ZHH Study in GLD

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Introduction

Motivation of ZHH study

- Investigation of the ILC performance for heavy Higgs (M_H>160GeV).
  - Higgs decay to WW instead of bb.
  - ZHH must be studied, separated from light Higgs case.
- ZHH for light Higgs (M_H<160GeV) is also studied.

Current activity

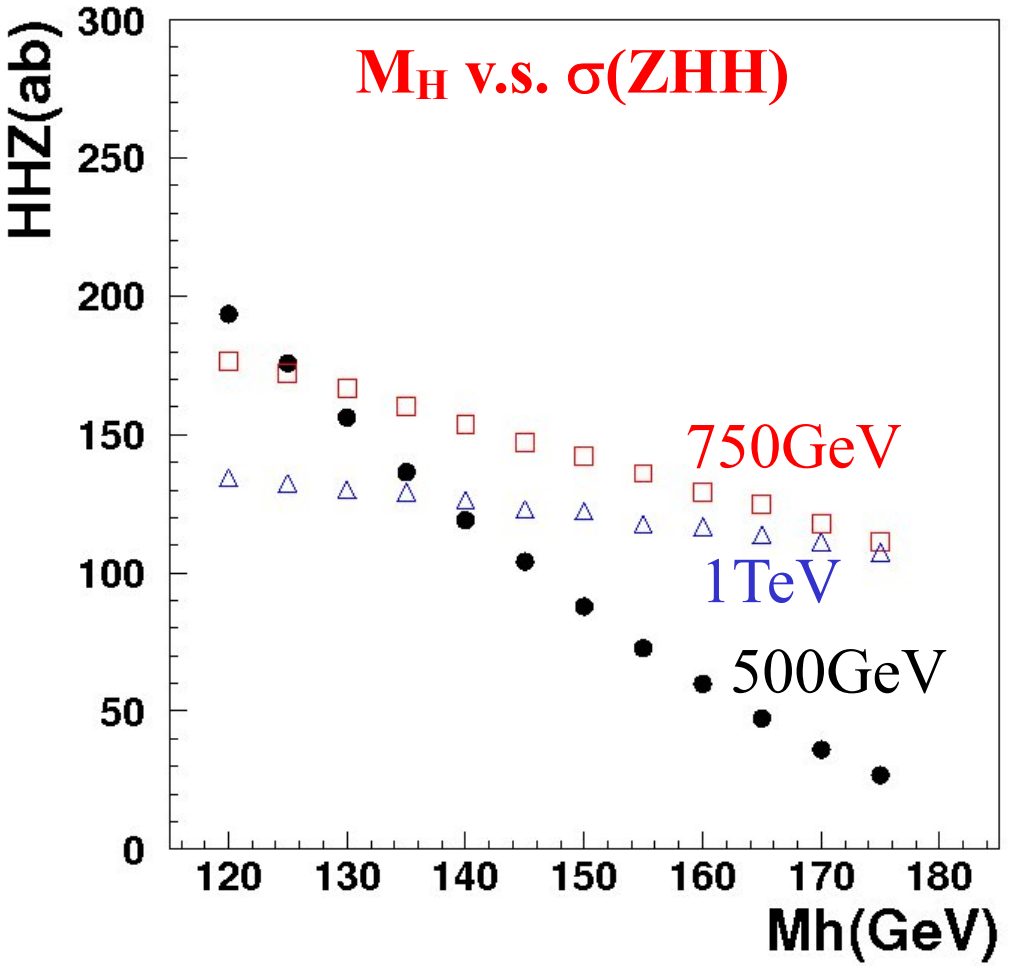
- Investigation of the cross-section and kinematic distributions.
  - Validity check of event generator calculation (MadGraph).
- Preparation of analysis code for quick-simulator.
- Study of B.G. processes.

Current status is presented.

ZHH cross-section

σ(ZHH) is calculated by MadGraph as a function of M_H.

