Precision measurement of Little Higgs with T-parity parameters at ILC

Tohoku Univ. Eriko Kato

This study addresses how the ILC, the next generation lepton collider will provide precision measurements on Little Higgs parameters. The Little Higgs model is one of the attractive beyond standard model that is expected to manifest at the Terascale.

Introduction

ILC (International Linear Collider)

A new era of particle physics has opened with the start-up of the Large Hadron Collider (LHC) at CERN . The LHC, a proton-proton collider, will operate at the highest energy ever achieved. The ILC will explore the same energy range by colliding electrons with positrons. Because of it's background clean environment and fixed center mass energy, the ILC would provide results with extraordinary precision, enabling the exploration of unknown regions of the Terascale.

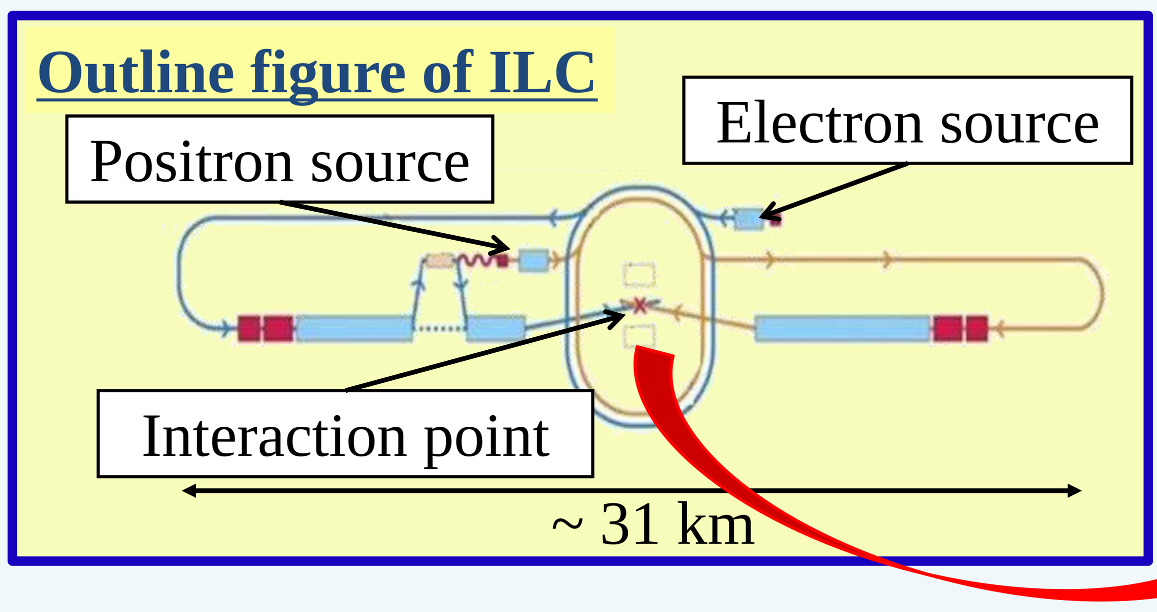
What is the ILC?

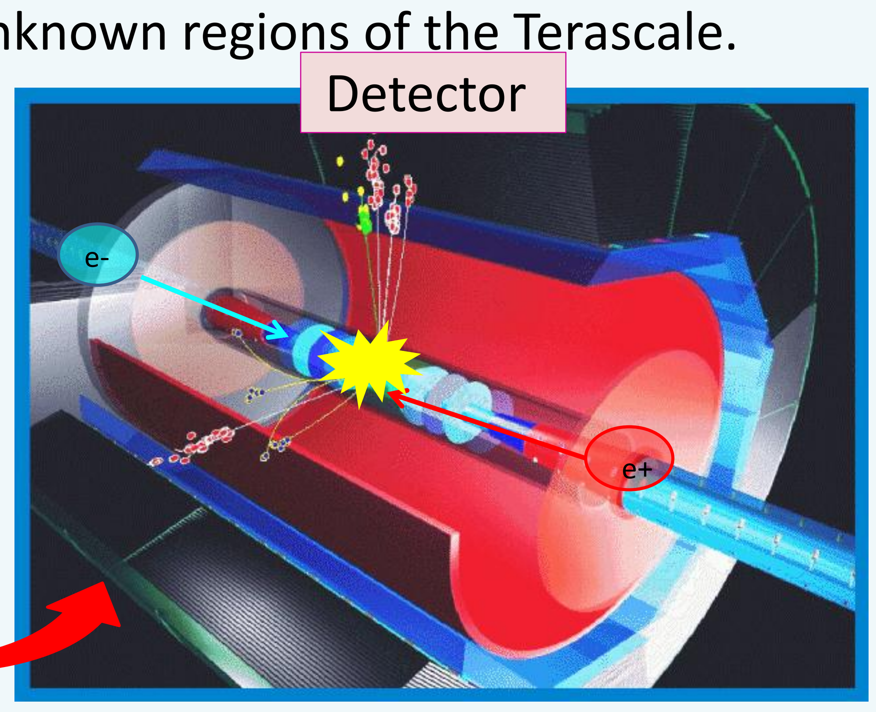
- Total length 31km e^+e^- linear collider
- Center mass energy: 250GeV~1TeV
- High Luminosity (@1TeV,4 years): 500fb^{-1}

