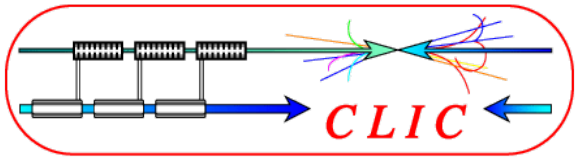
# CLIC Simulation Software – Overview and Plans

**ALCPG, Albuquerque**
**September 30, 2009**


**Christian Grefe**

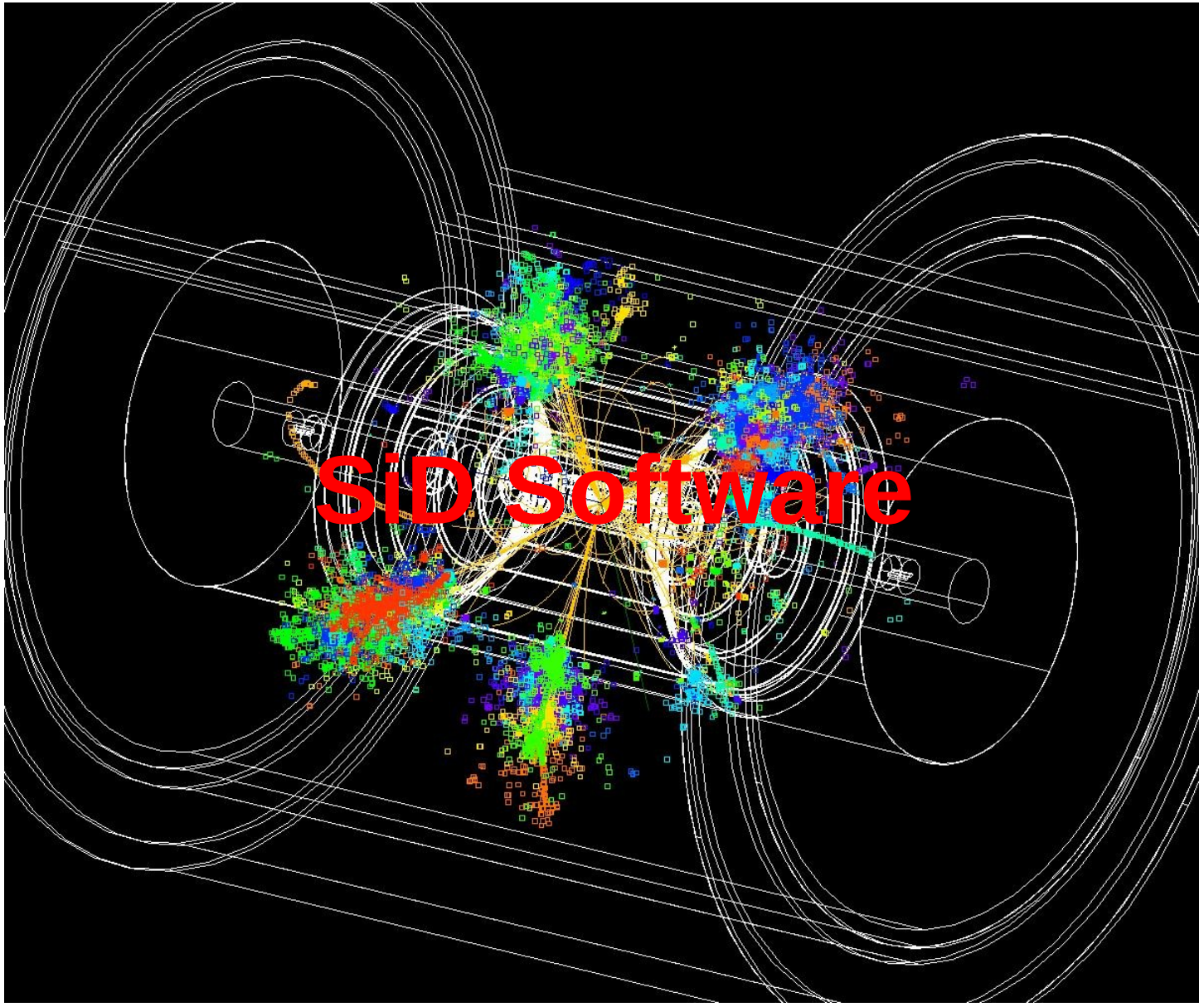
**On behalf of the Linear Collider Detector Group @ CERN**

