# Status of ttH sample

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# ttH Whizard

- 6jets+lepton+missing ttH
  - bbneyxh_o e1,E1 b,B,n1,E1,d:s:b,U:C,h omega w:c,c
  - bbvmyxh_o e1,E1 b,B,n2:n3,E2:E3,d:s:b,U:C,h omega w:c,c
  - bbxyenh_o e1,E1 b,B,u:c,D:S:B,e1,N1,h omega w:c,c
  - bbxymvh_o e1,E1 b,B,u:c,D:S:B,e2:e3,N2:N3,h omega w:c,c

  ➔ ~ 2 days CPU for integration to connverge with ~0.3% precission
- 8 jets ttH
  - bbxyyxh_o e1,E1 b,B,u:c,D:S:B,d:s:b,U:C,h omega w:c,c

  ➔ About 700 Whizard channels. “w:c,c” increased CPU a lot.

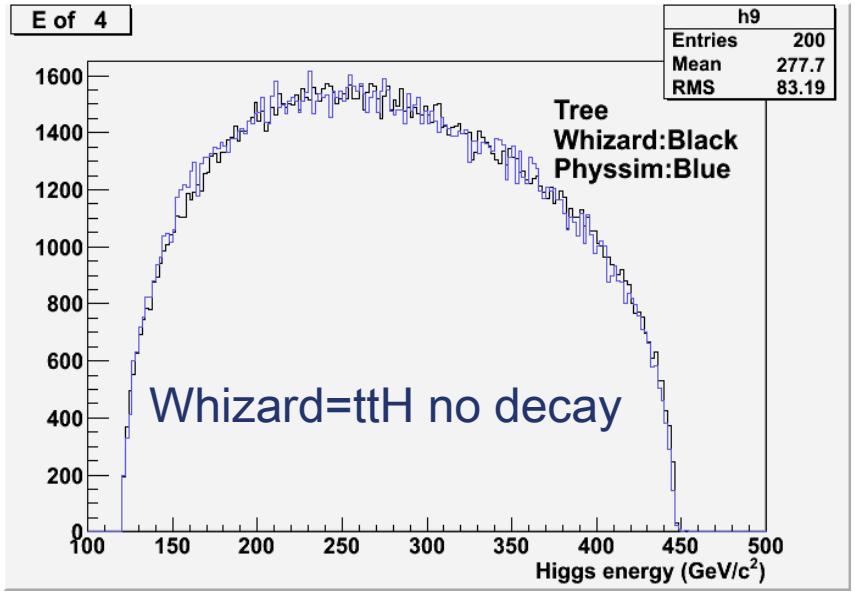
  ➔ 14 days for 4 loop of integration and ~3 % accuracy.
- 8 jets background
  - bbvmyxxx_o e1,E1 b,B,n2:n3,E2:E3,d:s:b,U:C,u:c,U:C omega w:c,c
  - bbvmyxyy_o e1,E1 b,B,n2:n3,E2:E3,d:s:b,U:C,d:s:b,D:S:B omega w:c,c

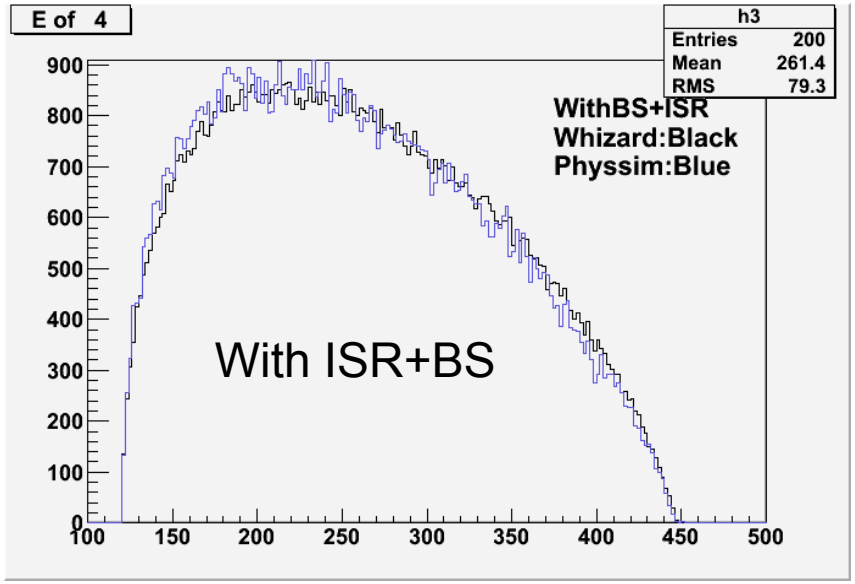
  ➔ failed to make fortran codes, bbvmyxx_o.f90 and bbvmyxyy_o.f90

