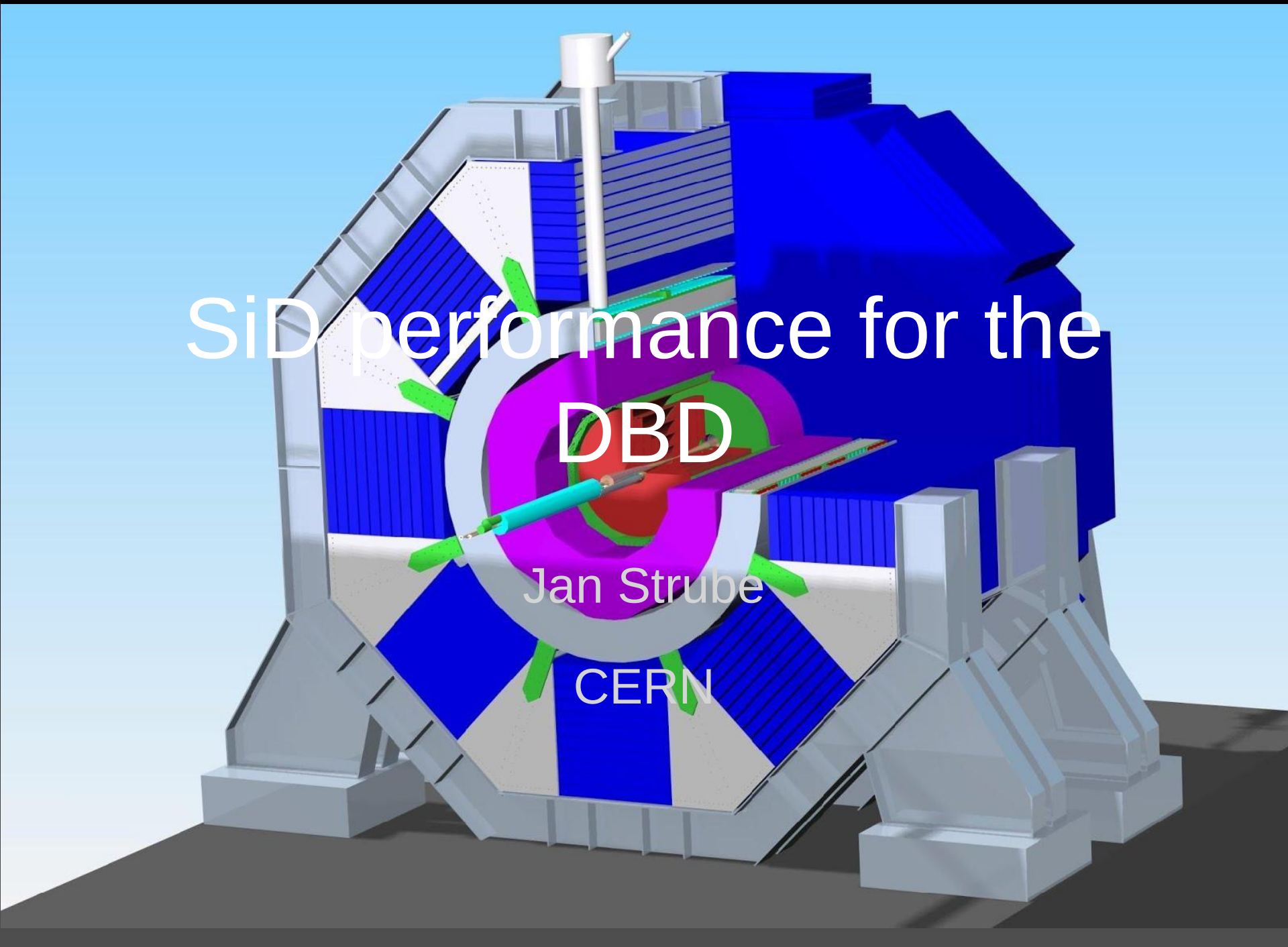


SiD performance for the DBD

Jan Strube

CERN

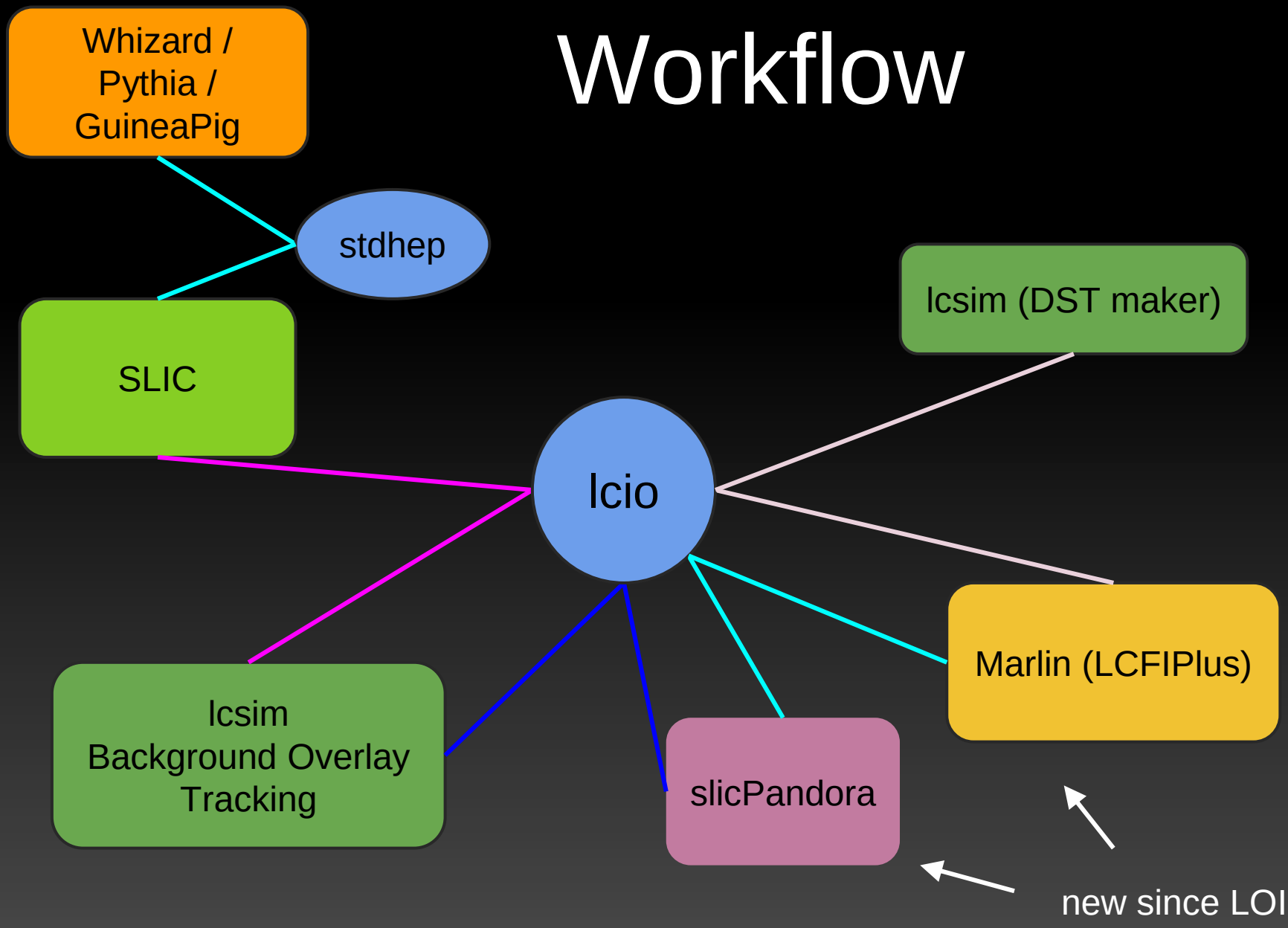
Content

Overview over the DBD simulation and reconstruction setup

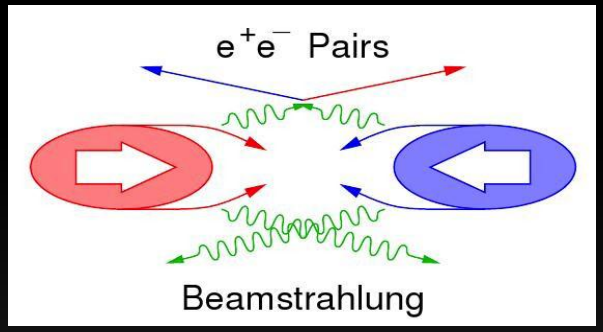
Introduction to Machine-induced background

Performance of the detector as relevant for the Analyses

Workflow


Whizard / Pythia / GuineaPig
stdhep
SLIC
lcsim (DST maker)
lcio
Marlin (LCFIPlus)
lcsim Background Overlay Tracking
slicPandora
new since LOI

