Higgs Working Group Report (I)

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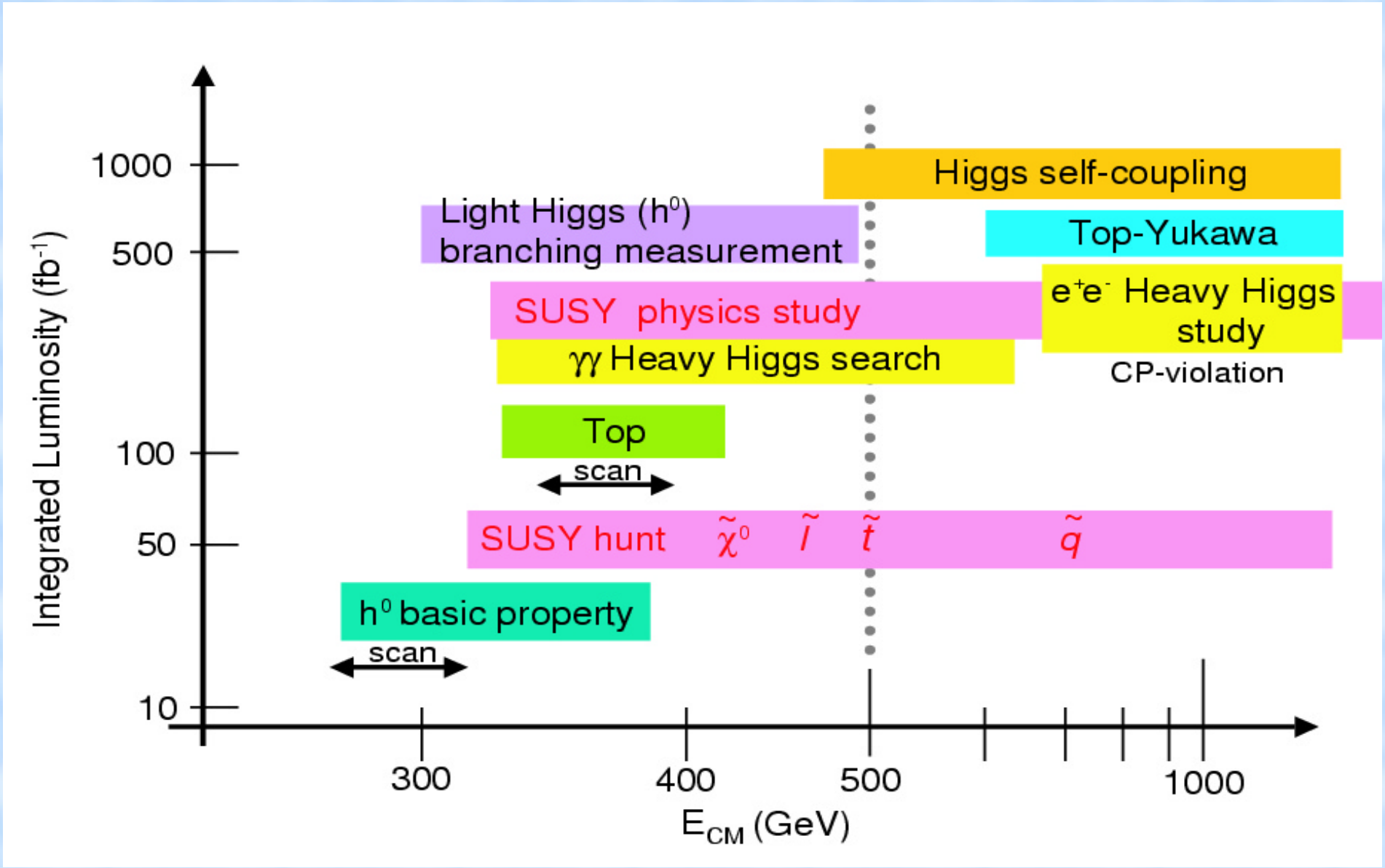
http://www.icepp.s.u-tokyo.ac.jp/~satoru/lchiggs/

