



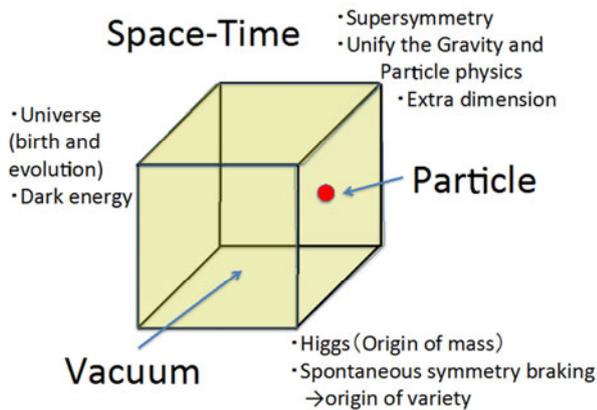
Title of Project : New expansion of particle physics of post-Higgs era by LHC revealing the vacuum and space-time structure

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【Purpose of the Research Project】

LHC (Large Hadron Collider) is the energy frontier collider operated at CERN and we have discovered the Higgs boson at LHC, it is the evidence that our vacuum plays important roles for Particle physics and Cosmology. We will discover Supersymmetric particles (or another phenomena beyond the Standard Model) using LHC. Based on these experimental results, we explore researches of the structure of vacuum, the origin of mass, the relation of particle and space-time. These researches make paradigm-shift including “particle”, “vacuum” and “space-time”.



【Content of the Research Project】

- (1) The Center of Mass Energy of LHC increases upto 13-14TeV. We focus on discovering a new phenomena beyond the Standard Model using LHC. Supersymmetry(SUSY) is the most promising candidate beyond the Standard Model. Studying SUSY particles, we identify “Dark Matter” in the Universe. We extend to study from the Particle physics to Cosmology. Also SUSY is a new symmetry related “Space-Time”, and it bridges a missing link between particle and gravity.
- (2) Using the Higgs boson, we study detail properties of the Higgs field, which fills in “Vacuum”. Phase transitions of our vacuum have driven an evolution of the Universe and changing particle properties.
- (3) We study “Space-Time” and “Vacuum” using particles (Higgs boson, SUSY particles and heavy

particles such as top quark and W/Z Gauge bosons.)

(4) New technologies of a detector and an accelerator are developed for future experiments, especially for High-Luminosity LHC and FCC.

【Expected Research Achievements and Scientific Significance】

(1) SUSY is the fundamental symmetry to exchange Boson and Fermion. The lightest Supersymmetric particle is a good candidate of the dark matter in the Universe. Furthermore SUSY is the necessary symmetry to unify the general relativity and the quantum theory.

(2) Higgs Boson unifies partially the electromagnetic force and the weak force. SUSY will unify completely three forces, EM, weak and strong forces (Grand Unified Theory).

(3) We determine stability of our vacuum using the Higgs boson. We examine also the detail history, namely Why is our Universe born? How makes evolution? What happen in Future?

(4) Development of the advanced technologies for the detector and accelerator. These will be used in The High Luminosity LHC project and we can expect many spin-off.

【Key Words】

SUSY (SUSY is a symmetry relates to a spin of particle and the most promising theory beyond the Standard model.)

Higgs Field (It gives mass to all particles, and hides in vacuum. The excited state of this field is the Higgs Boson, which is discovered at LHC.)

【Term of Project】 FY2016-2020

【Budget Allocation】 1,017,400 Thousand Yen

【Homepage Address and Other Contact Information】

<http://www.icepp.s.u-tokyo.ac.jp/vacuum-space-time/>