Purpose of ILC

- Search/study of Higgs particle
- Search for beyond the standard model

➢ **Evaluation on the precision measurement of New Physics models are extremely important.**





Energy resolution : $\Delta E/E=30\%/\sqrt{E(GeV)}$
Momentum resolution : $\Delta P_t/P_t^2=5\times10^{-5}(GeV/c)^{-1}$

Little Higgs with T-Parity model(LHT)

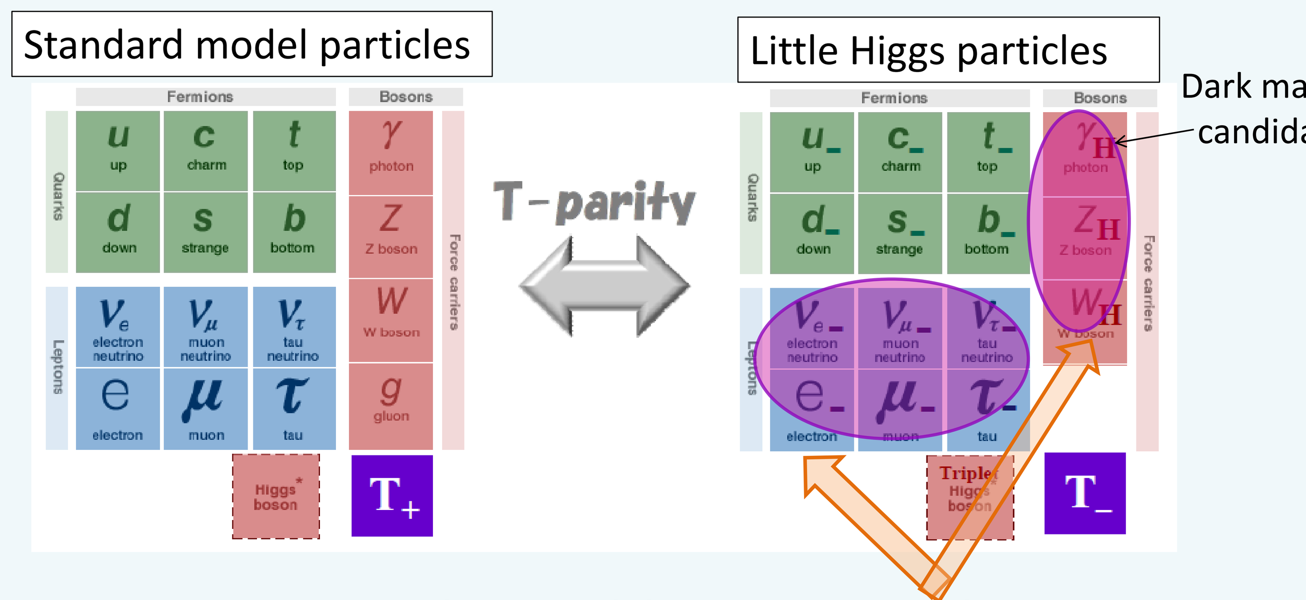
LHT explains…

- the mass of Higgs particle naturally
- dark matter problem(predicts a dark matter candidate)
- with consistency with previous electroweak precision measurement experiments

LHT features:

- LHT predicts new particles which acquire mass through global symmetry breaking(energy scale f)
- LHT is composed with very few parameters (only 2 in the gauge boson & lepton sector : f and κ)

➢ **Evaluation of LHT parameters(f & κ)are extremely important.**



Direct observable LHT particles at ILC

<Little Higgs mechanism>

Global symmetry : SU(5) → (f ~ 1 TeV) SO(5) → (v ~ <h>)
partial group: $[SU(2)_L\times U(1)_Y]^2$ → $SU(2)_L\times U(1)_Y$ → $U(1)_Y$

Simulation analysis

Simulation environment

Center mass energy 1TeV
Integrated luminosity 500fb^{-1}(4 years)