Beam-Induced Background

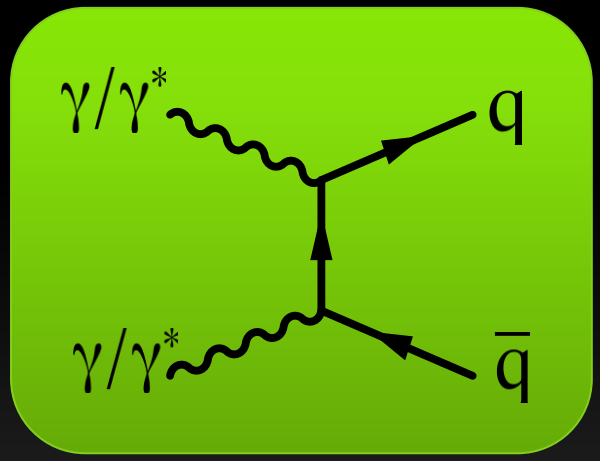


Pair background
1 event per BX
450k particles

Generated by GuineaPig
ascii → hepevt → stdhep

Merged with every "physics" event

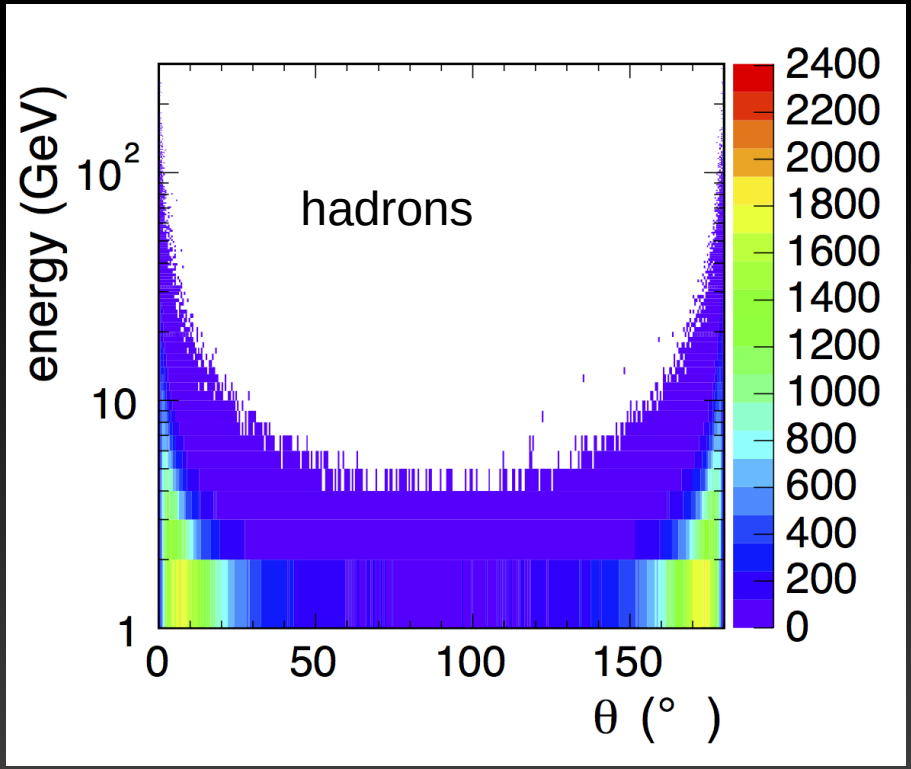
MCParticles that don't make hits will be dropped

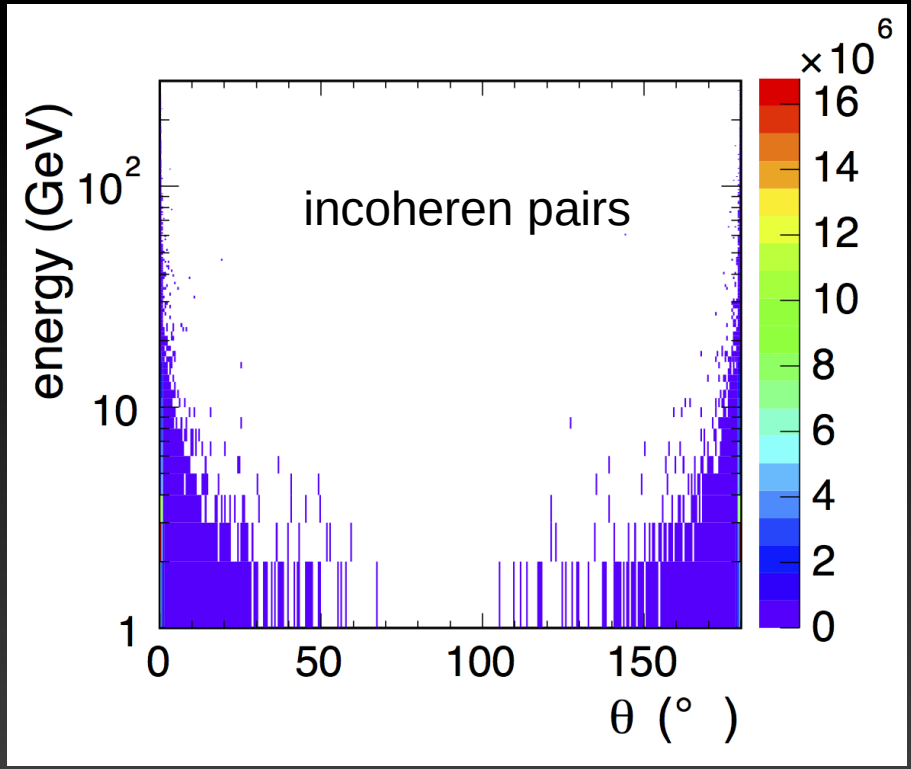


<u>γγ interactions</u>
4.1 events per BX @ 1 TeV
1.7 events per BX at 500 GeV

Generated by Whizard

Angular distribution of background





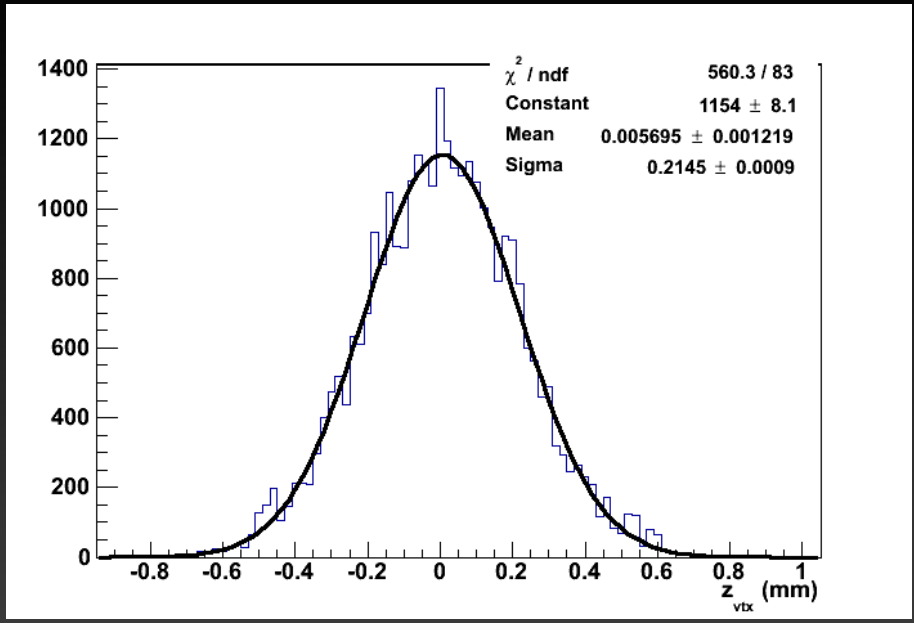
Incoherent pairs affect mostly occupancies and tracking efficiencies

