Mass-production for physics ?

Mikael Berggren[1]

[1]DESY, Hamburg

ILD optimisation, 3 Dec 2008

Context

- New benchmarks.
- Physics case.
- New simulation.
- Errors in LOI mass-production.

Context

- New benchmarks.
- Physics case.
- New simulation.
- Errors in LOI mass-production.

Context

- New benchmarks.
- Physics case.
- New simulation.
- Errors in LOI mass-production.

Context

- New benchmarks.
- Physics case.
- New simulation.
- Errors in LOI mass-production.

New Benchmarks

From PP:

- Be ready for whatever LHC *might* see in 2012.
- This does *not* include the SM Higgs.
- But:
  - $M_H = 200$ GeV(1 TeV).
  - Z' with $M_{Z'} < 1.5$ TeV (500 GeV).
  - tt resonance at $M_X < 1.5$ TeV (500 GeV).
  - GMSB Susy, with detector-stable $\tilde{\tau}_1$(500 GeV).
  - Redo LOI studies at 230, 350, 500 and 1000 GeV.

New Benchmarks

From PP:

- Be ready for whatever LHC *might* see in 2012.
- This does *not* include the SM Higgs.
- But:
  - $M_H = 200$ GeV(1 TeV).
  - Z' with $M_{Z'} < 1.5$ TeV (500 GeV).
  - tt resonance at $M_X < 1.5$ TeV (500 GeV).
  - GMSB Susy, with detector-stable $\tilde{\tau}_1$(500 GeV).
  - Redo LOI studies at 230, 350, 500 and 1000 GeV.

New Benchmarks

From PP:

- Be ready for whatever LHC *might* see in 2012.
- This does *not* include the SM Higgs.
- But:
  - $M_H = 200$ GeV(1 TeV).
  - Z' with $M_{Z'} < 1.5$ TeV (500 GeV).
  - tt resonance at $M_X < 1.5$ TeV (500 GeV).
  - GMSB Susy, with detector-stable $\tilde{\tau}_1$(500 GeV).
  - Redo LOI studies at 230, 350, 500 and 1000 GeV.

New Benchmarks

From PP:

- Be ready for whatever LHC *might* see in 2012.
- This does *not* include the SM Higgs.
- But:
  - $M_H = 200\ \mathrm{GeV}(1\ \mathrm{TeV})$.
  - Z' with $M_{Z'} < 1.5\ \mathrm{TeV}$ (500 GeV).
  - tt resonance at $M_X < 1.5\ \mathrm{TeV}$ (500 GeV).
  - GMSB Susy, with detector-stable $\tilde{\tau}_1$(500 GeV).
  - Redo LOI studies at 230, 350, 500 and 1000 GeV.

New Benchmarks

From PP:

- Be ready for whatever LHC *might* see in 2012.
- This does *not* include the SM Higgs.
- But:
  - $M_H = 200\ \mathrm{GeV}(1\ \mathrm{TeV})$.
  - Z' with $M_{Z'} < 1.5\ \mathrm{TeV}$ (500 GeV).
  - tt resonance at $M_X < 1.5\ \mathrm{TeV}$ (500 GeV).
  - GMSB Susy, with detector-stable $\tilde{\tau}_1$(500 GeV).
  - Redo LOI studies at 230, 350, 500 and 1000 GeV.

Physics Case

Other things:

- SPS1a' in detail:
  - Scans
  - $\tilde{\mu}$ and $\tilde{\mathrm{e}}$
  - 1 TeV: squarks
- Other SUSY scenarios. Parameter scans.
- $t\bar{t}$ in detail.
- SM-higgs.
- Higgs self-coupling in $\nu\nu HH$ at 1 TeV.
- Precision SM physics.

Physics Case

Other things:

- SPS1a' in detail:
  - Scans
  - $\tilde{\mu}$ and $\tilde{\mathrm{e}}$
  - 1 TeV: squarks
- Other SUSY scenarios. Parameter scans.
- $t\bar{t}$ in detail.
- SM-higgs.
- Higgs self-coupling in $\nu\nu HH$ at 1 TeV.
- Precision SM physics.

Physics Case

Other things:

- SPS1a' in detail:
  - Scans
  - $\tilde{\mu}$ and $\tilde{\mathrm{e}}$
  - 1 TeV: squarks
- Other SUSY scenarios. Parameter scans.
- $t\bar{t}$ in detail.
- SM-higgs.
- Higgs self-coupling in $\nu\nu HH$ at 1 TeV.
- Precision SM physics.

Physics Case

Other things:

- SPS1a' in detail:
  - Scans
  - $\tilde{\mu}$ and $\tilde{\mathrm{e}}$
  - 1 TeV: squarks
- Other SUSY scenarios. Parameter scans.
- $t\bar{t}$ in detail.
- SM-higgs.
- Higgs self-coupling in $\nu\nu HH$ at 1 TeV.
- Precision SM physics.