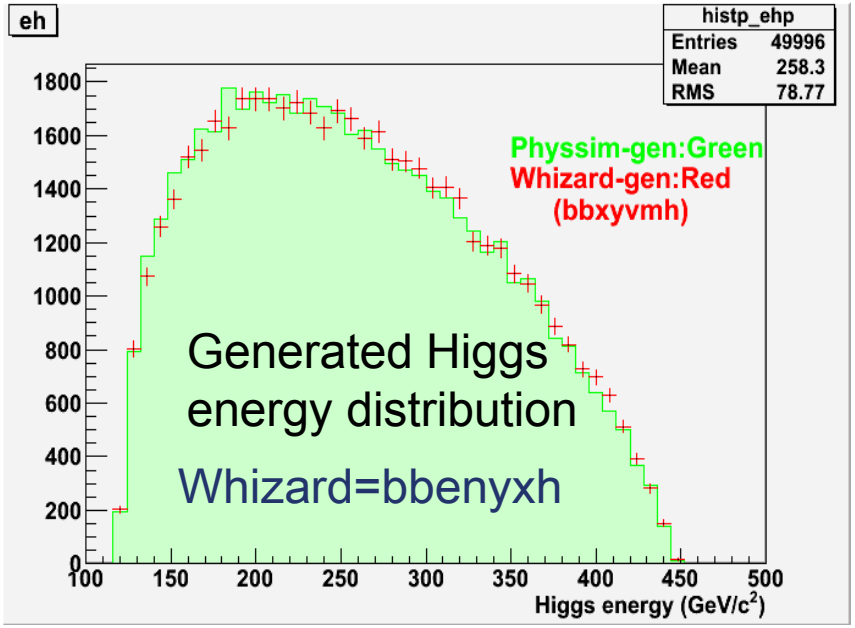
# How to proceed: Physsim or Whizard

- Whizard
  - Generate: 6-jet+Z, 4-jet+1-lepton+1-neutrino+Z
  - Z zero width, decay by Pythia, no Z pol effect.
  - ➔ Generation of this sample has not been tried yet.
- Physsim
  - ttH(6fH), ttZ→ttff(8f), ttg→ttbb(8f) by Helas (helicity amplitude)
  - No ISR g generated. no pT kick by ISR
  - Different hadronization function
    - Whizard passes 8 parton with color info to Pythia
    - Physsim passes parton P separately to Pythia
      - ➔ Particle(parton) order in McParticleLists are different
      - ➔ No color/Spin info, which exist in Whizard output.
  - Physsim update:
    - Same beamstrahlung function : done
    - Pythia: Opal tune parameter : done
    - Tauola version : 2.5 ➔ 2.7 : not complete