Hadrons have enough energy to reach the calorimeter

Luminous Region

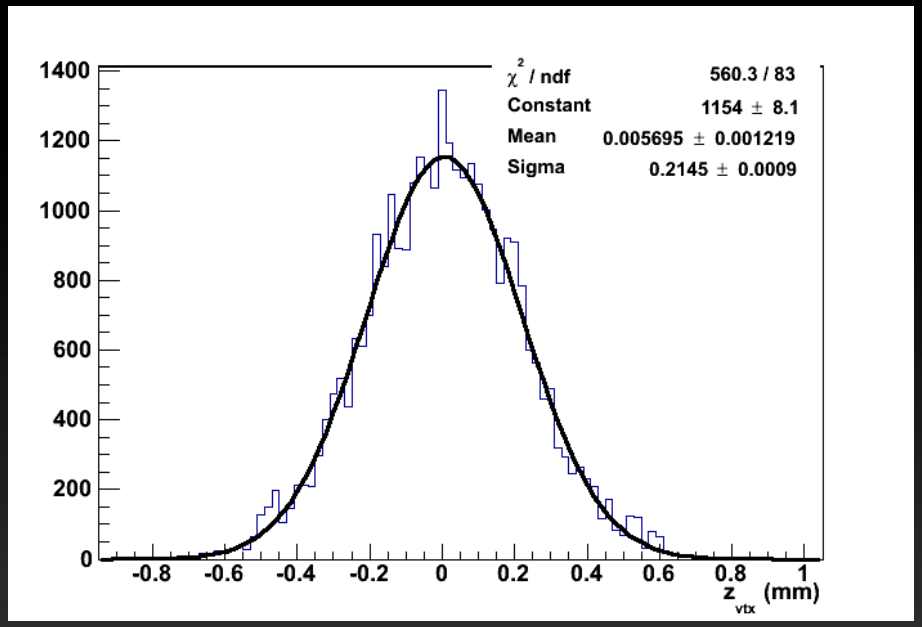
- Finite extension: σ_z = 225 μm
  - conservative compromise
- Events from beam-beam interactions (γγ→ hadrons, incoherent pairs) are distributed randomly over the luminous region
- Physics events always at z = 0

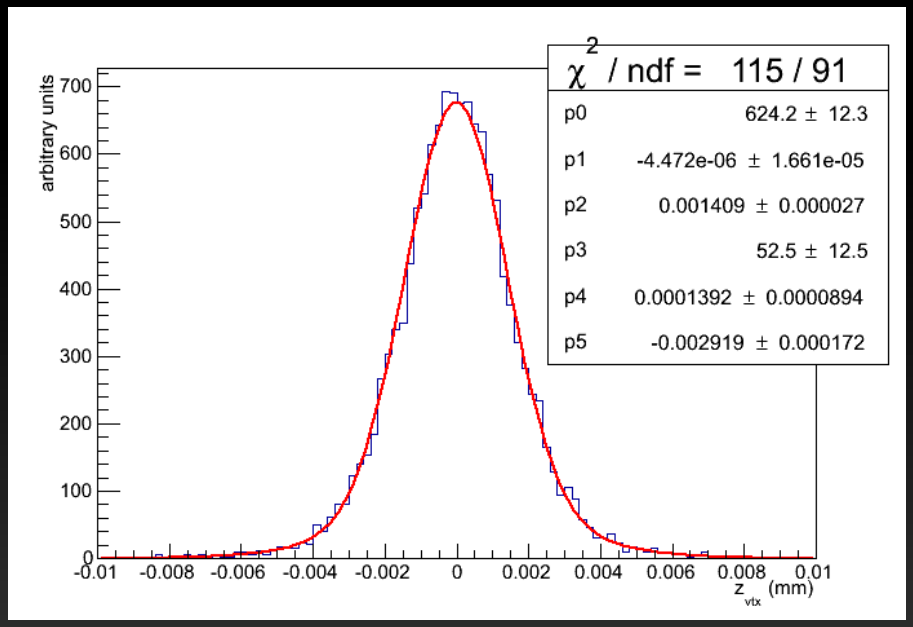
Reconstructed primary vertex position for γγ→ hadrons, pairs