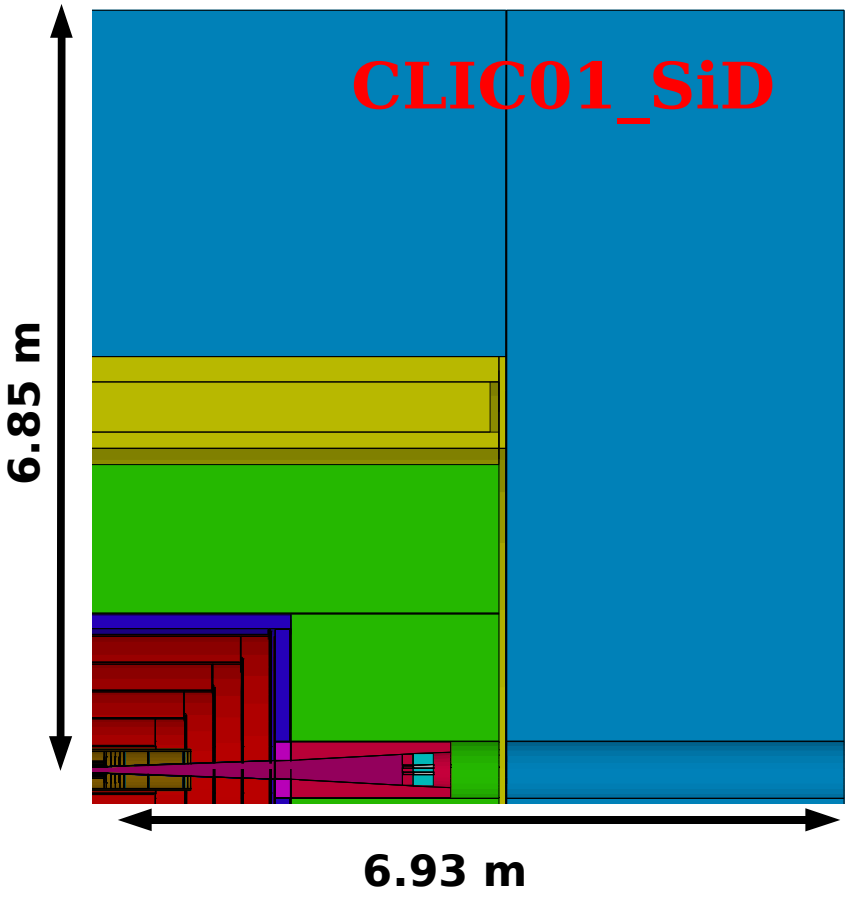


# Outline

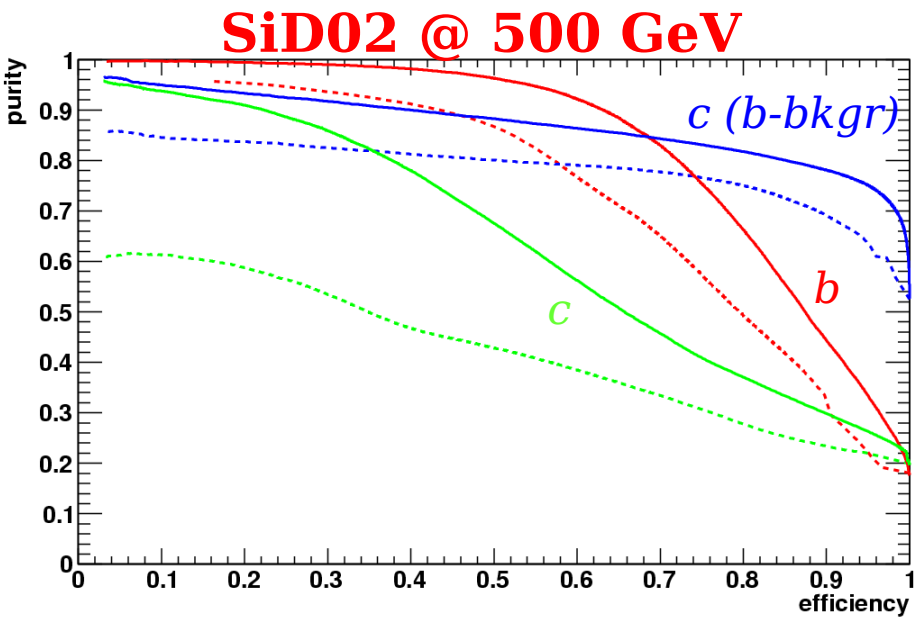
- Experience with SiD software
- Experience with ILD software
- General Issues

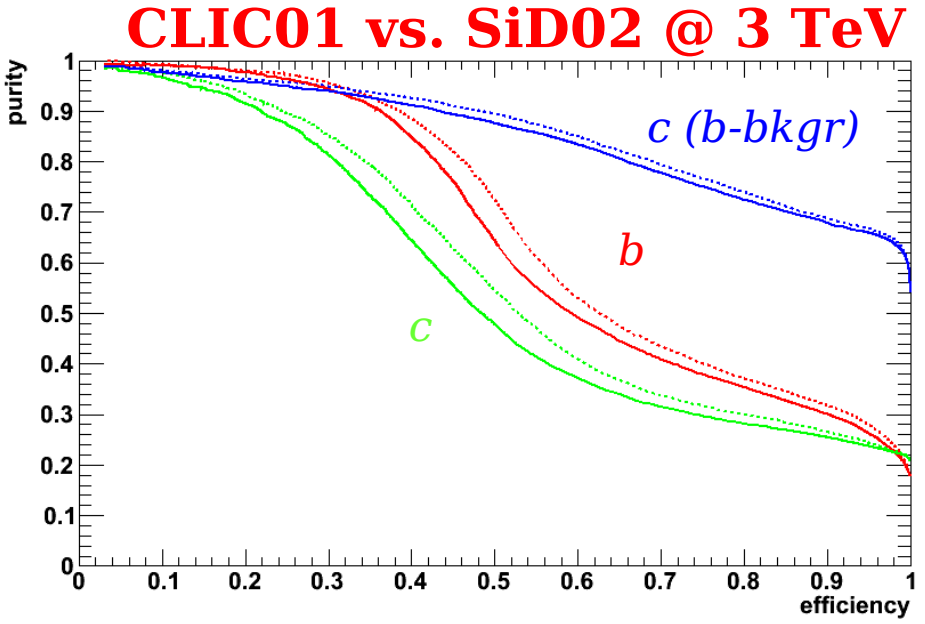

SiD Software

- Modified SiD02 to CLIC requirements
  - increased inner coil radius to allow for more HCal thickness
  - Changed HCal barrel material to tungsten
  - Increased number of HCal layers to 70
  - Changed vertex detector to avoid pair background: r_inner = 30 mm
- CompactXML is very convenient