Higgs Physics at GLC

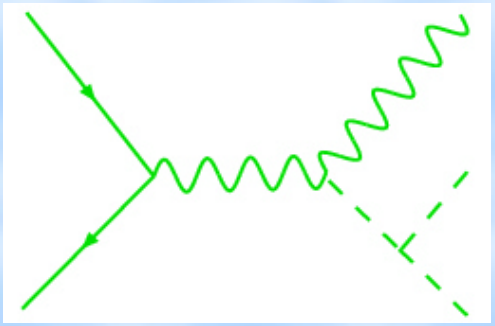
- LHC Higgs discovery
- GLC
  - **Precise measurement of Higgs sector**
- Higgs Physics at GLC
  - GLC I ($\sqrt{s}$=500 GeV)
    - Single Higgs production
      - Higgs mass and width
    - Higgs at **γ γ collider**
  - Energy Upgrade GLC II (TeV scale LC)
    - Multi Higgs production ⇒ Higgs self coupling
    - Top Yukawa
    - Heavy Higgs (MSSM,etc.)

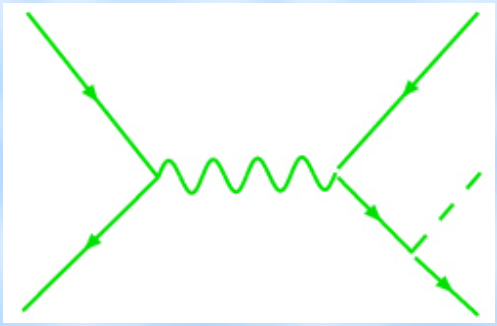
Physics at GLC



Higgs Working group

- Important topics
  - Higgs self coupling
  - Top Yukawa coupling





  - Heavy Higgs (MSSM,etc.)⇔New Physics group
  - Higgs at γ γ⇔γ γ working group
- Precise Study of Higgs Physics at GLC
  - Theoretical calculation (GRACE,HELAS,etc.)
  - Simulation (QuickSimulator,etc.)
    - collider and detector design
  - ACFA workshop (India 2003 Dec.)
  - LC workshop (Paris 2004 Apr.)

Procedure for Higgs analysis

1. Parton Generator
   - LCGrace (package based on GRACE 2.2.0)
     - Bases ⇒ Cross section
     - Spring ⇒ Events generator
2. Hadronizer
   - Pythia (interface from Spring to Pythia6)
   - Herwig
3. Simulator (Quick Simulator)
4. Analysis