# Whizard – Physsim comparison

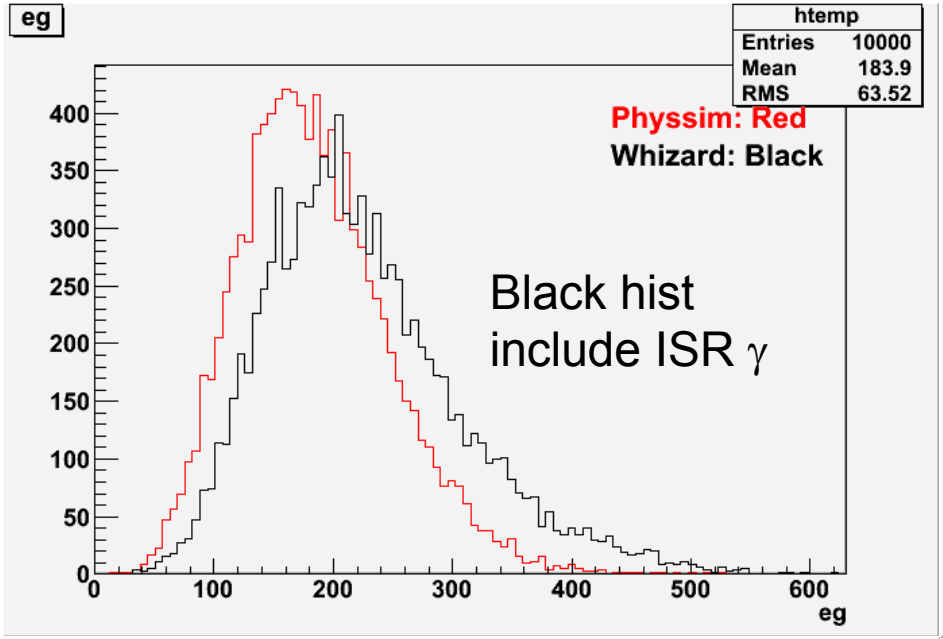


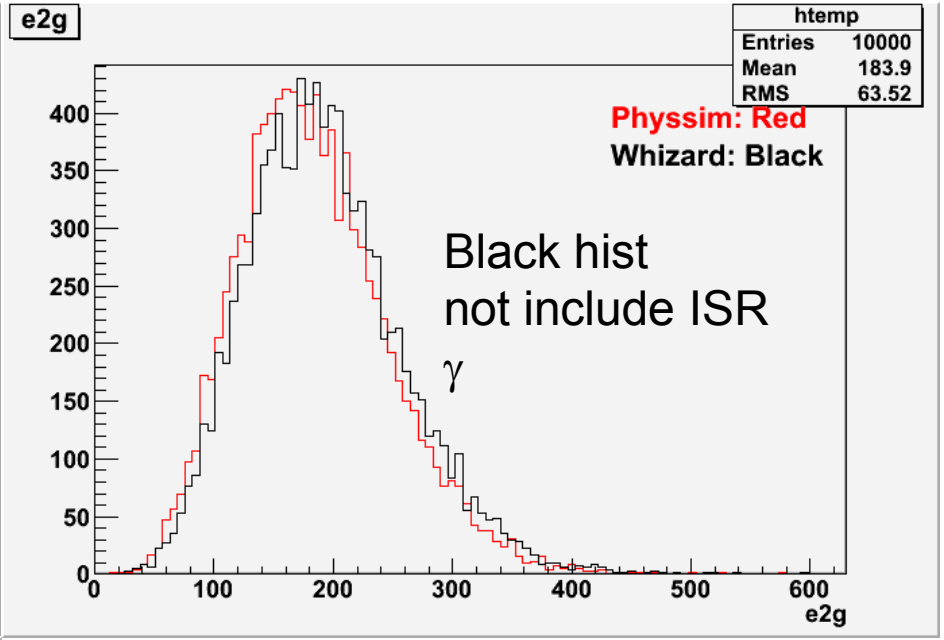



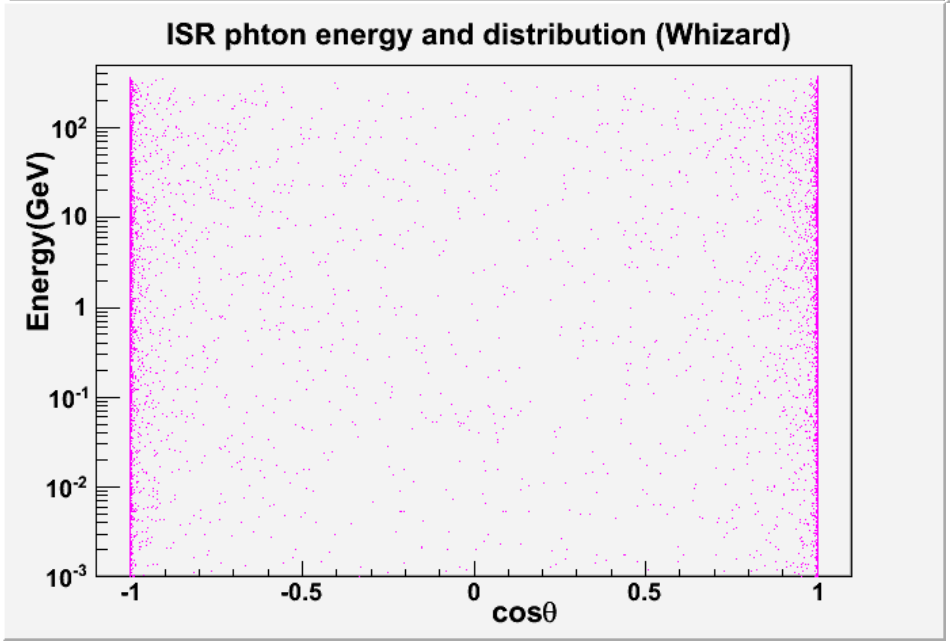




- ✓ Higgs energy distribution at tree level is consistent.
- ✓ Small difference is seen when ISR is ON
- ✓ Difference could be negligible
  Left sample is 8.3 ab-1 statistics