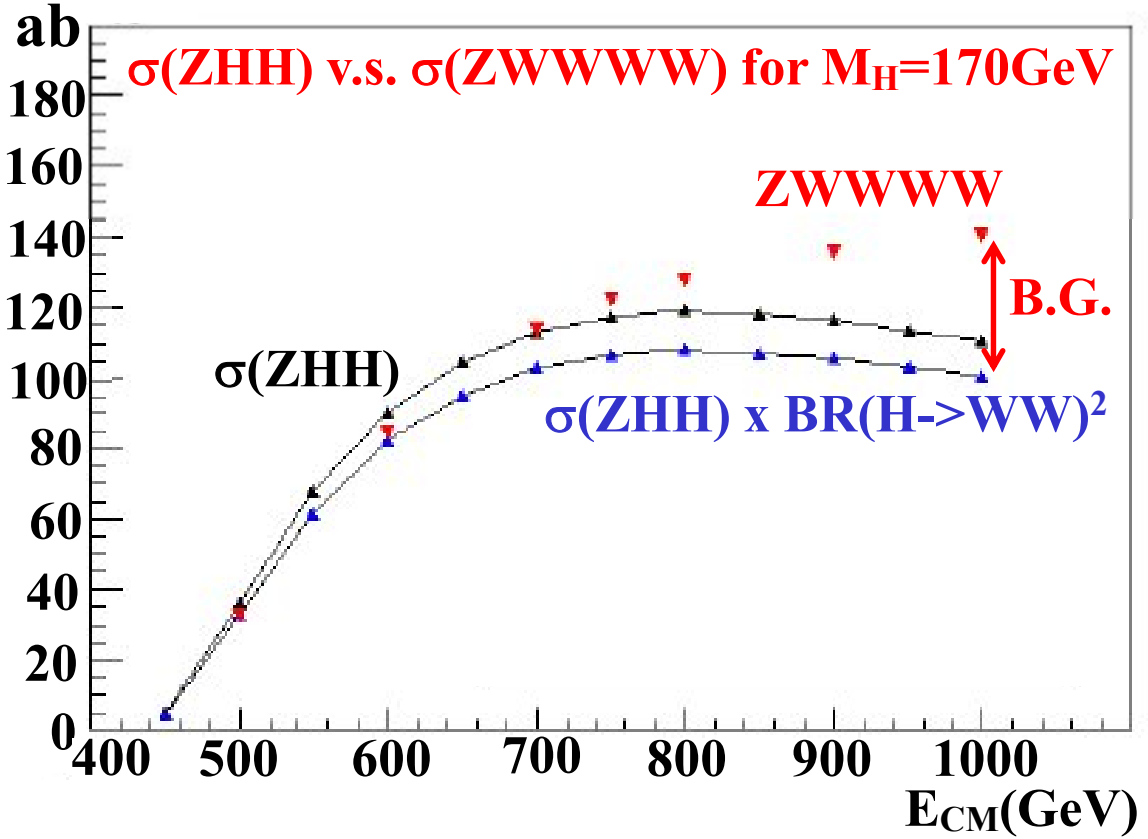
- Measurement for M_H>160GeV is difficult at E_{CM}=500GeV.
- σ(ZHH) is almost the same for E_{CM}=750GeV and 1TeV.
  - E_{CM}=750GeV is enough to study for M_H>160GeV.



The B.G. contamination is investigated for M_H=170GeV.

ZHH v.s. ZWWWW

- The intrinsic B.G. in ZHH->ZWWWW was studied for M_H=170GeV.
- σ(ZWWWW) was compared with σ(ZHH) x BR(H->WW)^2.
  - BR(H->WW) : 90%