LCGrace

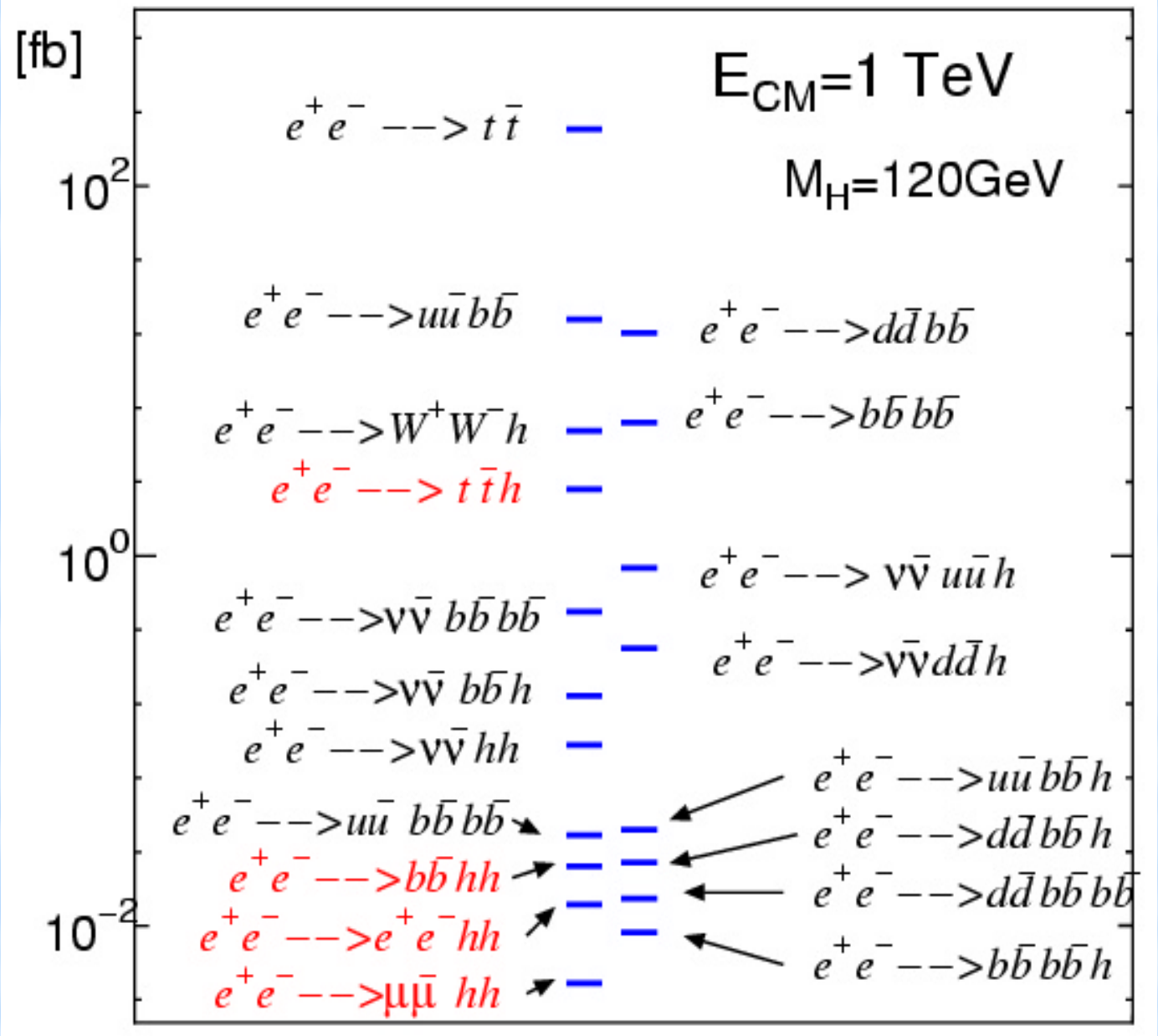
- Package based on the Grace system
  - Bases and Spring calculation
    Signal and Background processes
    for the light Higgs (Mh≦140 GeV)
    - $e^+e^- \rightarrow hhff \rightarrow bbbbff$ (final 6f)
    - $e^+e^- \rightarrow tth \rightarrow bbffffh$
- **How to use**
  - **runBases "Process name"?⇒ cross section**
  - **runSpring "Process name"⇒ event gentator**
    - **getparameters.f**
      …mass,energy,polarization,etc.etc.

Process ID and name

ID	process name	
1004	tT	$e^+e^- \to t\bar{t} \to b\bar{b}W^+W^-$
1100	wW	$e^+e^- \to W^+W^-$
1105	uUcC	$e^+e^- \to u\bar{u}c\bar{c}$
1106	dDsS	$e^+e^- \to d\bar{d}s\bar{s}$
1107	uUsS	$e^+e^- \to u\bar{u}s\bar{s}$
1108	uUbB	$e^+e^- \to u\bar{u}b\bar{b}$
1109	dDbB	$e^+e^- \to d\bar{d}b\bar{b}$
1110	bBbB	$e^+e^- \to b\bar{b}b\bar{b}$
1231	muMUbBbB	$e^+e^- \to \mu\bar{\mu}b\bar{b}b\bar{b}$
1232	uUbBbB	$e^+e^- \to u\bar{u}b\bar{b}b\bar{b}$
1233	dDbBbB	$e^+e^- \to d\bar{d}b\bar{b}b\bar{b}$
1340	bBbBbB	$e^+e^- \to b\bar{b}b\bar{b}b\bar{b}$
1345	nNbBbB	$e^+e^- \to \nu\bar{\nu}b\bar{b}b\bar{b}$
1405	tTh	$e^+e^- \to t\bar{t}h \to b\bar{b}W^+W^-h$