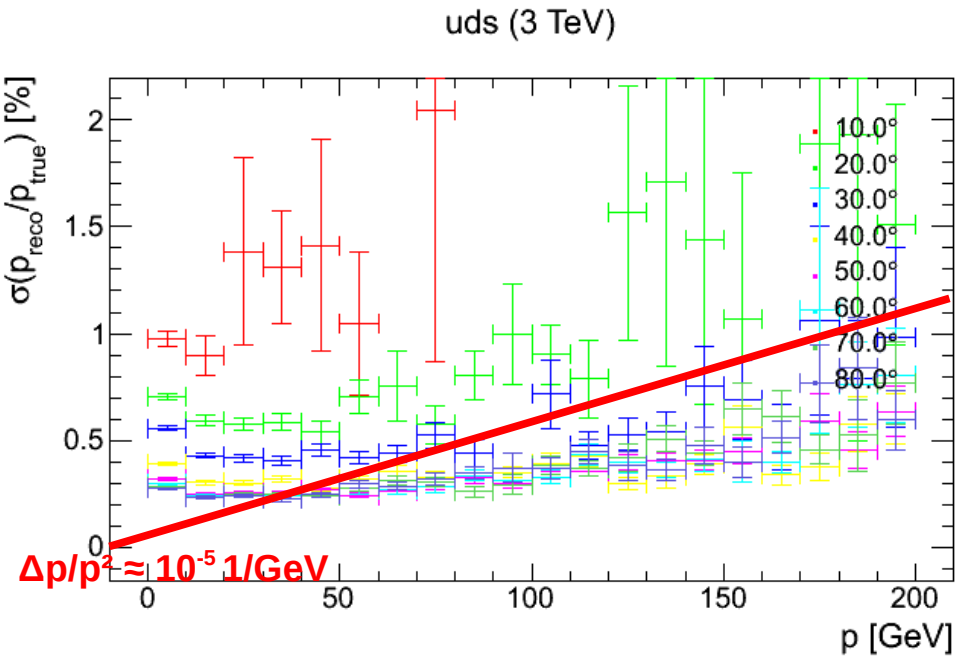
- Recently started study of flavor tagging using LCFI
- Only FastMC until now
- Study impact of modified vertex detector
- Automatization of neural net training
- Next steps:
  - Full simulation
  - Inclusion of beam-background
  - Optimization for 3 TeV
  - Use in physics analysis