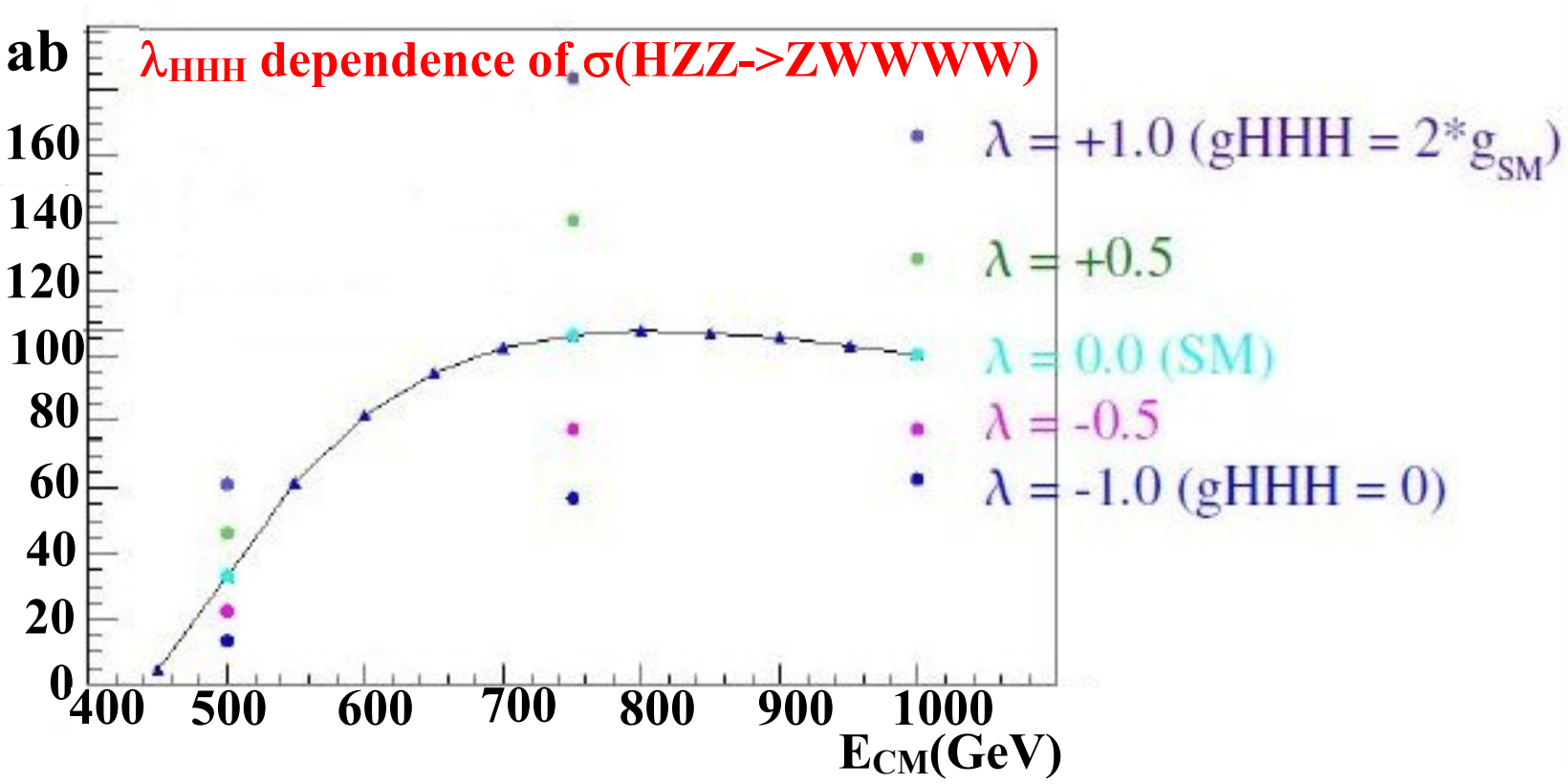
- σ(ZHH) has a peak at E_{CM} of ~750GeV.
- B.G. becomes larger for E_{CM} >800GeV.

E_{CM}=750GeV is the best for M_H=170GeV.

g(HHH) v.s. σ(ZHH->ZWWWW)

g(HHH) dependence of σ(HZZ->ZWWWW) was investigated.

