Physics: Plans and outlook (summary of physics session)

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September 26, 2013

ILD Meeting @ Krakow

Wednesday, September 25, 2013

09:00 - 10:30 ILD physics

Location: IFJ PAN (Main Auditorium)

Update on Higgs self-coupling

09:00 **Higgs Self Coupling Analysis using the events containing H-->WW* decay** *15'*
Speaker: Mr. Masakazu Kurata (The university of Tokyo)
Material: **Slides**

09:15 **Detector requirements from Higgs physics** *15'*
Speaker: Dr. Taikan Suehara (Tohoku University)
Material: **Slides**

09:30 **Detector requirements from top physics** *20'*
Speaker: Roman Poeschl (LAL Orsay)
Material: **Slides**

09:50 **Detector requirements from electroweak precision observables** *20'*
Speaker: Dr. Graham Wilson (KU)
Material: **Slides**

10:10 **Detector requirements from BSM physics** *20'*
Speaker: Dr. Jenny List (DESY)
Material: **Slides**

Detector optimization from the viewpoint of physics: Higgs, Top, EWPO, BSM
- major detector requirements and reconstruction issues
- benchmark analyses for detector optimizations
- overlap is ok

This summary should be regarded as a starting point.
There are many important points raised by the speakers which I have undoubtedly missed.

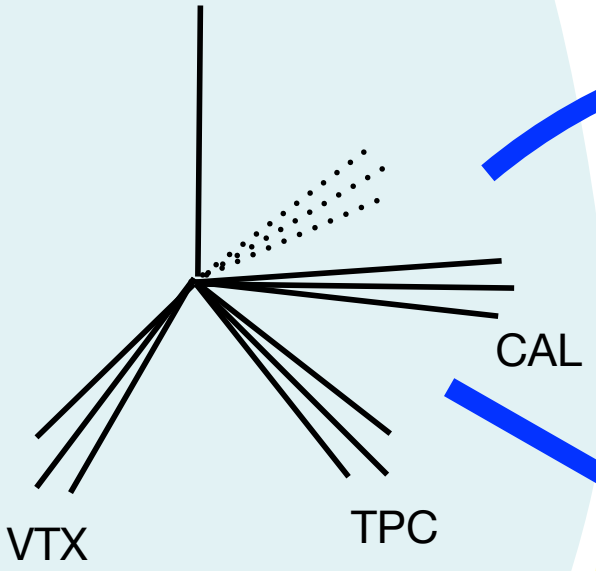
Optimization Space

Global parameters

R, L (CAL), θ_{min}, ...

B-field

Material budget



Local, detector component parameters

Internal & scale-invariant

Technology choice

detailed design

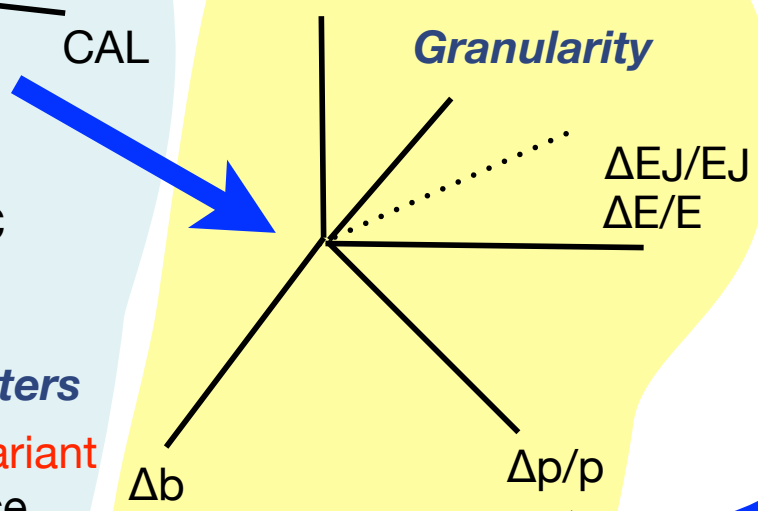
Make them as orthogonal or diagonal as possible !

Confirmation to clear the threshold rather than optimization?