# After hadronization: γ  ΣEγ distribution

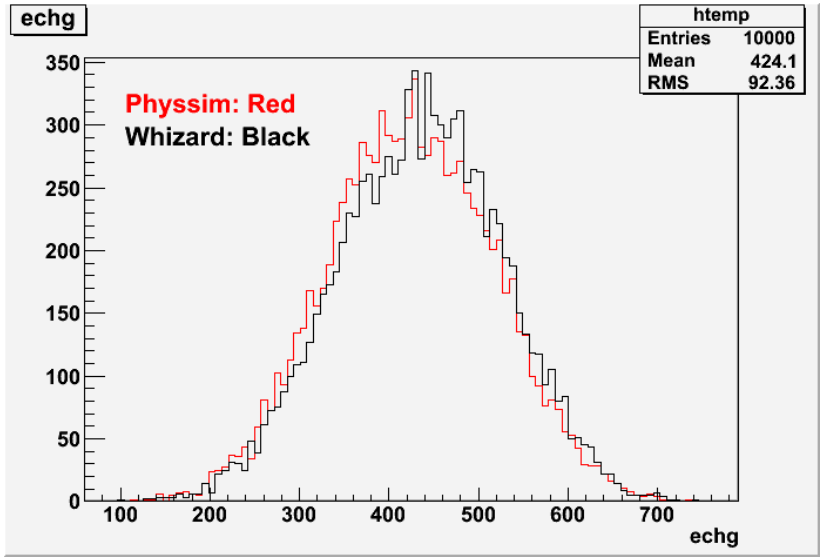


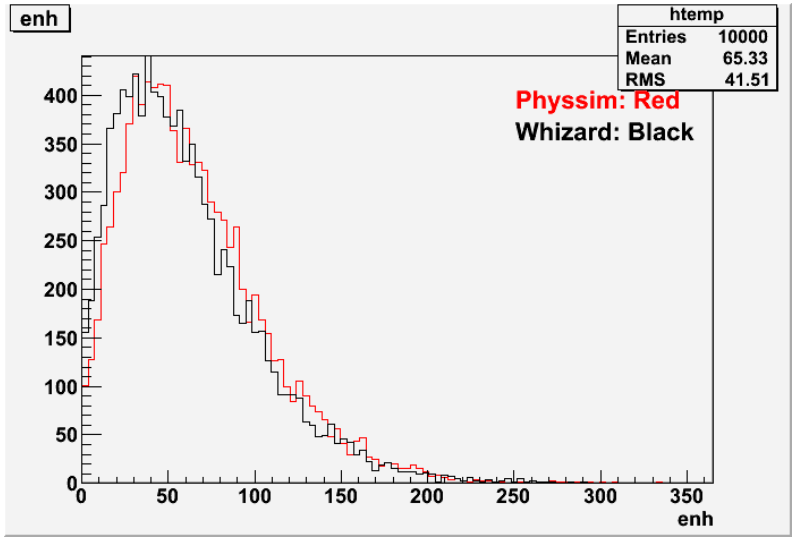



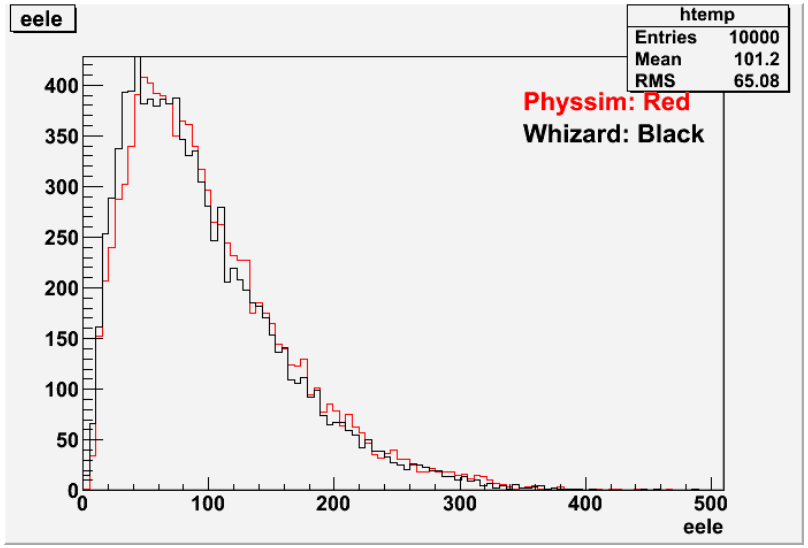



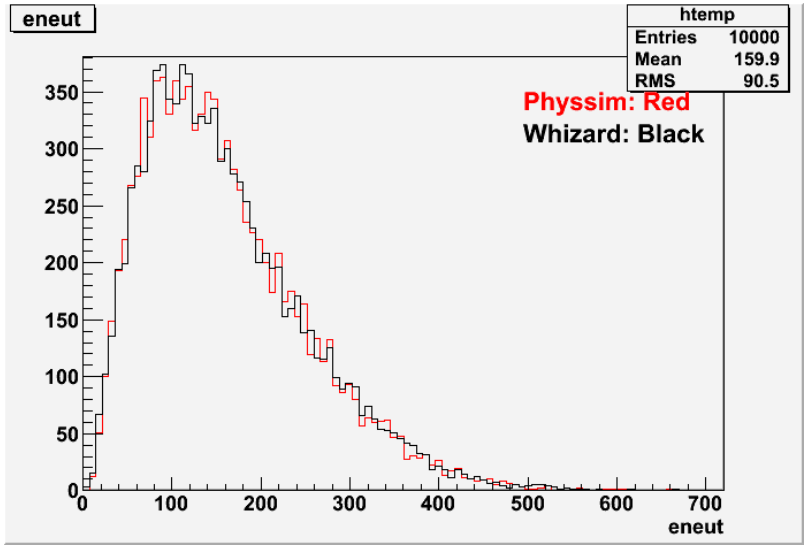

- ✓ First 2γs in MCParticeList of Whizard sample are considered as ISR.
- ✓ ΣEγ is different.
  Physsim does not generate ISR γ
- ✓ Whizard ISR γ : forward peak, but also generate energetic γ in central region ( ~4% of events include γ of E>10GeV, |cosθ|<0.9 )

