Proposal: Benchmarking for the ILD optimisation study

J.List

ILD Meeting @ LCWS

Belgrade, October 8, 2014

Goals of further Simulation Studies

Open physics case questions

- High-level perspective
- Ultimate luminosity requirements
- Polarisation sharing
- Not yet (fully) demonstrated key measurements

=> interplay with running strategy & accelerator & detectors

Detector issues not yet studied (sufficiently)

- Calibration & alignment
  => need for Z pole running?
  => machine implications!
- Systematic uncertainties
- PID, low momentum particles…

Detector cost justification (reduction?)

- shrink overall size?
- Ecal technology?
- **Why a TPC?**
- …

Change requests from machine

- L* = 4.4 m -> 4.0 m ?
- Crossing angle
  14mrad -> 10mrad ?

=> cf Yokoya-San's presentation & MDI session

Strategy for Detector & Physics Benchmarking

- 1-1 relation between physics measurement and one specific detector performance aspect is *rare*

$\Rightarrow$can we factorize the two?

- Physics studies:
  - formulate *requirements* on various detector performance aspects, ideally "partial derivative"
  - this includes requirements on controlling systematics
- Detector benchmarking:
  - Test a comprehensive list of performance aspects for various detector configurations

Strategy for Factorisation

Detector-level performance

- Efficiencies, resolutions etc
- Study for O(3-4) detector models in full simulation

Example: Particle ID

- Determine actual capabilities in FullSim
- Study impact on analyses by varying PID efficiencies & fake rates in SGV

Physics performance

- ILD_o1 full simulation: reference analysis
- Where ever possible: determine *relative impact* of
  - efficiencies
  - resolutions
  - systematic uncertainties

  in SGV or cheated full sim

Optimisation benchmarks
- Detector Level -

- Hermeticity:
  - for high E (>90%E_{beam}?) e^{+-}/ γ
  - for "normal" e, μ, γ, π, n
- Calorimetry:
  - Jet energy resolution, including $5 < E_{jet} < 50$ GeV
  - Photon energy & angle resolution
  - Bhabha reconstruction
- Tracking system:
  - Efficiency, fake rate
  - $\sigma(1/p_t)$, σ_{IP}
  - Vertex efficiency, resolution
  - Jet charge
  - Flavour tag
- Low momentum particles (p_t = 0.1….2 GeV):
  - Tracking efficiency, $\sigma(1/p_t)$, σ_{IP}
  - Calorimeter detection efficiency
- Particle ID (dE/dx & calo)
  - e / μ / π^{+-} / p / K / n / π^0/ γ
  - Low p_t and "normal"
  - Particle ID in jets
- Exclusive decay mode reconstruction:
  - τ leptons
  - B, D hadrons

Optimisation benchmarks
- Physics Level -

m_H from ee->ννH->ννbb

- JER
- π^0 reconstruction
- b-tag, l in jet, excl. B decays
- JES, b-tag, had., frag, neutral hadrons fraction uncertainties

Similar, but for "light jets":
m_W from ee->eνW->eνqq

Higgs CP properties H->ττ

- τ reconstruction
- PID, Exclusive decay modes
- momentum & impact parameter

Near-degenerate Higgsinos

- Reco of low momentum particles
- Fake tracks
- PID, Exclusive decay modes
- Hermeticity
- Low and high-energy photon energy & angle resolution

A_{FB} (top)

- JER, lepton ID, b-tag
- *Jet charge*, excl. B-decays,

Mono-photon WIMPs

- Photon energy resolution & scale, hermeticity, *suppression of Bhabhas, dL/dE_{CM}*

First Testcase: Hermeticity

- Two changes in the pipeline
  - L*: we have been asked to evaluate how far can reduce L*
  - Smaller crossing angle 14 -> 10 mrad: this is an **offer** from the machine side – but will only come if **we quantify the benefits**
- In both cases:
  - Study hermeticity for e, y, mu, hadrons in various configurations
  - Quantify impact of loss / gain of hermeticity for physics analyses

=> Understand "parameter space" around the optimum, take informed decision

News from the ILD Analysis WG

- Started to collect an up to date list of ongoing activities – will help to channel newcomers to places where they're most urgently needed
  - please check http://agenda.linearcollider.org/getFile.py/access?contribId=6&resId=0&materialId=slides&confId=6526
  - Email comments / additions to jenny.list@desy.de
- Started a subgroup on systematic uncertainties led by M. Vos, G. Wilson + NN (Higgs/flavour tag)

Your comments?