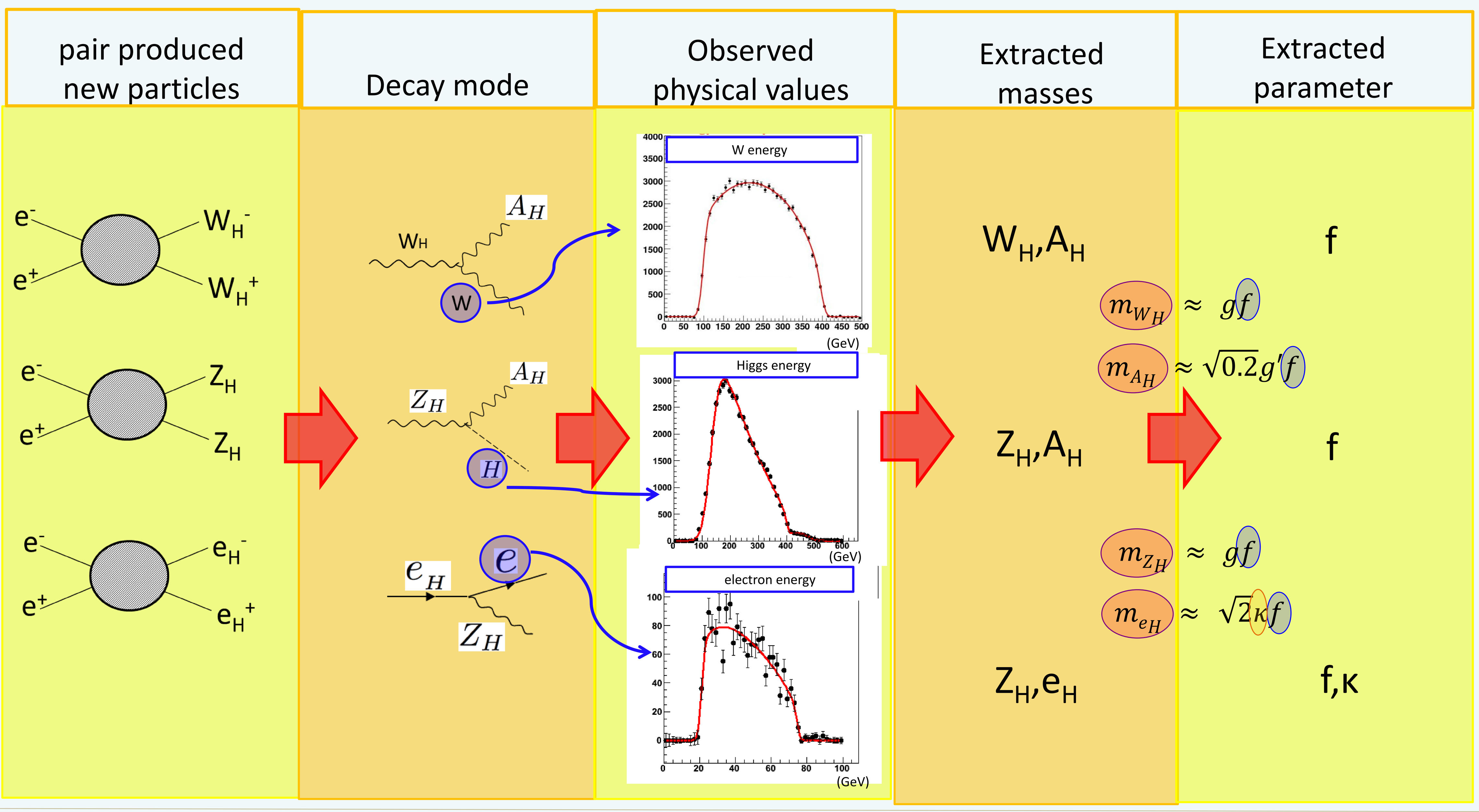
➢ Little Higgs New particles are produced at 1TeV

Analysis procedure

We want to extract the masses of pair produced Little Higgs new particles.

1. Reconstruct detectable particles like W bosons ,Higgs Bosons and electrons.
2. Fit the energy distribution of the reconstructed particles.
3. Recognize the edge of the distribution and extract masses of pair produced new particles.
4. Extract model parameters through pair produced new particle masses.

※note that A_H is a dark matter candidate and cannot be observed by the detector.



Result

LHT particles	Mass	Precision measurements
A_H	81.9(GeV)	1.3%
W_H	369(GeV)	0.20%
Z_H	368(GeV)	0.56%
e_H	410(GeV)	0.46%

$m_{W_H}(f)$ $m_{A_H}(f)$
$m_{Z_H}(f)$ $m_{e_H}(f,\kappa)$

Parameters	True value	Precision measurement
f	580(GeV)	0.16%
Κ	0.5	0.094%

➢ We were able to **extract all the parameters** In the heavy gauge boson sector and heavy lepton sector with **high accuracy.**

➢ **ILC** has **high sensitivity** among **LHT masses and parameters**

Plan

Evaluate the sensitivity of the heavy neutrino mass .

➢ With this we can obtain the total mass spectrum of LHT heavy Gauge boson sector and heavy lepton sector