- $g(HHH) = g_{SM}(HHH) \times (1 + \lambda)$
- The cross-section dependence on g(HHH) is clearly seen.



The kinematic distributions of Z and W will be checked.

MadGraph v.s. GRACE

Validity of MadGraph calculation was checked by comparison with GRACE.

- M_H=170GeV, E_{CM}=550GeV

σ(ZHH→ZWWWW)

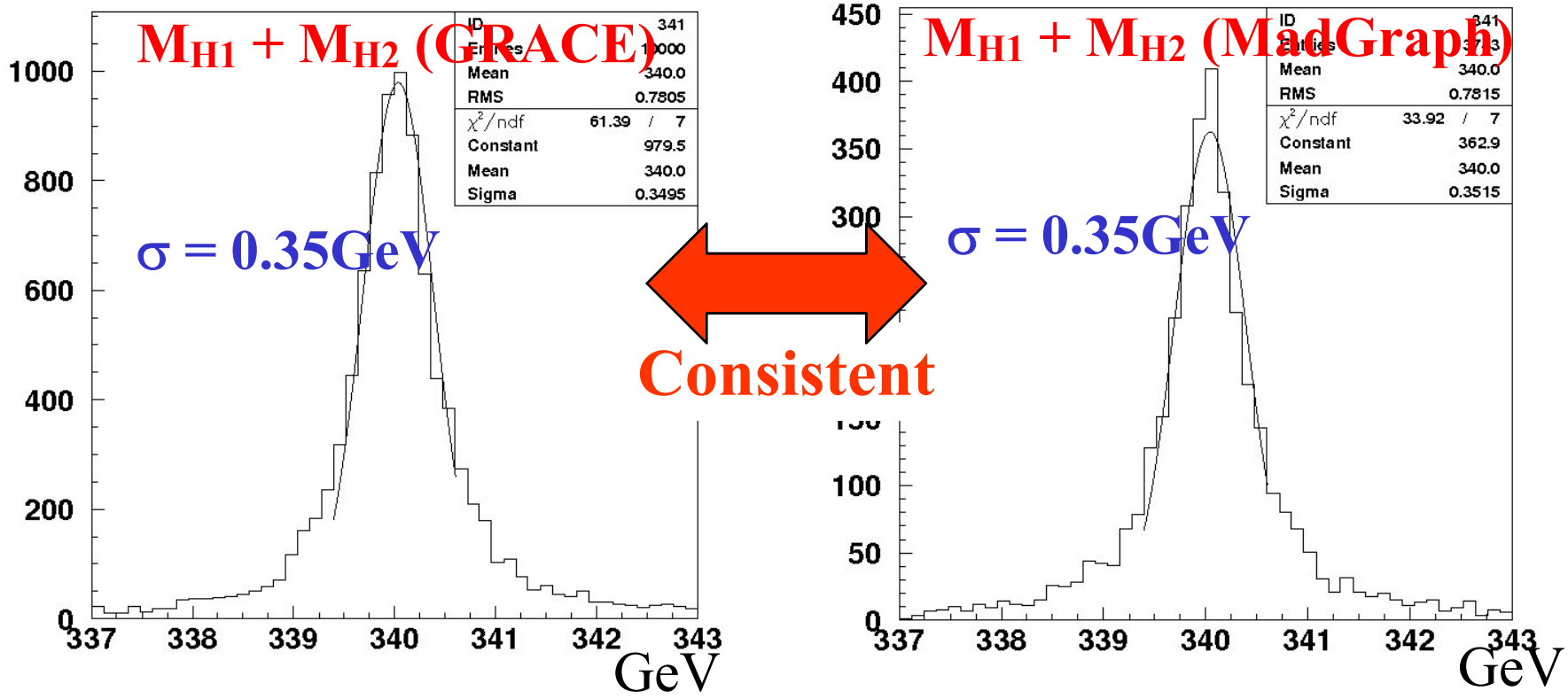
- **GRACE : 64.9 ab**
- **MadGraph : 63.3 ab**
  - σ(ZHH→ZWWWW) = σ(ZHH) x BR(H→WW)^2
  - σ(ZHH) : 67.896 ±0.709 ab
  - BR(H→WW) : 0.9656 by HDECAY
- This difference is within calculation accuracy of MadGraph.
- The result is also consistent with WHIZARD.

