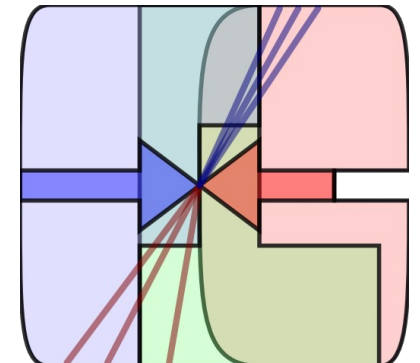# Towards an updated physics case: SUSY & other new Physics

ILD Meeting @ LAL
May 24, 2011
J.List, DESY

Outline:
- Physics Case & DBD
- ILD and DBD Physics Chapter
- SUSY / Exotics
- How to continue?

Towards an updated physics case

- … physics case?!

- heard lot of great news on detector technologies, detector integration, software baseline, benchmark analyses

- but the physics case has been made 10 years ago?!

- in principle: yes!

- but: LHC (and Tevatron!) are taking data and producing results by the hour → things start to change!

=> we have to react to this, and possibly fast!

→ The DBD will have "Physics Chapter"!

The DBD Physics Chapter - Plan

* 0 -- Intro: Jae Yu, Michael Peskin

* 1 -- W and Z: Tim Barkow, Juergen Reuter

* 2 -- 2-fermion: Yuan-Ning Gao, Maxim Perelstein

* 3 -- top: Andrei Nomerotski, Andre Hoang

* 4 -- SM Higgs: Keisuke Fujii, Heather Logan

* 5 -- Extended Higgs: Klaus Desch, Shinya Kanemura

* 6 -- SUSY + new spectroscopy: J.L., Howard Baer

* 7 -- Cosmological connnection: Geraldine Servant, Tim Tait

Where will the contents come from?

- not the benchmarks! → will go into ILD / SiD parts

- input from "theorists":

    - on the "The latest model I invented will be great to study at the ILC"-level

    - on parameter determination strategies

    → both highly welcome!

- but: the driving force needs to come from the hard core ILC community → ILD & SiD!

- for the physics case, the differences between the concepts are *not* substancial → here, we should be pulling the same rope (in the same direction ;-)

What we learned from LoIs

- no surprises w.r.t. TESLA /JLC fast simulation

  - THE exception: ZHH, but probably related to too optimistic fragmentation?

  - differences ILD/SiD: mostly in analysis technique, rarely in detector performance

- this is good news, since:

  - full simulation validated against testbeam data => performance demonstrated, not "postulated"

  - much better understanding of beam-backgrounds, dead material, …

What we learned from LoIs II

- analyses with full simulation take time!

- weren't able to produce enough background events
  $\rightarrow$ weights up to 5000

- channels selected to challenge the detectors don't give the full picture of the ILCs physics potential!

- Ex: Charginos / Neutralinos in Point 5:

  - only studied hadronic channels (WW/ZZ separation)

  - but we will of course also exploit the (semi-)leptonic channels!

Are the alternatives?

of course:

- parametric simulations from JLC / TESLA times:
    - Quicksim
    - Simdet
- fast simulation based on covariance matrices

    - LiCToy

    - SGV → talk by M. Berggren:

        - tuned to match ILD_00 full sim & rec
        - producing ILD DSTs
            => can be used "mixed" with Mokka / Marlin:
            - signal + main bkg → Mokka
            - other backgrounds → SGV

What to study in Mokka

=> need to decide carefully which questions need to be answered in full simulation:

- benchmarks

- detailed reconstruction performance studies (esp. backgrounds, timing)

- technology comparisons

- (yet) unvalidated features: dE/dx....

- "difficult cases": ZHH....

SUSY in the DBD – ideas for a "minimal set"

A: CP, RP conserving, Neutralino LSP

- scenario with large part of electroweak sector accessible, a la SPS1a':
    - all possible measurements
    - exploiting different beam energies, threshold scans, polarisations → determine SUSY parameters

    → partially done for LoI!

- scenario with smaller part of spectrum accessible
    - what can still be done?

SUSY in the DBD – ideas for a "minimal set"

B: Gravitino LSP

- for LoI: non-pointing photons from χ → γ Gravitino

    – only SiW ECAL

    – now: compare to SciW ECAL?

- meta-stable staus:

    – anomalous dE/dx

    – late decays in calorimeter

→ Simdet study by H.-U.Martyn..... needs updating!

SUSY in the DBD – ideas for a "minimal set"

C: CP violation

- ongoing study → c.f. talk by M. Terwort

- ...

SUSY in the DBD – ideas for a "minimal set"

D: RPV SUSY

- bilinear RPV : study ongoing by B.Vormwald

  – not trivial to generate events

  $\rightarrow$ close contact to authors of Spheno / Whizard

- ...

Beyond SUSY in the DBD

- little Higgs models → talk by E.Kato

- Large Extra Dimensions?

- Technicolor?

- Leptoquarks?

- Unparticles?

- …

Here come your ideas,

So what now for ILD?

- message from JSB is very clear:
  ILD does not want to choose technologies at this stage.

- important now:

  - defend the physics case:

    - understand what LHC will and will not be able to do
    - re-evaluate ILC potential in view of new results

  - demonstrate that we have *at least one* technology
    which is feasible and meets requirements

  => have to choose *something* for the next round of larger
  scale simulation & reconstruction!

  … what does this actually mean?

Simulation "use cases"

- new 1 TeV benchmarks:
    - in full simulation, with machine and important physics backgrounds

    => rather large production → sw baseline

- dedicated subdetector technology comparisons
    - first step: study "reconstruction performance"
    - then: decide if something more is to be learned from a "physics performance" study

    => smaller dedicated samples → not influenced by baseline choice!

Simulation "use cases" II

- *concept* feasibility studies:
    - main issue: forward pattern recognition in presence of background!
    - => problem is *software*, not mass production
        → again independent of sw baseline

- physics case:
    - we are on this together!
    - technology choices, or even ILD / SiD difference should not matter here
    - wide range of contributions from theory calculations via fast sim to full sim
        → independent of sw baseline choices

Conclusions

- in view of LHC, we have to re-state our physics case!

- needs joint effort from SiD, ILD, Theory -
  and our experimental colleauges who signed the LoIs!

- it's *our* job to make the high level of understanding of our
  detector performance *and* of accelerator parameters
  available to the community at large

- collaborate with Theory and fitting groups on parameter
  scans, interpretation of LHC results, selecting models....

- the Physics Chapter working groups have been set-up,
  → but need to be filled with life

- *we* need to start the effort in order to get the community
  (back) on board!

- issues from LoI:
    - generator – fixed, $\rightarrow$ talk from sw meeting
    - gammagamma event weights up to 5000
      also other backgrounds partially high weights
    - concentrated on detector challenging channels, not full physics potential
    - background not overlayed for most analyses
    - BeamCal treatment, crossing angle