Fitted width: 214 μm

Primary Vertex Resolution



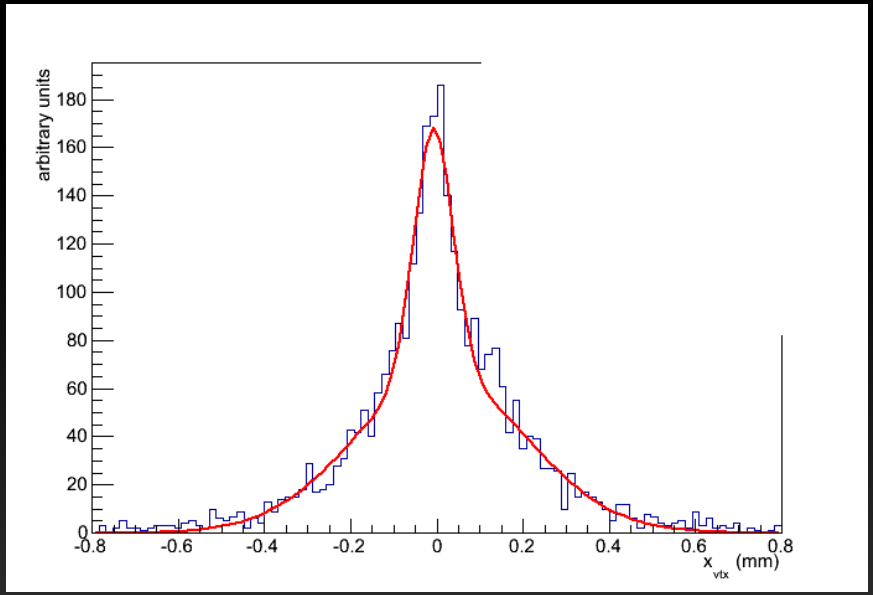


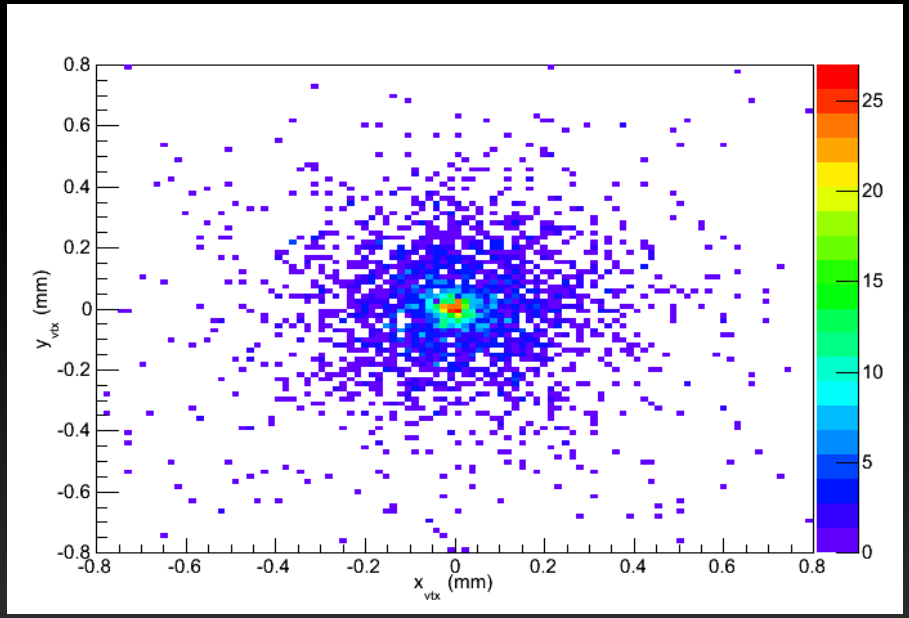
Note the different scales

e^+e^- → hadrons
and pair background
Resolution 214 μm

ttH semi-leptonic channel
resolution < 3 μm

Primary Vertex Resolution II



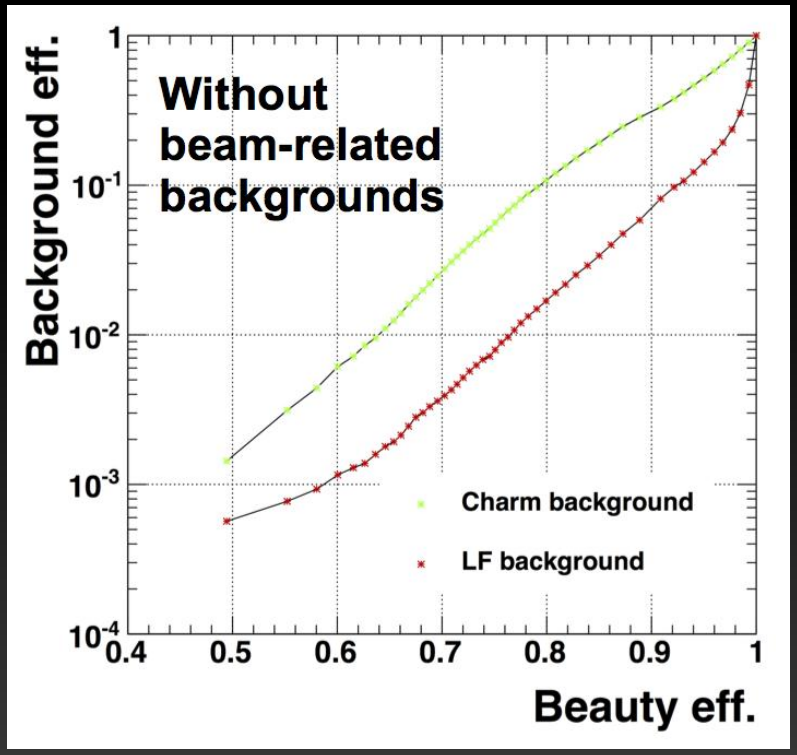


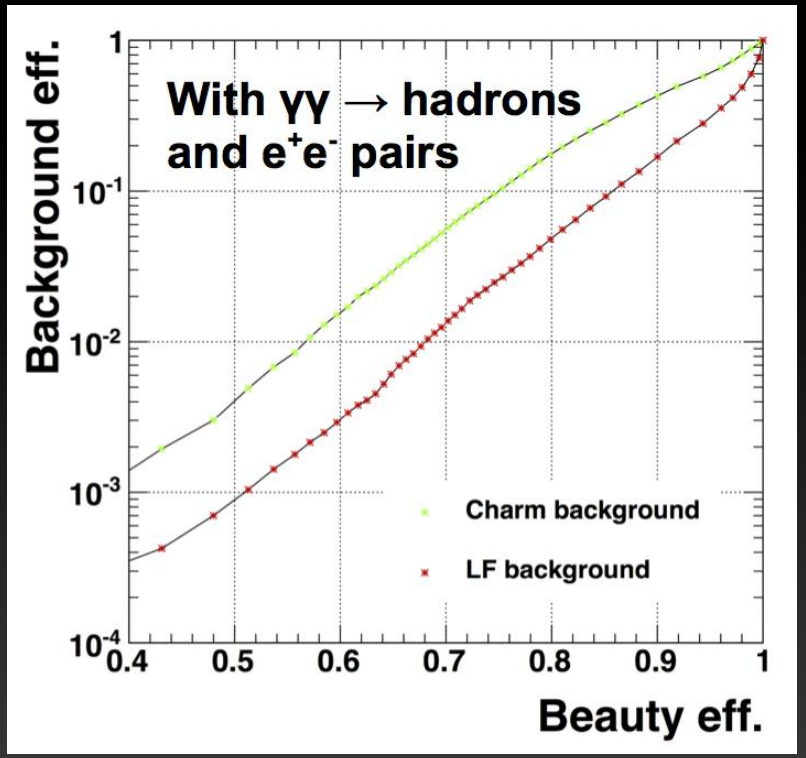
$e^+e^- \rightarrow$ invisible
+ pair background
+ hadrons

Full detector simulation and reconstruction

Fit with two 2D Gaussians:
Width of the narrow Part: 33 µm

Flavor Tagging





Using LCFIPlus, tuned for SiD detector
Classifier trained on dijet events

from top Yukawa coupling analysis (see P. Roloff talk)

Single Particle ID

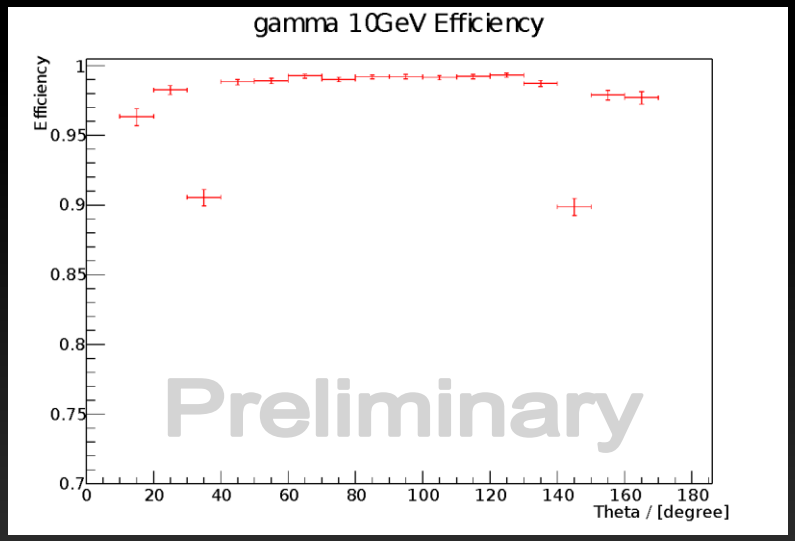
Why?

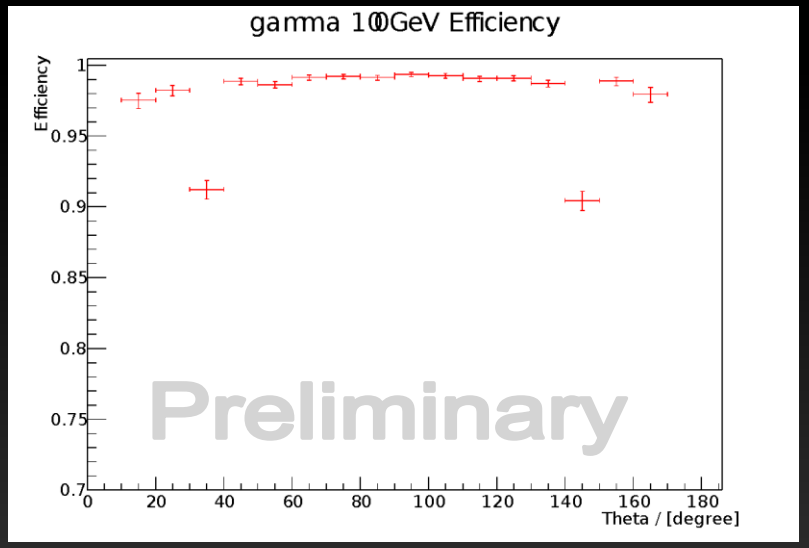
- Several analyses depend on excellent PID
  - WW, tth (semi-)leptonic, hmumu
- Currently, PID comes from PandoraPFA
  - Performance must not be perfect, but must be well-known and understood
- Digital HCAL: remove muons before clustering

How?

