有識者会議
議論のまとめ
（英語版）

LC推進会議

2015年10月15日

徳宿克夫（KEK)

経緯

- 6月25日　第4回有識者会議　開催：
  「これまでの議論のまとめ」 の議論
- 8月6日 「これまでの議論のまとめ」をWeb掲載
  日本語版・英語版　を同時掲載

http://www.mext.go.jp/b_menu/shingi/chousa/shinkou/038/gaiyou/1360593.htm

提言1：

ILC計画は巨額の投資が必要であり、一国のみで実現することはできず、国際的な経費分担が必要不可欠な計画である。巨額の投資に見合う科学的成果が得られるべきであるとの観点から、標準理論を超える新展開のために、ヒッグス粒子及びトップクォークの精密測定のみならず、新粒子の発見の可能性についても見通しを得るべき

Recommendation 1: The ILC project requires huge investment that is so huge that a single country cannot cover, thus it is indispensable to share the cost internationally. From the viewpoint that the huge investments in new science projects must be weighed based upon the scientific merit of the project, a clear vision on the discovery potential of new particles as well as that of precision measurements of the Higgs boson and the top quark has to be shown so as to bring about novel development that goes beyond the Standard Model of the particle physics.

提言1- 補足第2パラグラフ

- As the ILC project requires huge investment, it is indispensable and essential prerequisite for the implementation to have a clear vision of participation and cost sharing by international partners including European countries and the United States while taking into account mid-term and long-term domestic economic and financial situations.

提言2：

ILCの性能、得られる成果等については、２０１７年末までの計画として実施されているLHCでの実験結果に基づき見極めることが必要であることから、LHCの動向を注視し、分析・評価すべき。併せて、技術面での課題の解決やコスト面でのリスクの低減について、明確にすることが必要

Recommendation 2: Since the specifications of the performance and the scientific achievements of the ILC are considered to be designed based on the results of LHC experiments, which are planned to be executed through the end of 2017, it is necessary to closely monitor, analyze and examine the development of LHC experiments . Furthermore, it is necessary to clarify how to solve technical issues and how to mitigate cost risk associated with the project.

提言３:

提言１及び提言2に関する事項を含めて計画の全体像を明確に示しつつ、国民及び科学コミュニティの理解を得ることが必要

Recommendation 3: While presenting the total project plan, including not only the plan for the accelerator and related facilities but also the plan for other infrastructure as well as efforts pointed out in Recommendations 1 & 2, it is important to have general understanding on the project by the public and science communities.

Challenges and activities to understand natural laws in a unified framework

Supporting document

Particle physics experiments with large accelerators

Non-accelerator particle physics and cosmic-ray experiments

Physics experiments using accelerators

Precision measurements using high-intensity accelerators
(SuperKEKB, J-PARC, MEG etc.)

High energy frontier experiments
(Proton accelerator experiment LHC, Electron accelerator ILC)

Neutrino, proton-decay experiments

(Hyper-Kamiokande, KamLAND-Zen etc.)

Cosmic-ray experiments

Direct searches for dark matter
(XMASS etc.)

Cosmic gamma-ray observation
(CTA etc.)

Observational cosmology

Cosmic Microwave Background (CMB) observation (B-mode polarization measurement)
(LiteBIRD etc.)

Large-scale galaxy survey
(SuMIRe etc.)

Searches for physics beyond the Standard Model

Searches for new signals beyond the Standard Model

Precision measurements of the properties of elementary particles/Searches for rare decays of elementary particles
- Test of the broken symmetry between particles and anti-particles

Higgs mechanism
- Precision measurement of couplings with other particles in the Standard Model
- Understanding the mechanism through which elementary particles obtain their mass (Higgs mechanism)

Searches for new particles and new physics

New particle searches

SUSY particles	Composite Higgs	Extra Dimensions
Proof of SUSY theory accountable for force unification and dark matter	Higgs boson composed of other particles requires other theories than SUSY	Suggests Superstring theory accountable for force unification including gravity

Investigation of signals beyond the Standard Model

Proton decay
- Observation of proton decay into lighter particles will prove the Grand Unification Theory (GUT).

Neutrino
- Understanding the origin of the neutrino mass (Clue to investigate the GUT)
- Investigation of matter and anti-matter asymmetry

Structure and formation process of the Universe

Dark Matter
- Massive but optically invisible particles (It is not understood what they are.)

Dark Energy
- Energy accelerating expansion of the Universe (It is not understood what it is.)

Cosmic Microwave Background
- Primordial light carrying information of the Big Bang and Cosmic Inflation

Large-scale galaxy survey

Understanding natural laws of elementary particles and Universe in a unified framework

Ultimate Theory (ex: Superstring Theory)

Supersymmetry (SUSY) or other new physics (ex: Extra Dimensions)

Grand Unification Theory (GUT)

Theory of Gravity

Cosmology

Unification of four forces

- Unification of forces including gravity
- Understanding the process of the force differentiation caused by spontaneous symmetry breaking

Reason why most of antimatter disappeared

- Understanding the difference between matter and anti-matter

Composition of the Universe

- Standard Model can explain only 5% of the component
- Clarification of the rest, Dark Matter and Dark Energy

Formation process of the Universe

- Clarification of Cosmic Inflation and Big Bang in the early Universe.

4. Discussion on Interim Report by the Special Committee

Possible draft recommendations by the Special Committee:

(1) Strategy and perspective of the new particle exploration should be clarified.

(2) Energy scale of ILC should be examined based on the results of the current LHC experiment.

(3) Understanding by the public and other science community than particle physics is very important in the decision making process.

参考： 嶋崎氏のFALCトークのスライド：（6月19日)
http://agenda.linearcollider.org/event/6727/other-view?view=standard