Full simulation

Global parameters

Granularity



Single particle performance

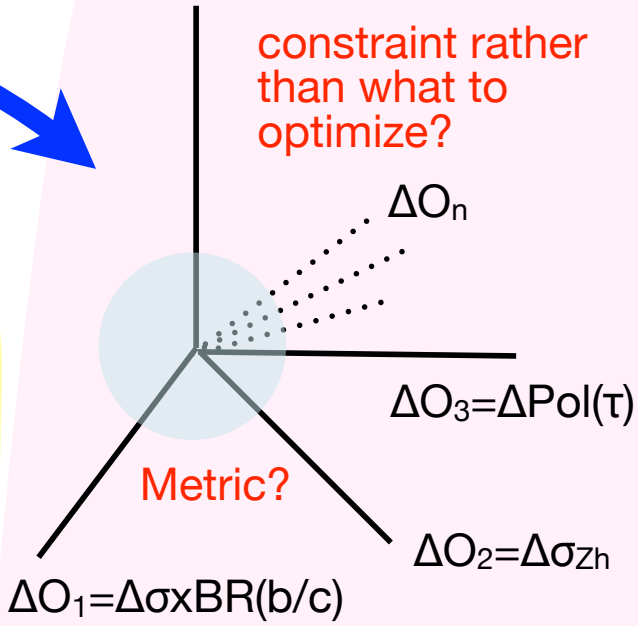
resolutions on x^μ and p^μ, etc.

Fast Simulation

parametric study

Cost = fn(R,L,granularity,..)

constraint rather than what to optimize?



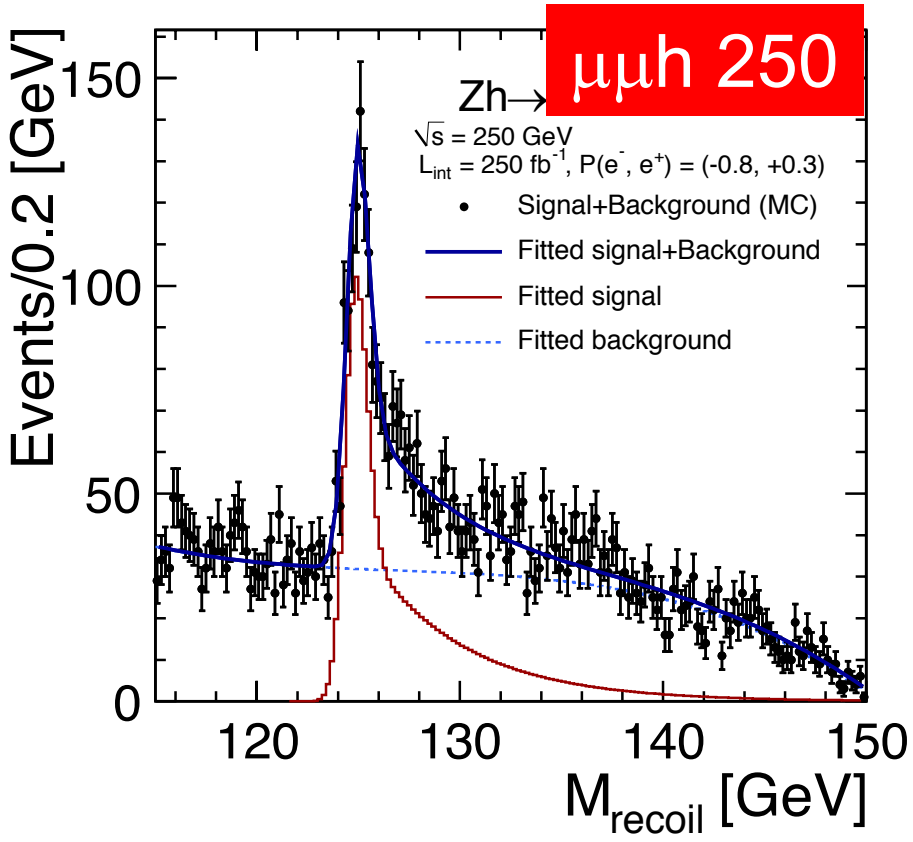
Physics performance

Benchmark observables for evaluation

New benchmark?

