

The Origin of Mass and Strong Coupling Gauge Theories

Proceedings of the 2006 International Workshop

M. Harada, M. Tanabashi & K. Yamawaki

Editors

SCGT 06



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PREFACE

Origin of Mass is the most urgent problem to be solved in particle theory and is the main target of the upcoming LHC experiments. Also, detailed mechanism of the origin of mass of hadrons should be tested through chiral symmetry restoration and deconfinement in QCD by the ongoing RHIC and upcoming LHC heavy ion collisions.

Based on the strong coupling gauge theories (SCGT), many Composite Models such as the Walking Technicolor, Top Quark Condensate, Little Higgs, Higgsless model, etc. have been proposed over decades to explain the dynamical origin of the mass of elementary particles, and are ready to be tested in the LHC. Many mechanisms proposed for the chiral phase transition in QCD should also be tested in the RHIC/LHC experiments.

The main obstacle of the strong coupling theories like QCD is the difficulty at obtaining the nonperturbative solution and making a definite prediction to be precisely compared with the experiments. Apart from the first-principle method of the lattice gauge theories, several alternative methods have been investigated to draw some, though not completely quantitative, predictions: Effective field theories (Chiral Perturbation Theory) with/without Hidden Local Symmetry (Moose or deconstructed extra dimensions), large N expansion, ladder Schwinger-Dyson Equation (gap equation) & Bethe-Salpeter equation, etc. as well as hints from some exact non-perturbative results of SUSY gauge theories.

Since the first meeting of the Nagoya SCGT Workshop held in 1988 (SCGT 88), which was motivated by the Walking Technicolor and some composite ideas like Hidden Local Symmetry, we have organized four SCGT workshops in 1988, 1990, 1996 and 2002 for discussing various developments of SCGT and new ideas. Physicists including many leading physicists from all over the world came together for the Workshops and created a new phase at each meeting.

From November 21-24, 2006, facing the start of the LHC experiment, we organized the fifth Nagoya SCGT workshop “International Workshop:

Origin of Mass and Strong Coupling Gauge Theories (SCGT 06)” in a spirit similar to the previous SCGT meetings. Among the 90 attendants included Prof. G. ’t Hooft and many eminent physicists. In addition to the traditional approaches, recent highlights include the holographic approach to the QCD and other SCGT, which shed new light on the related extra dimensions in terms of deconstruction or Moose/Hidden Local Symmetry. This volume contains 44 reports on the recent progress.

The workshop was financially supported by Daiko Foundation, The Mitsubishi Foundation, the Nagoya University Foundation, a JSPS Grant-in-Aid [(B) 18340059] and a JSPS Award for Eminent Scientists. On behalf of the Organizing Committee, we would like to express our sincere thanks to these organizations for their generous support. We also would like to acknowledge the Research Center for Materials Science, Nagoya University, for their generous offer of the Workshop site at Noyori Memorial Hall of the Center. Special thanks are due to young physicists at Nagoya University for their devoted assistance in preparing the workshop. Finally, we would like to thank Mrs. M. Kitajima for her patient assistance in administrative matters.

Editors

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