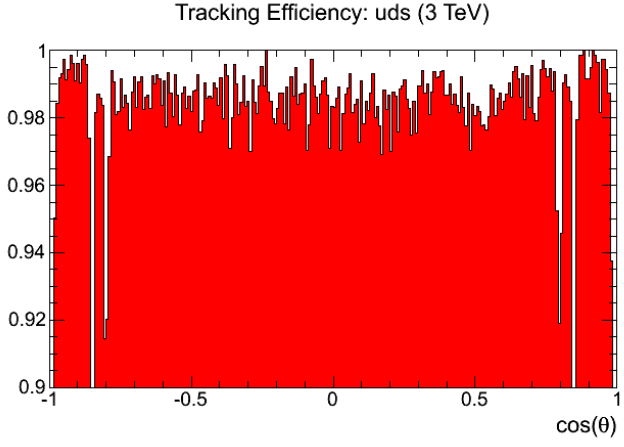


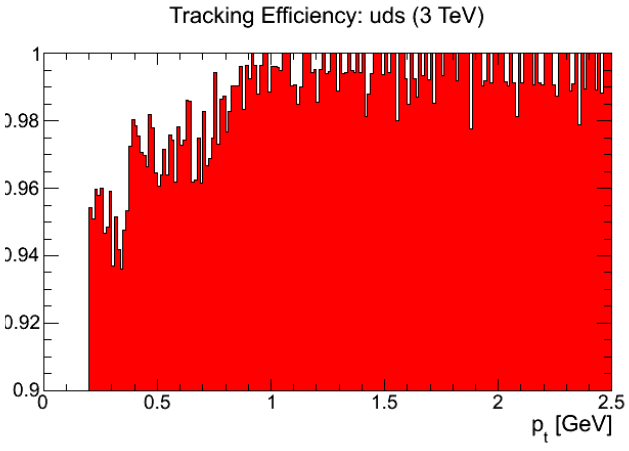



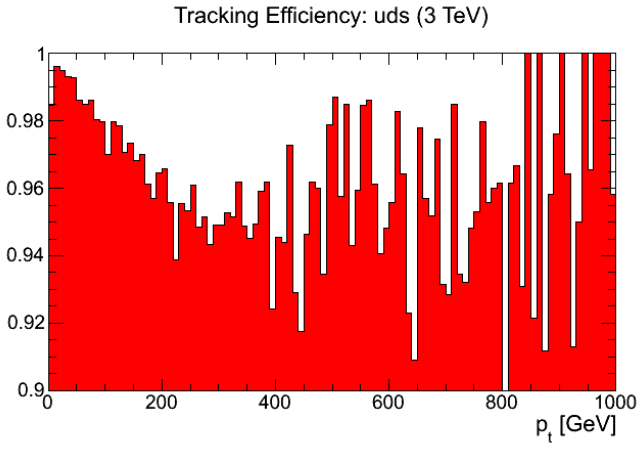

**Tomáš Laštovička**

- Tracking algorithms work out of the box with SiD standard strategies
- Tracking performance goal reached
- Low tracking efficiency for high $p_t$ needs to be investigated
- Next steps
  - Optimize strategies
  - Add with beam-background – time stamping?



