Little Higgs T-parity @ILC

Optimization meeting

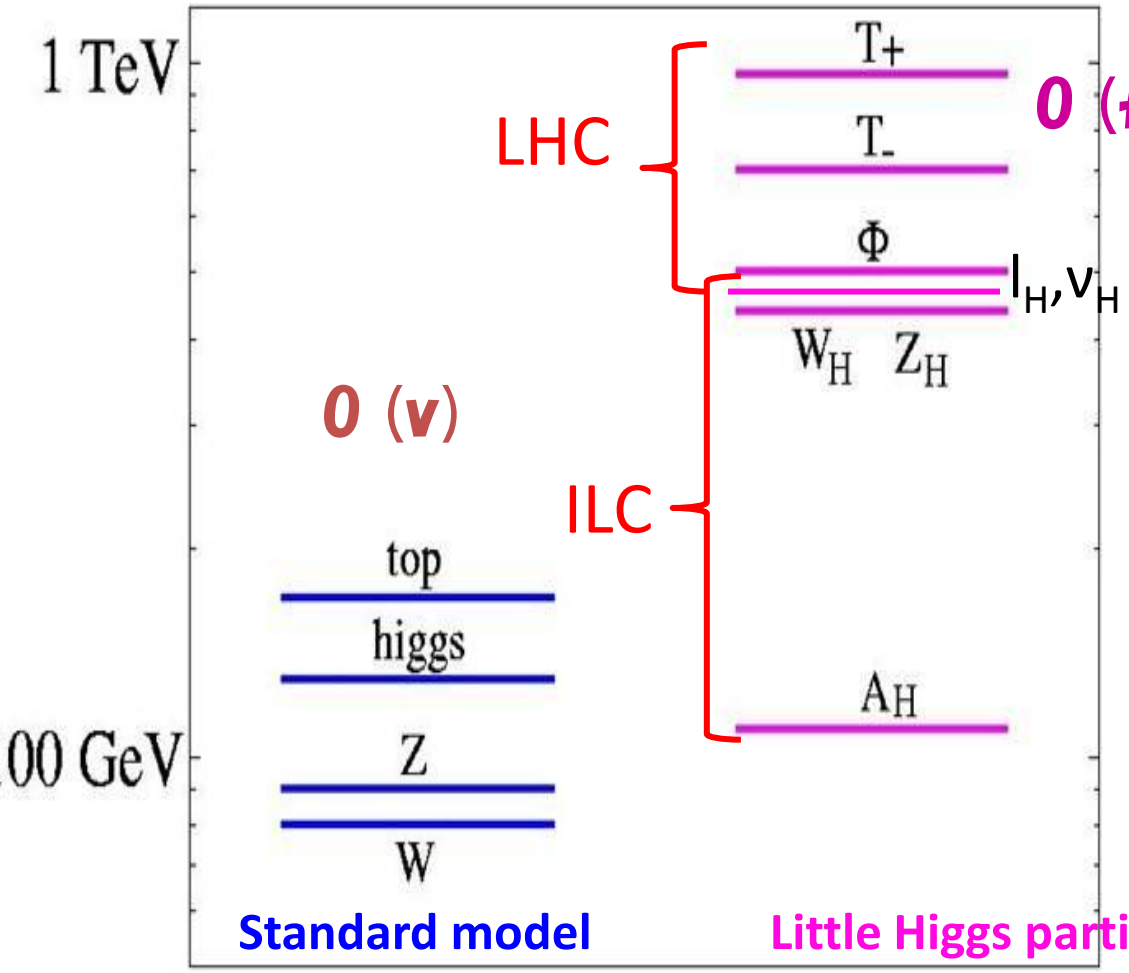
2011.02.18 Eriko Kato

outline

- Summary of study
- LHC's little Higgs search
- short term schedule

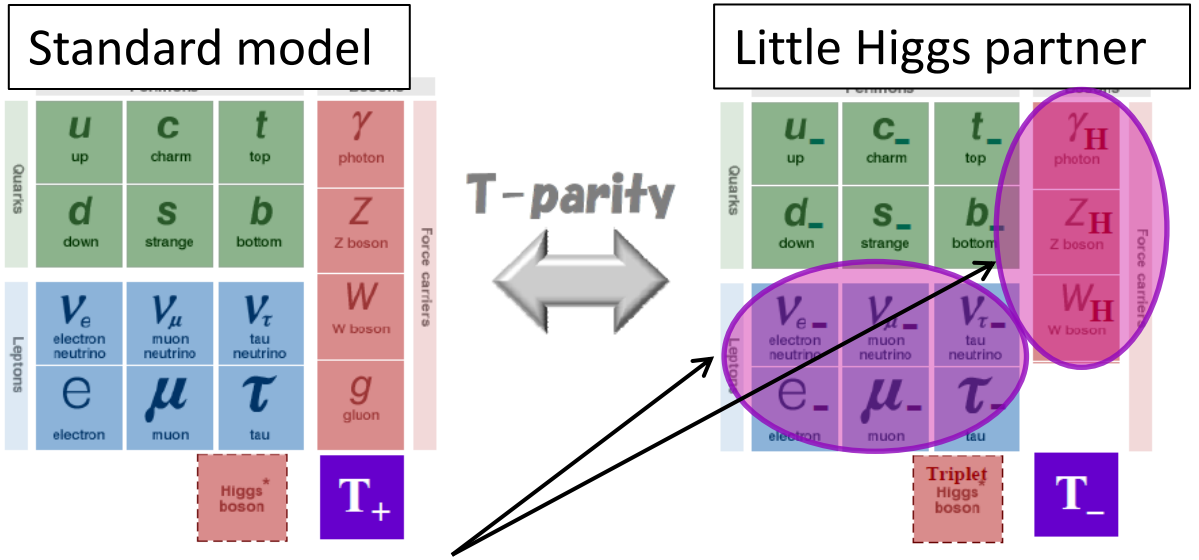
Summary of study

■ Mass spectrum



particle	mass	sensitivity
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%

Model parameter



- All physics involving this LHT sector can e described with parameter f and κ.

SM particle mass proportional to v

LHT particles proportional to f
Lepton partners are also proportional to κ

parameter	True value	Measurement accuracy
f	580(GeV)	0.16%
K	0.5	0.094%

e_H, ν_H mass extraction

Analysis mode

i) $e_H e_H$ ($eZ_H eZ_H$)

- Signal: $eeHHA_HA_H \rightarrow e_H$ mass extraction DONE!

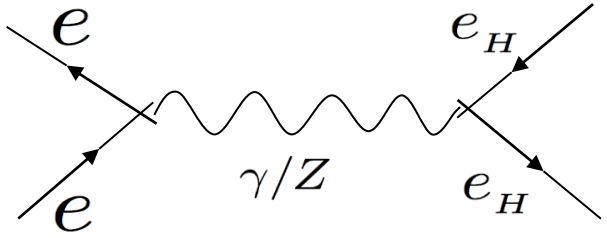