- Generate single particle of given type
- Full detector simulation
- org.lcsim tracking
- PandoraPFA reconstruction
- Plot ratio of reconstructed / generated particles of given type

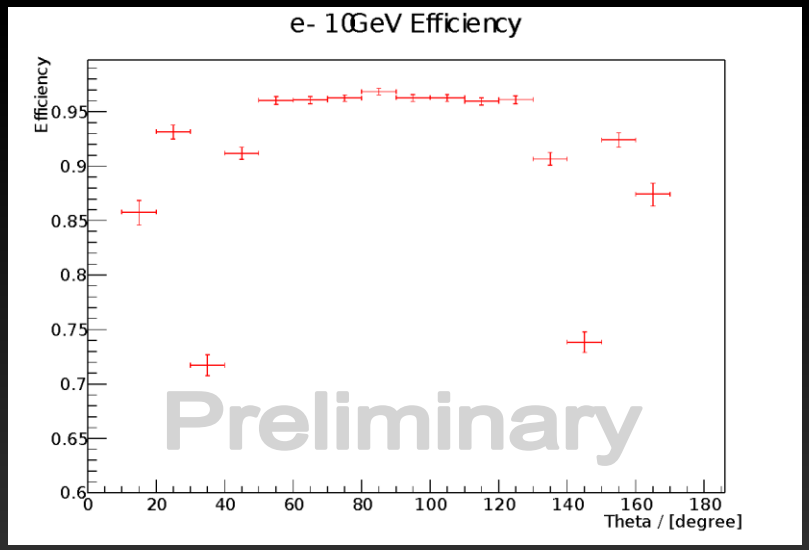
Single Photons

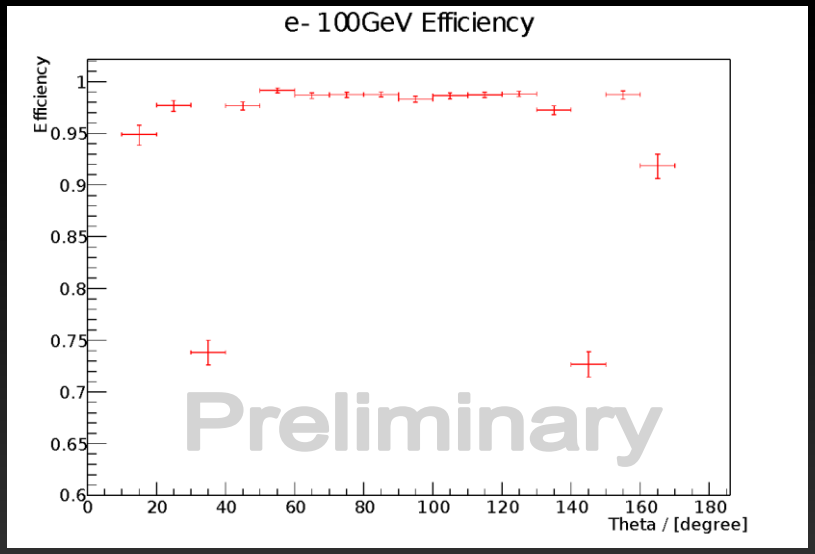




Photon Identification > 97% in barrel and endcap
Transition region needs optimization