# After hadronization: Other particles. Small differences

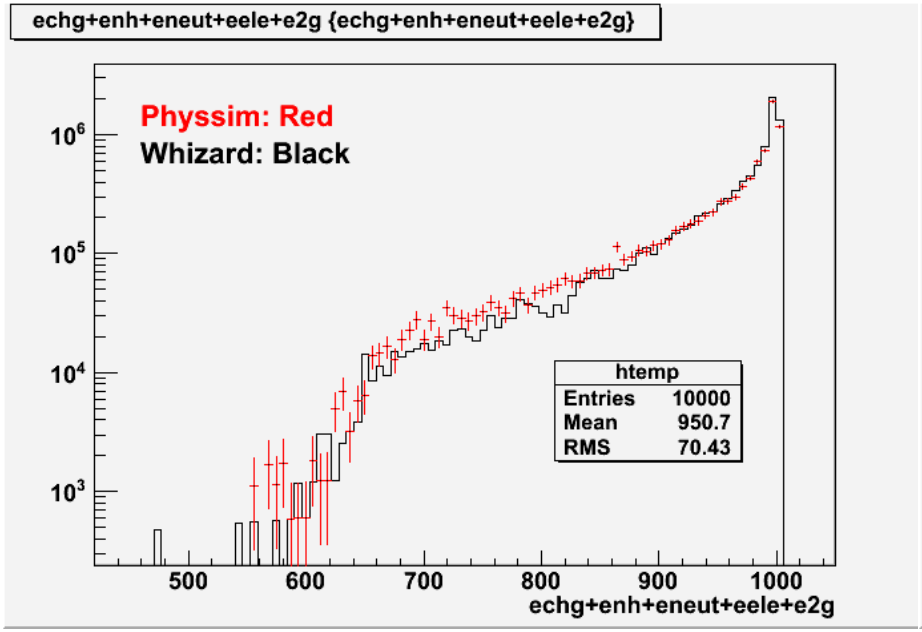


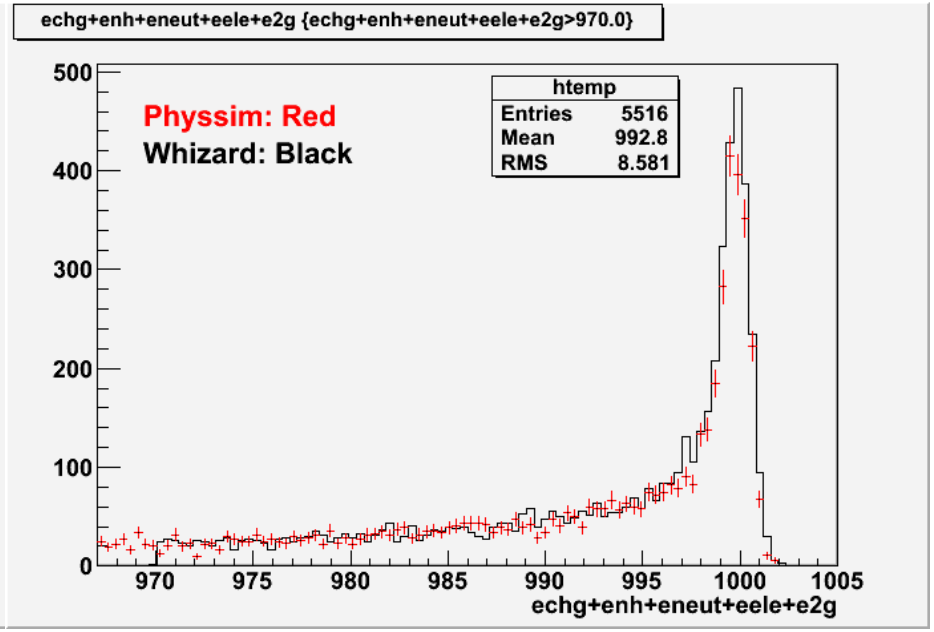



# Energy sum of all particles
# (Energy other than ISR and Beamstrahlung )



# Conclusion and Plan

- Differences are seen between Physsim and Whizard.
  These difference would be not critical for benchmark studies.

- Continue checking consistency between Whizard and Physsim using bbenyxh process.

- Physsim update ( needs to be investigated )
  - Hadronizer update. Either
    - Switch from tauola v5 to DESY-Tauola (v7)
    - Or Use ilc_fragment_call  in A6F, instead of the hadronizer in Physsim
  - Include EPA for ISR

- Update interfaces of ttbb and TTZ

➔ This will be stright forward

# Plan of Stdhep sample production (Draft)

- Samples with Higgs : Generator = Physsim
  1. ttH → 6-quark + H, H→ bb
  2. ttH → e/μ/τ + ν + 4-quark + H, H→ bb
  3. ttH → 6-quark + H, H→ non-bb
  4. ttH → e/μ/τ + ν + 4-quark + H, H→ non-bb
- Samples without Higgs : Generator = Physsim
  5. ttbb → 6-quark+bb
  6. ttZ → 6-quark+qq
  7. ttbb → e/μ/τ + ν + 4-quark + bb
  8. ttZ → e/μ/τ + ν + 4-quark + bb
  9. ttZ → 6-quark+ (e/μ/τ – pair)
- 6-fermion background : Generator = Whizard
  10. tt → 6-quark
  11. tt → e/μ/τ + ν + 4-quark