Physics Case

Other things:

- SPS1a' in detail:
  - Scans
  - $\tilde{\mu}$ and $\tilde{\mathrm{e}}$
  - 1 TeV: squarks
- Other SUSY scenarios. Parameter scans.
- $t\bar{t}$ in detail.
- SM-higgs.
- Higgs self-coupling in $\nu\nu HH$ at 1 TeV.
- Precision SM physics.

New Simulation and Reconstruction

- We will have new simulation and reconstruction for the DBD
- It's mainly detector performance.
- The first aim is to increase realism, and what it will hopefully show is that ILD00 wasn't far off.
- The second aim is to bring all alternative technologies to the same level of sophistication.
- but: the design goals of all alternative technologies - physics-wise - is the same.

New Simulation and Reconstruction

- We will have new simulation and reconstruction for the DBD
- It's mainly detector performance.
- The first aim is to increase realism, and what it will hopefully show is that ILD00 wasn't far off.
- The second aim is to bring all alternative technologies to the same level of sophistication.
- but: the design goals of all alternative technologies - physics-wise - is the same.

New Simulation and Reconstruction

- We will have new simulation and reconstruction for the DBD
- It's mainly detector performance.
- The first aim is to increase realism, and what it will hopefully show is that ILD00 wasn't far off.
- The second aim is to bring all alternative technologies to the same level of sophistication.
- but: the design goals of all alternative technologies - physics-wise - is the same.

New Simulation and Reconstruction

- We will have new simulation and reconstruction for the DBD
- It's mainly detector performance.
- The first aim is to increase realism, and what it will hopefully show is that ILD00 wasn't far off.
- The second aim is to bring all alternative technologies to the same level of sophistication.
- but: the design goals of all alternative technologies - physics-wise - is the same.

New Simulation and Reconstruction

- We will have new simulation and reconstruction for the DBD
- It's mainly detector performance.
- The first aim is to increase realism, and what it will hopefully show is that ILD00 wasn't far off.
- The second aim is to bring all alternative technologies to the same level of sophistication.
- but: the design goals of all alternative technologies - physics-wise - is the same.

Lessons from LOI

- In most cases: The LOI full-sim studies confirmed older fast-sim (Simdet, SGV, ...) studies.
- There is even post-LOI fastsim studies reproducing the LOI results (Hengne's Higgs studies for the SB2009)
- Exception: the Higgs self-coupling, which did not confirm earlier studies. However, the difference seems to be localised to the generator, rather than to detector simulation.
- SiD - ILD difference:
  - Detector performance as expected
  - Physics performance: Large differences.
  - $\rightarrow$ difference in analysis, not simulation.

Lessons from LOI

- In most cases: The LOI full-sim studies confirmed older fast-sim (Simdet, SGV, ...) studies.
- There is even post-LOI fastsim studies reproducing the LOI results (Hengne's Higgs studies for the SB2009)
- Exception: the Higgs self-coupling, which did not confirm earlier studies. However, the difference seems to be localised to the generator, rather than to detector simulation.
- SiD - ILD difference:
  - Detector performance as expected
  - Physics performance: Large differences.
  - $\rightarrow$ difference in analysis, not simulation.

Lessons from LOI

- In most cases: The LOI full-sim studies confirmed older fast-sim (Simdet, SGV, ...) studies.
- There is even post-LOI fastsim studies reproducing the LOI results (Hengne's Higgs studies for the SB2009)
- Exception: the Higgs self-coupling, which did not confirm earlier studies. However, the difference seems to be localised to the generator, rather than to detector simulation.
- SiD - ILD difference:
  - Detector performance as expected
  - Physics performance: Large differences.
  - $\rightarrow$ difference in analysis, not simulation.

Lessons from LOI

- In most cases: The LOI full-sim studies confirmed older fast-sim (Simdet, SGV, ...) studies.
- There is even post-LOI fastsim studies reproducing the LOI results (Hengne's Higgs studies for the SB2009)
- Exception: the Higgs self-coupling, which did not confirm earlier studies. However, the difference seems to be localised to the generator, rather than to detector simulation.
- SiD - ILD difference:
  - Detector performance as expected
  - Physics performance: Large differences.
  - $\rightarrow$ difference in analysis, not simulation.