The kinematic distributions are compared.

MadGraph v.s. GRACE (2)

The kinematic distributions of MadGraph were compared with GRACE.

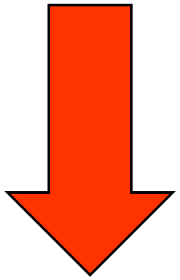
- The momentum and angular distribution were consistent.
- Reconstructed ($M_{H1} + M_{H2}$) distribution was also consistent.



The cross-section and kinematic distributions are consistent with GRACE.

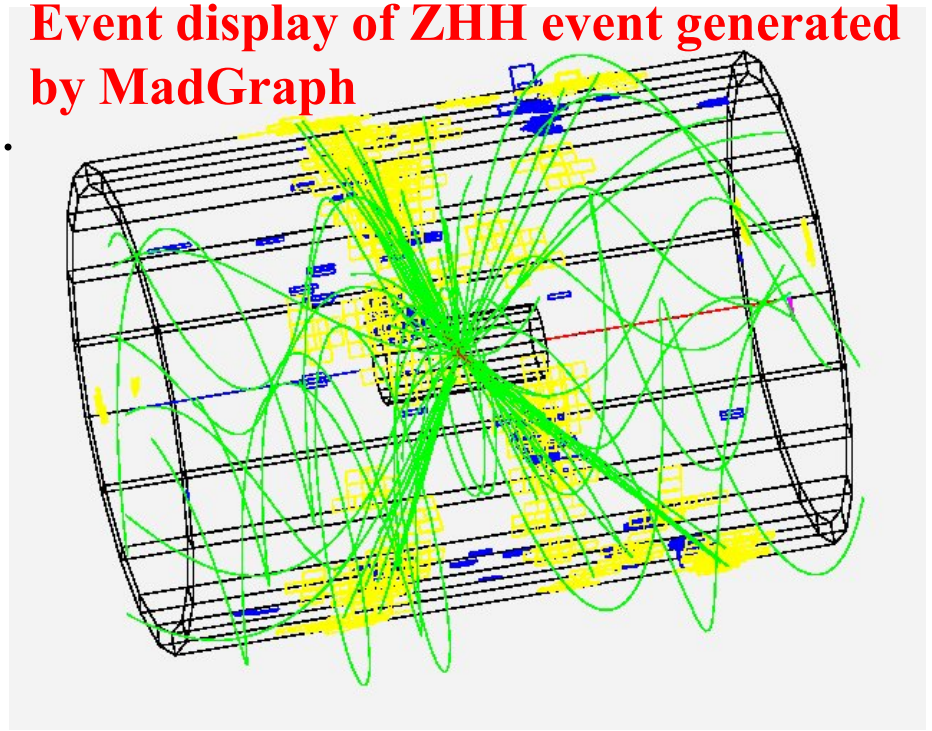
Event display in Quick-Sim

- Simulation is performed by quick-simulator.
- ZHH events produced by MadGraph are read successfully in quick-simulator.
  - Z and H are decayed by Pythia.



Development of analysis code is ongoing.

Event display of ZHH event generated by MadGraph



The first analysis result will be presented at the next ACFA meeting on March.

Summary

- Study of ZHH events was started.
  - MadGraph is used for event generator.
  - Simulation is performed for quick-simulator.
- σ(ZHH) is calculated by MadGraph.
  - The kinematic distribution is consistent with GRACE.
- σ(ZHH) depends on λ_{HHH} clearly.
  - The kinematic distribution will be investigated.
- Development of the analysis code for quick-simulator is ongoing.