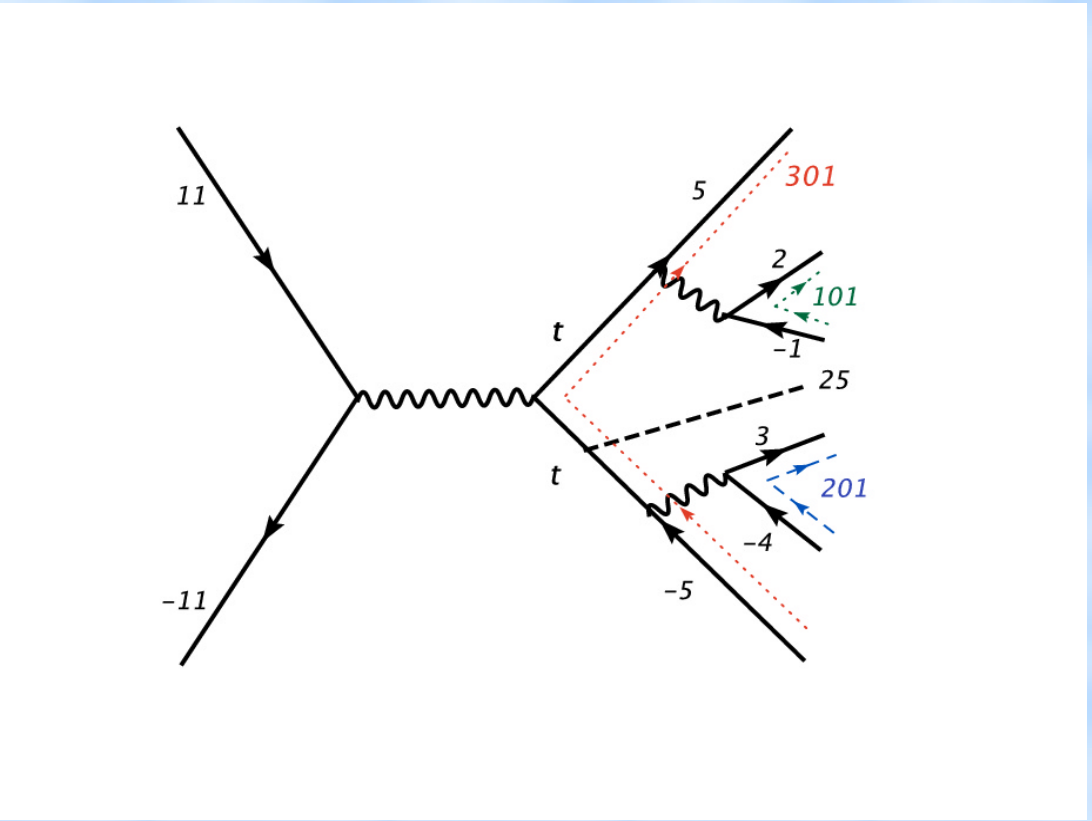
ID	process name	
1500	wWh	$e^+e^- \to W^+W^-h$
1511	nNmuMUh	$e^+e^- \to \nu\bar{\nu}\mu\bar{\mu}h$
1512	nNuUh	$e^+e^- \to \nu\bar{\nu}u\bar{u}h$
1513	nNdDh	$e^+e^- \to \nu\bar{\nu}d\bar{d}h$
1514	nNbBh	$e^+e^- \to \nu\bar{\nu}b\bar{b}h$
1520	muMUtuTUh	$e^+e^- \to \mu\bar{\mu}\tau\bar{\tau}h$
1523	muMUbBh	$e^+e^- \to \mu\bar{\mu}b\bar{b}h$
1530	uUcCh	$e^+e^- \to u\bar{u}c\bar{c}h$
1531	dDsSh	$e^+e^- \to d\bar{d}s\bar{s}h$
1532	uUsSh	$e^+e^- \to u\bar{u}s\bar{s}h$
1533	uUbBh	$e^+e^- \to u\bar{u}b\bar{b}h$
1534	dDbBh	$e^+e^- \to d\bar{d}b\bar{b}h$
1535	bBbBh	$e^+e^- \to b\bar{b}b\bar{b}h$
1900	nNhh	$e^+e^- \to \nu\bar{\nu}hh$
1901	eEhh	$e^+e^- \to e^+e^-hh$
1902	muMUhh	$e^+e^- \to \mu\bar{\mu}hh$
1903	bBhh	$e^+e^- \to b\bar{b}hh$