1 TeV

- Not done before.
- Requested by RD.
- Clearly part of the physics case for the ILC ("... upgradable to 1 TeV").
- Does it require improvements in software, or could it be done with ILD00 ???
- Specific physics-channels not present at 500 GeV:
  - Higgs self-coupling in *WW* fusion.
  - Squarks

1 TeV

- Not done before.
- Requested by RD.
- Clearly part of the physics case for the ILC ("... upgradable to 1 TeV").
- Does it require improvements in software, or could it be done with ILD00 ???
- Specific physics-channels not present at 500 GeV:
  - Higgs self-coupling in *WW* fusion.
  - Squarks

1 TeV

- Not done before.
- Requested by RD.
- Clearly part of the physics case for the ILC ("... upgradable to 1 TeV").
- Does it require improvements in software, or could it be done with ILD00 ???
- Specific physics-channels not present at 500 GeV:
  - Higgs self-coupling in *WW* fusion.
  - Squarks

1 TeV

- Not done before.
- Requested by RD.
- Clearly part of the physics case for the ILC ("... upgradable to 1 TeV").
- Does it require improvements in software, or could it be done with ILD00 ???
- Specific physics-channels not present at 500 GeV:
  - Higgs self-coupling in *WW* fusion.
  - Squarks

Consistency

So, in any case, there is new channels to simulate.
Then:

1. Either: New channels $\equiv$ New simulation ?
2. Or: new channels with old simulation ?

To be consistent, signal and background must be done the same way !

Case 1 = new background production. Not necessarily a “mass production” if background is eg. 6f only (Higgs self-coupling)

Case 2 = Why use an old simulation/reconstruction for physics, when a new better was used for detector optimisation ?

Consistency

So, in any case, there is new channels to simulate.
Then:

1. Either: New channels $\equiv$ New simulation ?
2. Or: new channels with old simulation ?

To be consistent, signal and background must be done the same way !

Case 1 = new background production. Not necessarily a “mass production” if background is eg. 6f only (Higgs self-coupling)

Case 2 = Why use an old simulation/reconstruction for physics, when a new better was used for detector optimisation ?

Consistency

So, in any case, there is new channels to simulate.
Then:

1. Either: New channels $\equiv$ New simulation ?
2. Or: new channels with old simulation ?

To be consistent, signal and background must be done the same way !

Case 1 = new background production. Not necessarily a “mass production” if background is eg. 6f only (Higgs self-coupling)

Case 2 = Why use an old simulation/reconstruction for physics, when a new better was used for detector optimisation ?

Time-scales

- Mass production: DBD - 13 months
- Our present scheme assumes this.
- If we decide not to do a physics mass-production, this changes.
- ... and changes now !

Time-scales

- Mass production: DBD - 13 months
- Our present scheme assumes this.
- If we decide not to do a physics mass-production, this changes.
- ... and changes now !

Errors etc. in generation and simulation for LOI

Generation:

- CKM-matrix was diagonal. Need to go to newer whizard (1.40 $\rightarrow$ 1.96).
- Fragmentation tune in PYTHIA. Default tuning was used, not the "best LEP tuning"
- τ polarisation. OK for τ-pairs and $\tilde{\tau}$, but (probably) not for eg. $W \rightarrow \tau\nu$. Needs whizard-TAUOLA interface.

Simulation/reconstruction:

- To much material in VTX.
- The PFOid processor was not tuned.
- Pandora created clusters in BeamCal, without considering beam-background, which makes no sense.
- No crossing-angle.

Errors etc. in generation and simulation for LOI

Generation:

- CKM-matrix was diagonal. Need to go to newer whizard (1.40 $\rightarrow$ 1.96).
- Fragmentation tune in PYTHIA. Default tuning was used, not the "best LEP tuning"
- τ polarisation. OK for τ-pairs and $\tilde{\tau}$, but (probably) not for eg. $W \rightarrow \tau\nu$. Needs whizard-TAUOLA interface.

Simulation/reconstruction:

- To much material in VTX.
- The PFOid processor was not tuned.
- Pandora created clusters in BeamCal, without considering beam-background, which makes no sense.
- No crossing-angle.

Errors etc. in generation and simulation for LOI

Lacking features in simulation:

- No dE/dx information in TPC. An obvious difference to SiD!
- timing.
- Statistics !!!! $\rightarrow$ FastSim !!

Are these problems so severe that it demands redoing the LOI-mass-production anyhow ?

Errors etc. in generation and simulation for LOI

Lacking features in simulation:

- No dE/dx information in TPC. An obvious difference to SiD!
- timing.
- Statistics !!!! $\rightarrow$ FastSim !!

Are these problems so severe that it demands redoing the LOI-mass-production anyhow ?

SB2009

New machine parameters:

- New beam-spectra
- Not useful to do mass-production with obsolete parameters !
- When will we have the definite numbers?!
- ... and how does that work with our planning ?

Backgrounds:

- Same question:
- When will we know ?
- How does that fit with our planing ?
- Remember that this does feed in to physics, eg for low $\Delta(M)$ SUSY.