Track momentum resolution

Recoil mass



At 250 GeV:
beam energy spread is larger than the detector resolution

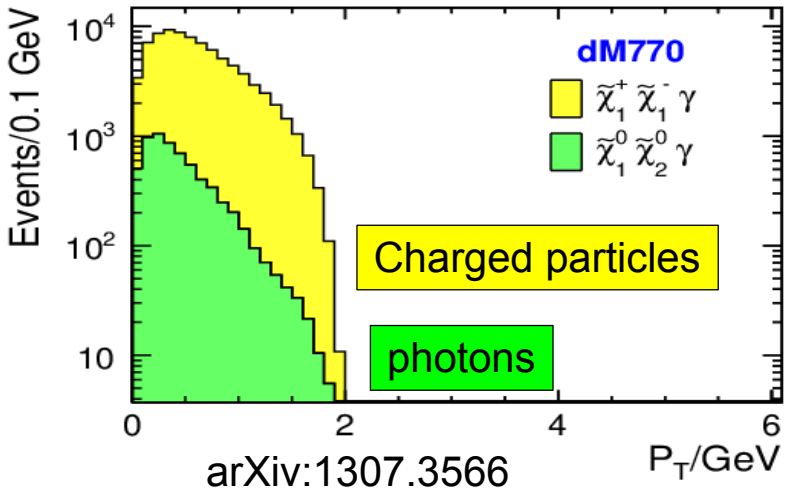
At higher energies:
detector resolution dominates

Lowest track pT that can be reconstructed?
→ Standalone silicon tracking

Implications:
new particles with very small mass differences

Challenge: pair backgrounds

- P_T spectrum of **Higgsino decays - ΔM = 770 MeV (!)**



arXiv:1307.3566

Impact parameter resolution

flavor tagging

h→bb/cc/gg: Higgs BR
tth: Top Yukawa coupling
hhh: Higgs self-coupling

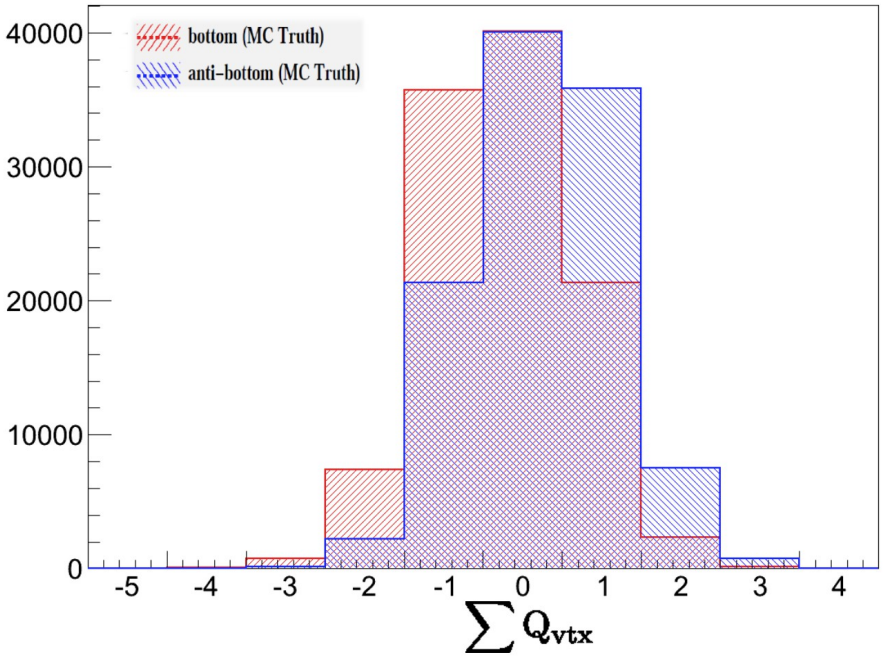
h→WW*: anomalous coupling

tau finding

h→tautau: BR, CP mixing

vertex charge

top pair asymmetries



Jet energy resolution

W/Z separation

qqh analysis
h→WW*, ZZ* : BRs
chargino/neuralino anaylsis
…

Multi-jet environment:

