneous chiral symmetry breaking is a central issue in modeling elementary particles, since hierarchical breakings of chiral symmetries do explain various characteristics of elementary particles. We developed a new method of non-perturbative treatment of the field theory, which will clarify new features of the dynamics of chiral symmetry breaking.

In the path integral formalism of the field theory, we integrate out the high frequency parts of fields to leave an effective action written in terms of low frequency fields only. This transformation defines a change of effective action with respect to the energy scale which is the maximum energy of un-integrated field modes, and is called the non-perturbative renormalization group equation. This equation is a functional differential equation represented by a flow in the infinite dimensional action functional space.

We approximate it by projecting the flow onto a finite dimensional subspace defined by local actions with finite order polynomials in fields. Applying this approximation to scalar theories in general space-time dimension, we found that the usual polynomial action expanded around the origin of fields suffers divergent series, while a subspace defined by polynomials expanded around the moving minimum of the local action, we call a co-moving frame, gives a best converging results. We also compared our method with other non-perturbative expansion, 1/N expansion and epsilon expansion, and estimated the expected errors of our method due to ignorance of momentum dependent terms in the effective action.

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