SB2009

New machine parameters:

- New beam-spectra
- Not useful to do mass-production with obsolete parameters !
- When will we have the definite numbers?!
- ... and how does that work with our planning ?

Backgrounds:

- Same question:
- When will we know ?
- How does that fit with our planing ?
- Remember that this does feed in to physics, eg for low $\Delta(M)$ SUSY.

Other considerations

Get theorists on board !

- They will never do full sim.
- ... but tey should not do ad-hoc 4-vector smearing.
- We need an “approved” fastsim, like SimDet in the TESLA-days.

.....

Other considerations

Get theorists on board !

- They will never do full sim.
- ... but tey should not do ad-hoc 4-vector smearing.
- We need an “approved” fastsim, like SimDet in the TESLA-days.

.....

Other considerations

Get theorists on board !

- They will never do full sim.
- ... but tey should not do ad-hoc 4-vector smearing.
- We need an “approved” fastsim, like SimDet in the TESLA-days.

.....

Conclusions

- We have been asked to do a new mass-production for physics ...
- ... but no one I've asked have put forward any strong reason to do so for physics.
- Nevertheless, there are reasons to do it:
  - Errors and short-comings in the LOI samples.
  - Consistently do optimisation and physics analysis with the same software and detector model.
- There is one reason not to do it
  - Manpower !
- In any case, we need FastSim for $\gamma\gamma$ background, and to the theory-comunity.
- Is this all we need for physics?

The floor is open ...

Conclusions

- We have been asked to do a new mass-production for physics ...
- ... but no one I've asked have put forward any strong reason to do so for physics.
- Nevertheless, there are reasons to do it:
  - Errors and short-comings in the LOI samples.
  - Consistently do optimisation and physics analysis with the same software and detector model.
- There is one reason not to do it
  - Manpower !
- In any case, we need FastSim for $\gamma\gamma$ background, and to the theory-comunity.
- Is this all we need for physics?

The floor is open ...

Conclusions

- We have been asked to do a new mass-production for physics ...
- ... but no one I've asked have put forward any strong reason to do so for physics.
- Nevertheless, there are reasons to do it:
  - Errors and short-comings in the LOI samples.
  - Consistently do optimisation and physics analysis with the same software and detector model.
- There is one reason not to do it
  - Manpower !
- In any case, we need FastSim for $\gamma\gamma$ background, and to the theory-comunity.
- Is this all we need for physics?

The floor is open ...

Conclusions

- We have been asked to do a new mass-production for physics ...
- ... but no one I've asked have put forward any strong reason to do so for physics.
- Nevertheless, there are reasons to do it:
  - Errors and short-comings in the LOI samples.
  - Consistently do optimisation and physics analysis with the same software and detector model.
- There is one reason not to do it
  - Manpower !
- In any case, we need FastSim for $\gamma\gamma$ background, and to the theory-comunity.
- Is this all we need for physics?

The floor is open ...

Conclusions

- We have been asked to do a new mass-production for physics ...
- ... but no one I've asked have put forward any strong reason to do so for physics.
- Nevertheless, there are reasons to do it:
  - Errors and short-comings in the LOI samples.
  - Consistently do optimisation and physics analysis with the same software and detector model.
- There is one reason not to do it
  - Manpower !
- In any case, we need FastSim for $\gamma\gamma$ background, and to the theory-comunity.
- Is this all we need for physics?

The floor is open ...

Conclusions

- We have been asked to do a new mass-production for physics ...
- ... but no one I've asked have put forward any strong reason to do so for physics.
- Nevertheless, there are reasons to do it:
  - Errors and short-comings in the LOI samples.
  - Consistently do optimisation and physics analysis with the same software and detector model.
- There is one reason not to do it
  - Manpower !
- In any case, we need FastSim for $\gamma\gamma$ background, and to the theory-comunity.
- Is this all we need for physics?

The floor is open ...

Conclusions

- We have been asked to do a new mass-production for physics ...
- ... but no one I've asked have put forward any strong reason to do so for physics.
- Nevertheless, there are reasons to do it:
  - Errors and short-comings in the LOI samples.
  - Consistently do optimisation and physics analysis with the same software and detector model.
- There is one reason not to do it
  - Manpower !
- In any case, we need FastSim for $\gamma\gamma$ background, and to the theory-comunity.
- Is this all we need for physics?

The floor is open ...

Conclusions

- We have been asked to do a new mass-production for physics ...
- ... but no one I've asked have put forward any strong reason to do so for physics.
- Nevertheless, there are reasons to do it:
  - Errors and short-comings in the LOI samples.
  - Consistently do optimisation and physics analysis with the same software and detector model.
- There is one reason not to do it
  - Manpower !
- In any case, we need FastSim for $\gamma\gamma$ background, and to the theory-comunity.
- Is this all we need for physics?

The floor is open ...