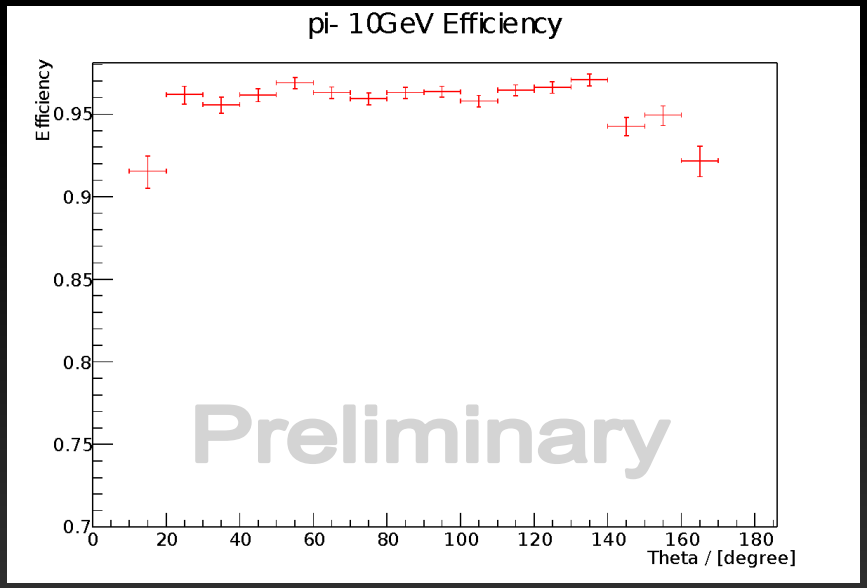
Single Electrons

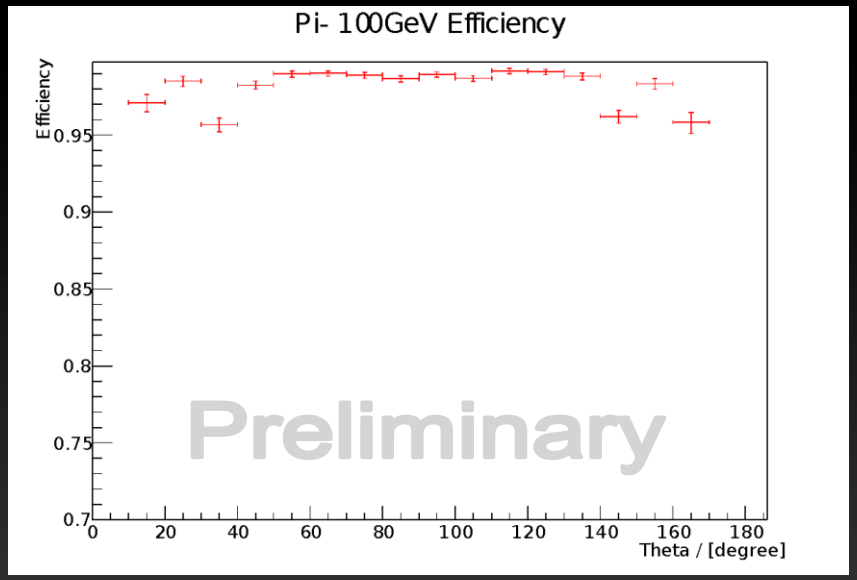




Electron Identification at higher energy slightly worse than tracking efficiency
Transition region needs optimization

Single Pions





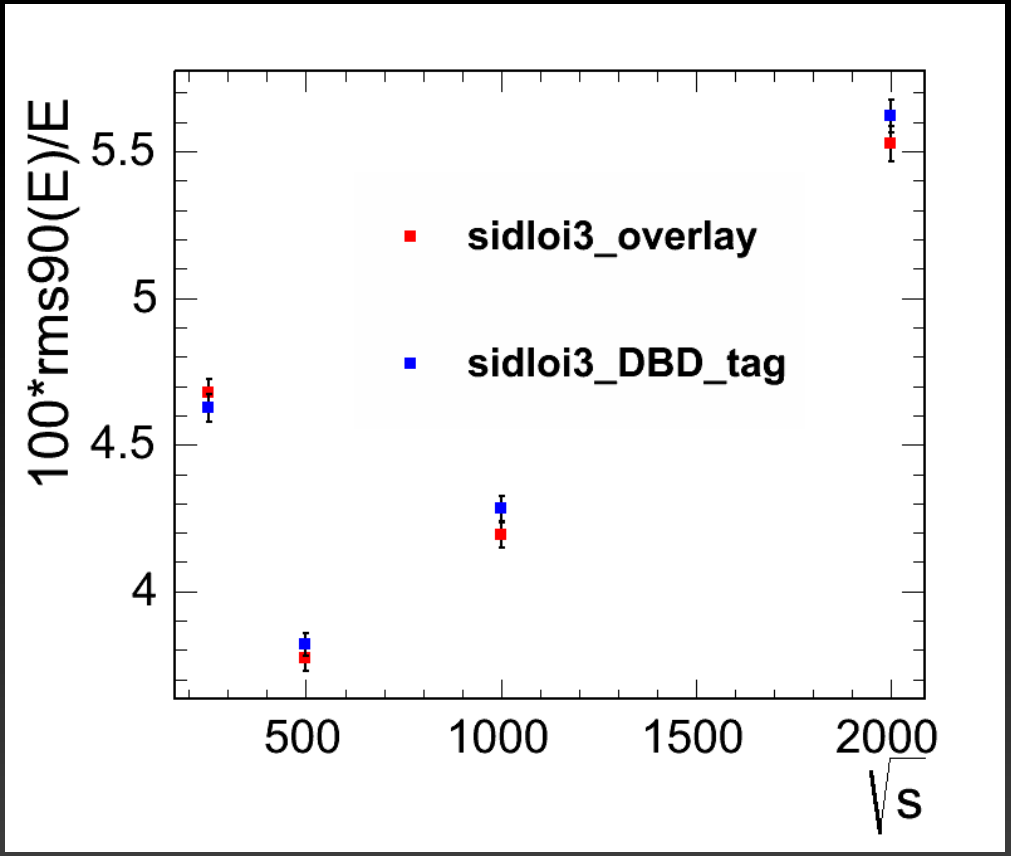
Pion Identification efficiency commensurate with tracking efficiency
At higher energies slight deterioration in the transition region

RMS_{90} versus energy

Performance of the detector in physics events
$ZZ \rightarrow$ 2 jets + invisible

Full simulation and reconstruction with and without background

Includes effects of jet finding



Studies indicate that performance at 1 TeV can be improved. Performance of PandoraPFA in DHCAL not yet optimal

Summary

- We have evaluated the performance of those aspects of the SiD Detector that are relevant for physics analyses
- The performance is more than adequate for DBD analyses in a realistic environment with machine-induced background
- Areas for improvement are clearly identified
- The DBD is not the end of SiD optimization studies

Backup