# Status of Physics DCR

Yasuhiro Okada (KEK)

on behalf of Abdelhak Djouadi, Joe Lykken, Klaus Moenig, Yasuhiro Okada, Mark Oreglia, Satoru Yamashita November 7, 2006, ILC-ECFA, Valencia, Spain

# Introduction

- By the end of 2006: Reference Design Report (RDR) ~300 p Detector Concept Report (DCR) ~200 p Physics part (~50 p) + Detector part Intended for an informed audience, including the funding agencies, and the physicists.
- DCR Physics Editors: 1 experimentalist + 1 theorist from each of three regions
   Mark Oreglia , Joe Lykken : N. America
   Klaus Moenig, Abdelhak Djouadi : Europe
   Satoru Yamashita, Yasuhiro Okada: Asia

#### What have been done.

- January, 2006. First phone meeting
   => Outline of Physics part
- March, 2006. Bangalore ILCWS

   (Discussions in physics WGs)
   >Detailed outline of each chapter (Higgs, SUSY, etc.)
- July, 2006. Vancouver LCWS
   =>First draft
- November, 2006. Valencia

# ILC WiKi page

- Current drafts for each chapter and the combined physics part are available at the ILC Wiki page.
   <u>http://www.linearcollider.org/wiki/doku.php</u>
   We will update the working draft frequently.
- Our plan is the same as the DCR detector part.
   End of December, release final physics DCR
   Beginning of January, solicit signatories for the DCR
   Feb.4-7 2007, Beijing, ILC-ACFA+GDE meeting
   present completed, signed, document to the community

# Outline

- 1. Introduction
  - Physics landscape in 2015
  - Important open questions in particle physics
  - Possible running scenario for ILC
  - Physics signals at the ILC
- 2. The Higgs system
- 3. Couplings of gauge bosons
- 4. The top quark
- 5. Supersymmetry
- 6. Alternatives to SUSY
- 7. Connections to cosmology

(We may slightly restructure the outline.)

# Current draft

• Most of chapters are very preliminary.

(Some chapter has been updated in response to feedback from the community.)

Most of materials are taken from existing documents and reports.

TESLA TDR, ACFA LC report, Snowmass 2001 resource book, GLC report, LHC/ILC report, Snowmass 2005 report, ECFA/DESY LC study, various LCWS proceedings and presentations, ...

#### Introduction

Physics landscape in 2015 Important open questions in particle physics Physics motivation for ILC

2015: LHC will have had the first look at Terascale physics

=> What will be compelling physics Issues? What will be roles of ILC? Why is ILC necessary?

Higgs physics (three possible outcomes)

SM like Higgs boson

Higgs boson with gross feature at the variant with the SM

No Higgs boson

ILC will be essential for all cases.

If LHC find

Z' => What is nature of new force?

SUSY=> Is it really SUSY?, SUSY breaking?, Unification? Dark matter?, etc.

New phenomena other the SUSY (Extra dim, new strong interaction)

Possible running scenario

Ecm= 200-500 GeV,

500fb<sup>-1</sup> for four years, ~1ab<sup>-1</sup> for the first phase

80% electron pol (mandatory).

>50% positron pol (option).

e<sup>+</sup>e<sup>-</sup> running scenario example

Upgrade to ~1 TeV

Options: GigaZ, e<sup>-</sup>e<sup>-</sup>, e<sub> $\gamma$ </sub> and  $\gamma\gamma$ 

#### **Physics and Detectors**

How detector performance affects physics results and needed luminosity.

Justification to ILC detector requirements .

# The Higgs Physics

- 1. Introduction
- 2. Current knowledge of the Higgs boson and expectation at LHC
- 3. Production of the Higgs boson at ILC
- 4. Expected sensitivity of the Higgs boson measurements
- 5. MSSM Higgs sector

#### Mass, Spin, CP, and branching ratio measurements

**SM Higgs Branching Ratio** bb 15 10<sup>1</sup> cross section (fb)  $\tau^+ \tau$ 10 J=0gg cc  $10^{-2}$ w<sup>+</sup>w =25 YΥ  $10^{-3}$ 210 220 230 240 250 100 110 120 130 140 150 160 M<sub>11</sub>(GeV)  $\sqrt{s}$  (GeV)

**TESLA TDR** 

9



10

MA (GeV)

# Coupling of gauge bosons

- 1. Ferimion pair production
- 2. Coupling among gauge bosons

(1)
$$e^+e^- \rightarrow f\bar{f}$$
 at  $\sqrt{s} = 500 \text{ GeV}$   
(2)GigaZ



Ex. WW  $\gamma$  anomalous coupling



# Top quark physics

- 1. Overview
- 2. Top quark mass and width
- 3. Top quark interactions

Theoretical and beam issues on top threshold scan.

Top Yulawa coupling and anomalous coupling to gauge bosons



# Supersymmetry

- 1. Introduction
- 2. Precision SUSY measurements at the ILC
- 3. Test of SUSY at the ILC
- 4. Cosmological connections

We plan to make "Cosmological connection" section a separate chapter "Connection to cosmology" with general introduction and other materials.

Mass and mixing determination of chargino, neutralino, slepton, squark.





Blair, Porod, Zerwas

Ellis, Olive, Santos, Spanos

#### Alternative scenarios to SUSY

- 1. Motivation to alternative scenarios
- 2. Model with large extra dimensions
- 3. Little Higgs models
- 4. Discrimination of Z' models through  $e^+e^- \rightarrow ff$



#### Feedback

We will finalize the draft in two months, Please check the wiki page regularly.

ILC Wiki page <u>http://www.linearcollider.org/wiki/doku.php</u>

Please send us your comments and suggestions.

Editors' address

- klaus.moenig@desy.de
- yasuhiro.okada@kek.jp
- lykken@fnal.gov
- m-oreglia@uchicago.edu
- satoru@icepp.s.u-tokyo.ac.jp
- djouadi@th.u-psud.fr