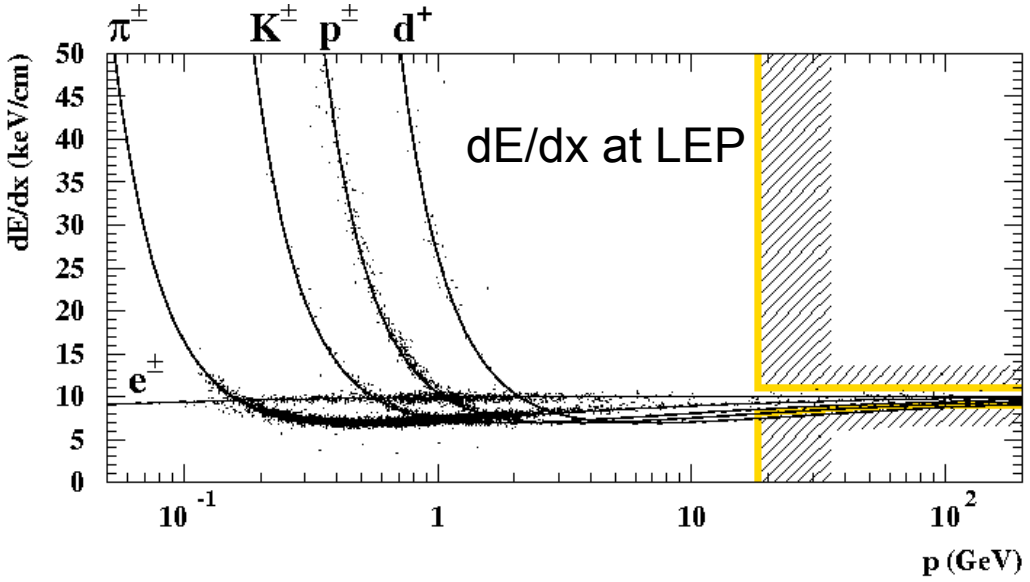
Jet clustering much more important!
→ still need to fully exploit detector

dE/dx

Particle ID

→ Improvement expected in:

Jet energy resolution
Flavor tagging
Vertex charge

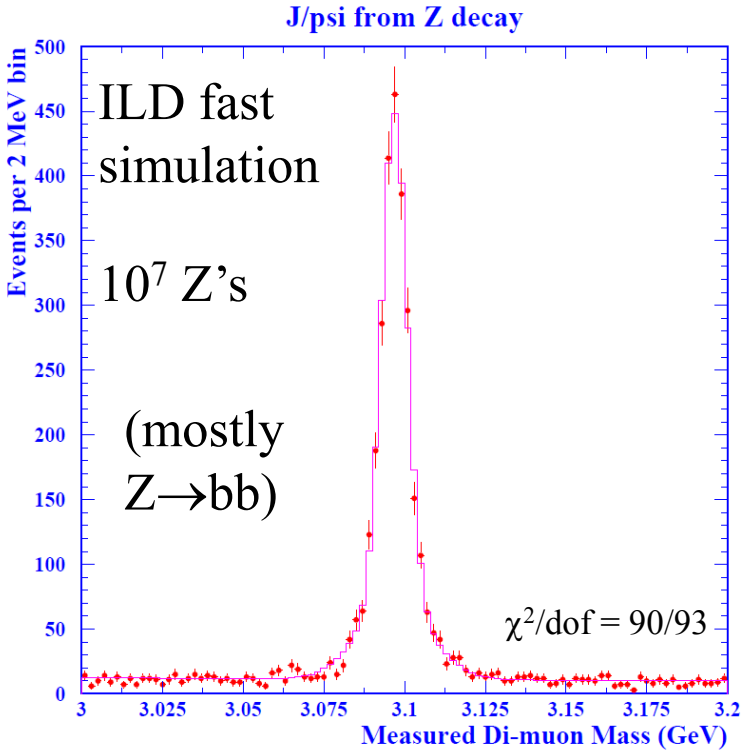


These need to be studied in concrete physics benchmarks.

Systematic uncertainties

Need optimization taking into account the systematic uncertainties

Luminosity spectrum
Momentum resolution
Momentum scale
Jet energy resolution
Jet energy scale
…



Momentum scale from J/psi

Summary

Detector optimization from the viewpoint of physics
detector requirements → physics observables

Study needed to fully exploit detector: vertex charge, dE/dx, …

Effective physics benchmarks need to be identified

Systematic uncertainties absolutely critical!