ii) $\nu_H \nu_H$($eW_H eW_H$)

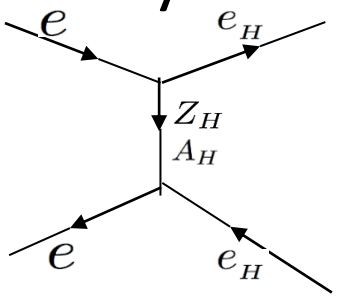
- Signal: $eeqqqq(2W)A_HA_H \rightarrow \nu_H$ mass extraction **→building generator**
- BG(LHT): $e_H e_H(eZ_H eZ_H \rightarrow eeHHA_HA_H)$
  $e_H e_H(eZ_H eA_H \rightarrow eeHA_HA_H)$
  $\tau_H \tau_H(\tau Z_H \tau A_H \rightarrow eeHA_HA_H)$
  $\nu_H \nu_H(\tau W_H \tau W_H \rightarrow eeqqqq(2W)A_HA_H)$
- BG(SM): tt, ttZ,ttH (top)
  enWZ, eeWW, eeZZ,WWZ,ZZZ, WWZZ (WZ)

Lepton sector analysis mode

Aim of this study:

Evaluate ILC's sensitivity on κ by measuring the mass of e_H .



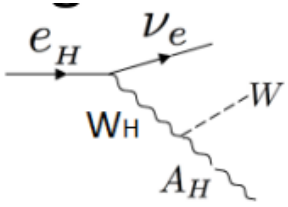


$m_{eH}=\sqrt{2}\kappa f=410GeV$

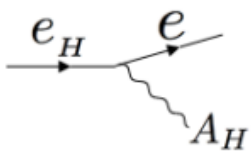
Analysis mode

There are 3 ways e_H can decay.

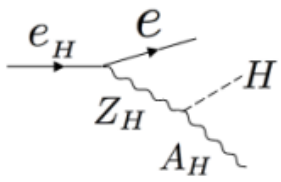
⇒ we will now focus on $e_He_H \rightarrow eZ_HeZ_H$