- Polarization combination: (-1.0, 1.0) and (1.0, -1.0) only
- Number of events: Largest of 5 $ab^{-1}$ or 50k events
  [ σ(ttH → e/μ/τ + ν + 4-quark + H)=1.37fb with (-1.0,1.0), 50k events=36$ab^{-1}$, 1.7GB ]
- 6-fermion samples will be generated by whizard.

# Backup slides

# DBD Benchmark

**1. Processes to be studied and goals for the analyses of these processes.**

We suggest the following new processes for study for the 2012 DBD:

1. $e^+e^- \to \nu\bar{\nu}h^0$ at $E_{\rm CM} = 1$ TeV, where $h^0$ is a Standard Model Higgs boson of mass 120 GeV, in the final states $h^0 \to \mu^+\mu^-$, $b\bar{b}$, $c\bar{c}$, $gg$, $WW^*$. The goal is to measure the cross section times branching ratio for these reactions. — Tim

2. $e^+e^- \to W^+W^-$ at $E_{\rm CM} = 1$ TeV, considering both hadronic and leptonic $(e, \mu)$ decays of the $W$. The goal is to use the value of the forward $W$ pair production cross section to measure in situ the effective left-handed polarization $(1 - P_{e^-})(1 + P_{e^+})/4$ for each of two polarization configurations. — Mikael

3. $e^+e^- \to t\bar{t}h^0$ at $E_{\rm CM} = 1$ TeV, where $h^0$ is a Standard Model Higgs boson of mass 120 GeV, in the final state $h^0 \to b\bar{b}$. The reaction involves final states with 8 jets and final states with 6 jets, one lepton, and missing energy. The goal is to measure the Higgs boson Yukawa coupling to $t\bar{t}$. — Akiya

The studies at 1 TeV should be carried out with an event sample of 1 ab$^{-1}$.
an electron and positron polarization consistent with the estimate from the GDE for 1 TeV

# For TTH : 1 TeV Cross sections(fb), with ISR, BS, No Pol.

## Without Higgs

v4 1.4245137E+05
v3 5.8559139E+04
v2 1.0617448E+04
ww 3.1549730E+03
qq 2.0324799E+03
aa 1.5586616E+03
az 1.2329374E+03
aww 2.5775764E+02
aaa 2.2905725E+02
tt 1.9659682E+02
aaz 1.8681679E+02
zz 1.7968303E+02
zww 5.8016322E+01
eeww 5.4879968E+01
ttg 4.1759286E+01
azz 3.3984933E+01
aaaa 1.8856775E+01
nnww 1.8101772E+01
aaaz 1.5361010E+01
nezw 1.4554051E+01
enwz 1.4511684E+01
aaww 1.3233322E+01