Event and Background (By Bases)



Spring to Pythia interface

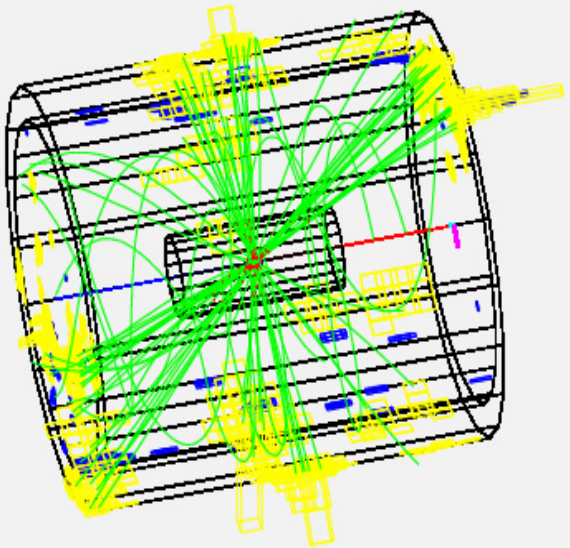
- Ex. $e^+e^- \rightarrow$ tth
  - Process ID 1405
- Spring output
  - Event information
- according to the Les Houches workshop

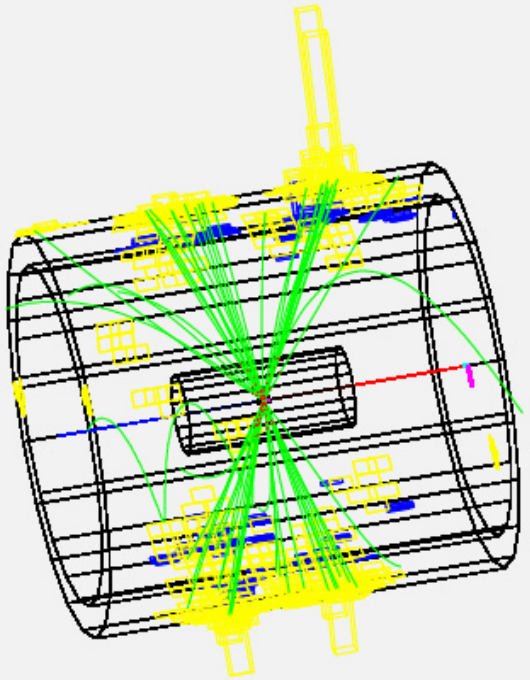


ID		color		px	py	pz	E	mass
11	-1 0 0	0	0	0.000000000	0.000000000	499.5406301	499.5406301	0.5109990600E-03
-11	-1 0 0	0	0	0.000000000	0.000000000	-498.8785341	498.8785341	0.5109990600E-03
5	1 1 2	301	0	41.12056912	154.2216149	-164.4307501	229.1967916	4.300000000
-5	1 1 2	0	301	-54.35215742	-99.73695046	-29.56412771	117.4484736	4.300000000
2	1 1 2	101	0	90.97351255	86.83345379	-50.28118897	135.4415988	0.5000000000E-02
-1	1 1 2	0	101	-8.664723072	44.42591945	11.96362802	46.81739250	0.1000000000E-01
3	1 1 2	201	0	7.593966843	-46.42994646	1.161168239	47.06131890	0.2000000000
-4	1 1 2	0	201	-73.12872730	-204.0589467	141.1014825	258.6454965	1.300000000
25	1 0 0	0	0	-3.542440722	64.74485552	90.71188404	163.8080923	120.0000000

Sample events

$e^+e^- \rightarrow tth$





$e^+e^- \rightarrow \nu\ \nu\ hh$

Current status of Higgs study

1. Parton Generator (LCGrace is ready)
2. Interface to Pythia 6.2
   (is almost ready)
   - according to the Les Houches workshop
   - Herwig?
3. Simulator
4. Analysis (Schedule -- Yamashita-san)