45.1%



33.2%

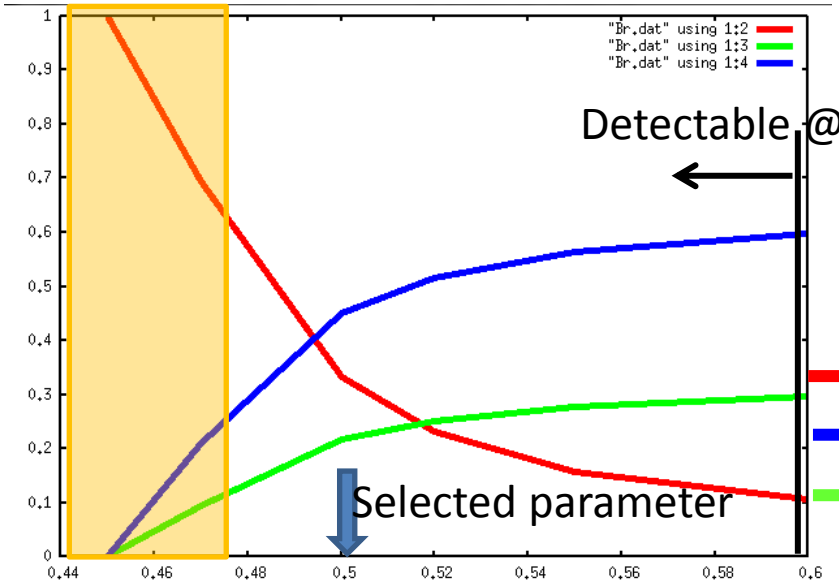


21.7%

Reference :arXiv: 4632v2 ”T-Parity odd heavy lepton at LHC”

e_H Branching ratio study

Branching ratio @f = 580[GeV]



Cross section

Detectable @ $3fb^{-1}$ LHC

$me_H \fallingdotseq mZ_H, mW_H$

- K increase → l_H becomes massive and cross section is reduced
  eA_H branching ratio decreases.
- K>0.5 → LHC $300fb^{-1}$(luminosity goal) $4.2\sigma(\nu W_H)$
- eA_H: enormous amount of SM & NP background
- eZ_H :2higgs(134GeV) characteristic final state , less background

e_H Branching ratio study

$$\mathcal{L}_{\mathrm{L}}^{(\mathrm{Gauge})} = \ldots + \frac{g}{\sqrt{2}} \left[\bar{e}_H \not{W}_H P_L \nu \right.$$

$$- \frac{g}{2} \left[\bar{e}_H \not{Z}_H \left(c_H - \frac{s_W}{5 c_W} s_H \right) P_L e \right.$$

$$- \frac{g}{2} \left[\bar{e}_H \not{A}_H \left(s_H + \frac{s_W}{5 c_W} c_H \right) P_L e \right. .$$

Charge suppressed

Mixing angle extremely small

$s_H \sim 0.1$

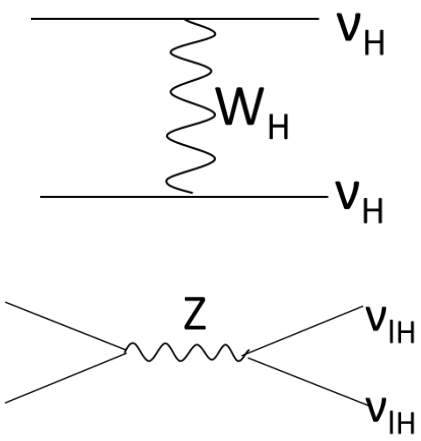
If there is enough phase space to decay,

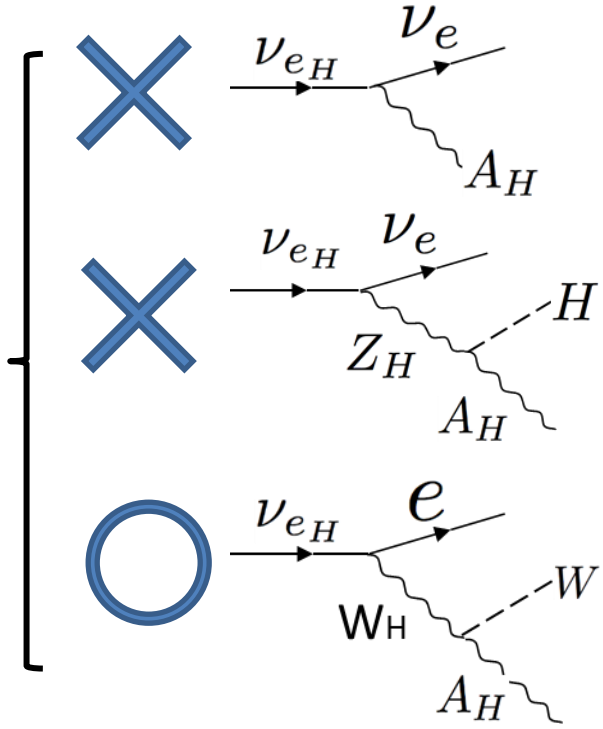
e_H is likely to decay to W_H &Z_H

ν_H mass extraction

$\nu_H\nu_H(eW_HeW_H)$

- Signal: eeqqqq(2W)A_HA_H →ν_Hのmass抽出
- BG: same as $e_He_H(eZ_HeZ_H \rightarrow eeHHA_HA_H)$





No signal!!

Same signal as Z_HZ_H
(with smaller cross section)

Branching ratio is probably
Around 45%
Cross section ~24fb

Summary & plan

- We were able to extract all parameters involving the LHT lepton and gauge boson sector.
- The mass spectrum will be complete with the mass extraction of $\nu_{H.}$

- At least extract ν_H mass by 3/9(ILC nennkai)