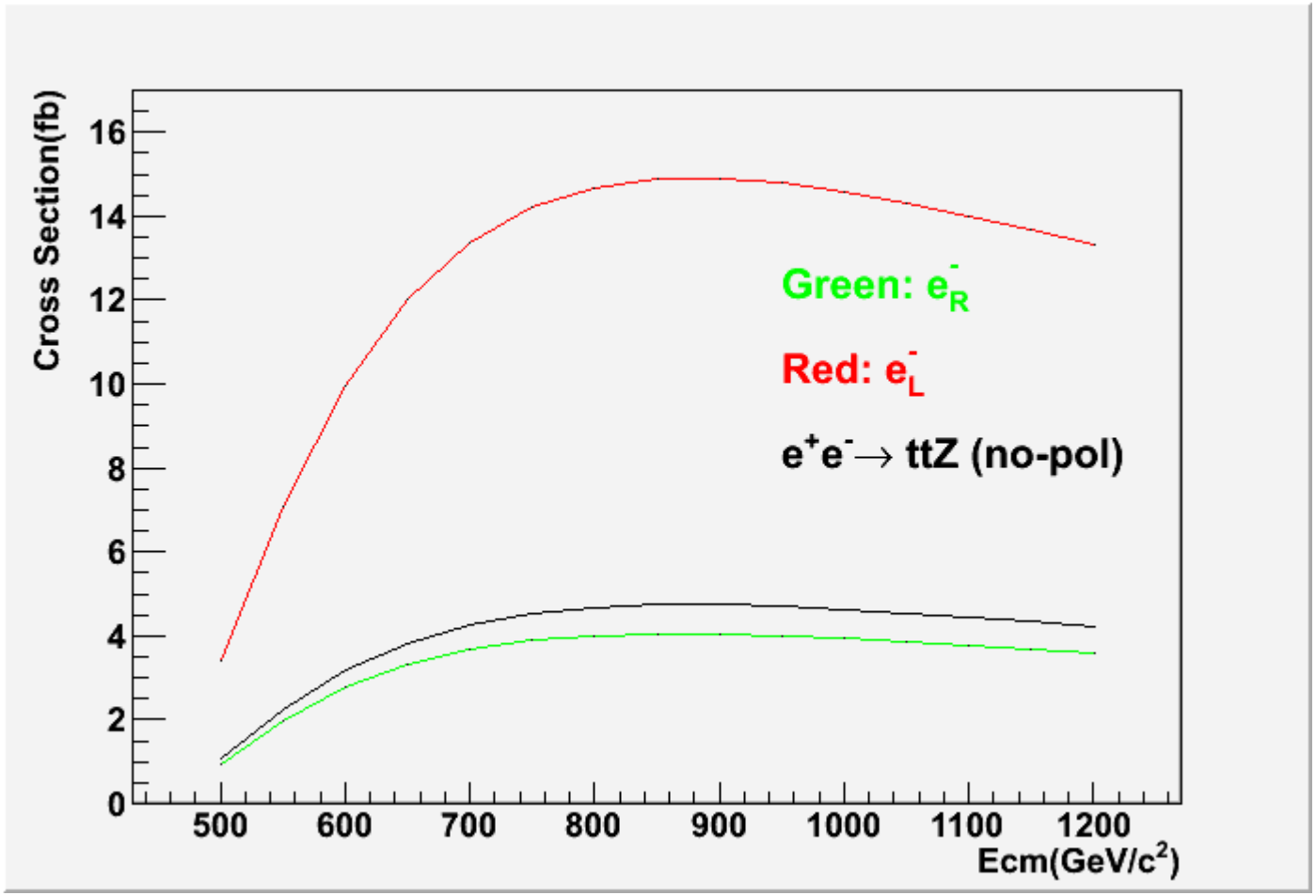
ttgg 5.7643777E+00
nnzz 5.7571646E+00
bwbwz 4.9670816E+00
azww 4.8862570E+00
ttz 4.4942257E+00
aazz 3.0604868E+00
aaaaa 1.0092561E+00
zzz 9.5863803E-01
aaaaz 7.9958795E-01
wwww 7.1567734E-01
aaaww 4.9552795E-01
zzww 4.2575859E-01
eezz 3.1947349E-01
azzz 1.5839218E-01
awwww 5.9735181E-02
aaazz 1.7021150E-02
aazzz 1.2713207E-02
zzzz 3.0240802E-03
azzzz 3.6507205E-04
zzzzz 8.2445179E-06

v2,v3,v4: any comb. of A,Z,W

## With Higgs

nnh 1.9977018E+02
v3h 8.3843180E+01
zh 1.7416253E+01
v2h 4.9381192E+00
wwh 4.1681393E+00
w2h 4.1680143E+00
azh 3.7805028E+00
tth 2.1792379E+00
awwh 3.9160376E-01
aazh 3.7662599E-01
zzh 3.5754913E-01
zhh 1.2969218E-01
azzh 6.1648548E-02
zwwh 5.8611556E-02
w3h 5.1585933E-02
aaazh 2.3916320E-02
aawwh 1.8962064E-02
wwhh 1.2731739E-02
eewwh 1.1745572E-02
nnwwh 1.1034237E-02

# ttH cross section




ttz 断面積: noISR, noBS

noPol 4.623 fb

e-L = 14.58 fb

e-R = 3.95 fb