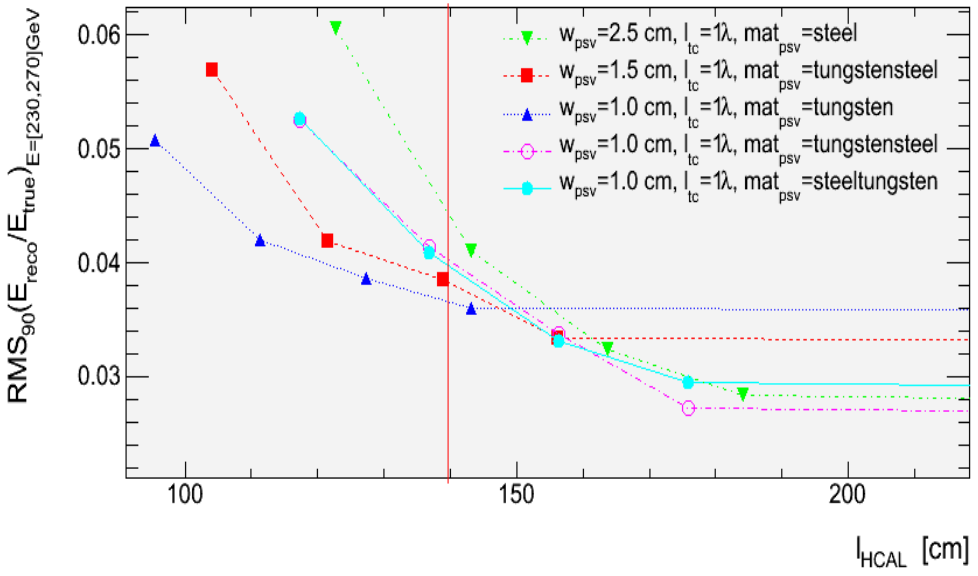



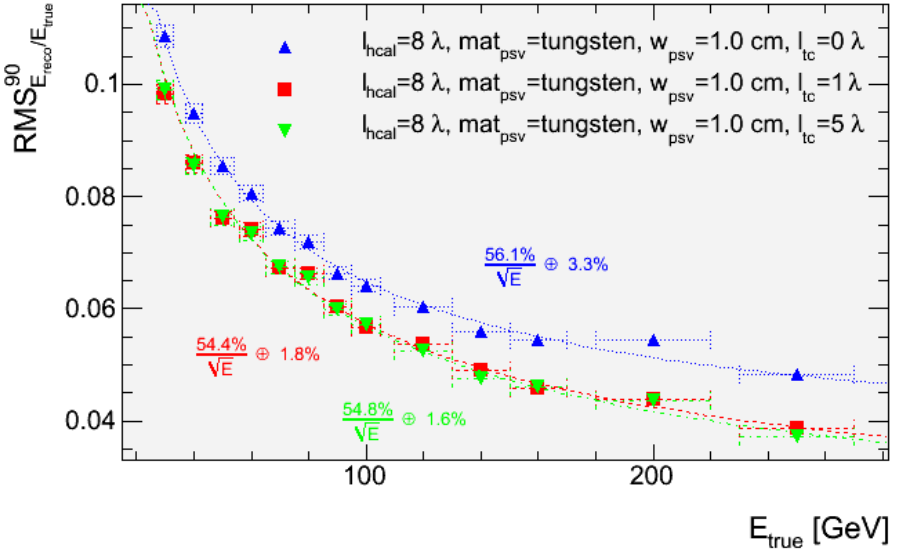



# Tungsten HCal Studies



- Simulation of various materials and various sampling ratios
- Optimization for available space (inner coill radius)
  - ~7.5 λ Hcal of ~10 mm W + 5 mm Scint (~70 layers)
- Impact of tail catcher
- Next steps
  - Need to investigate impact on PFA performance
  - Simulation studies for a W HCal prototype

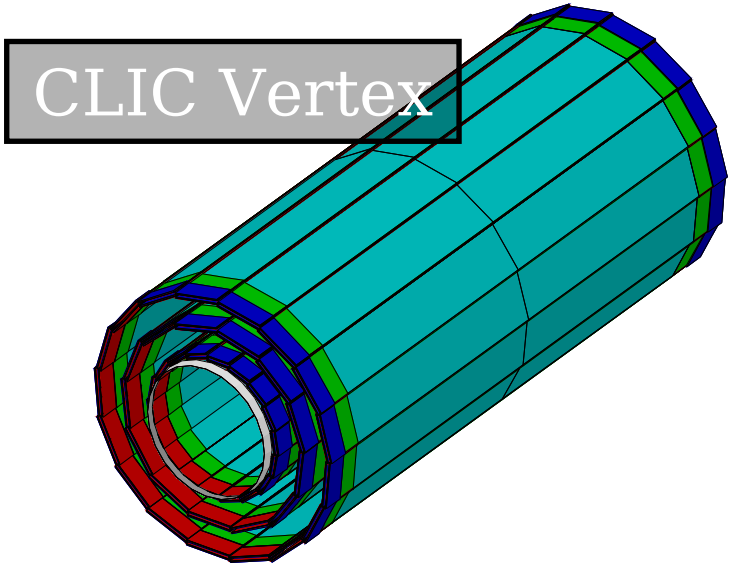


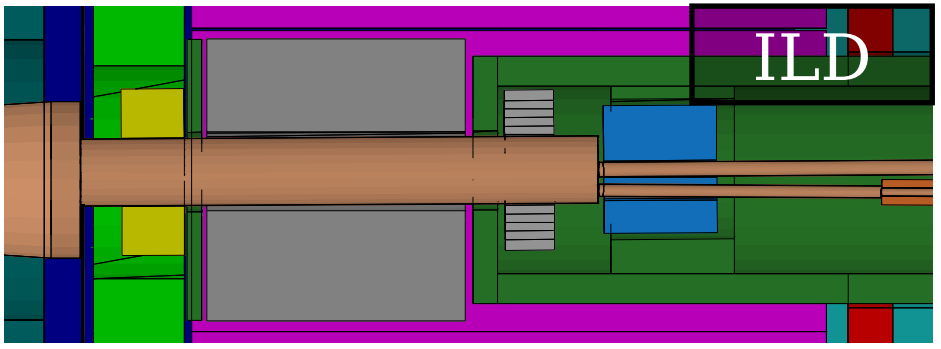



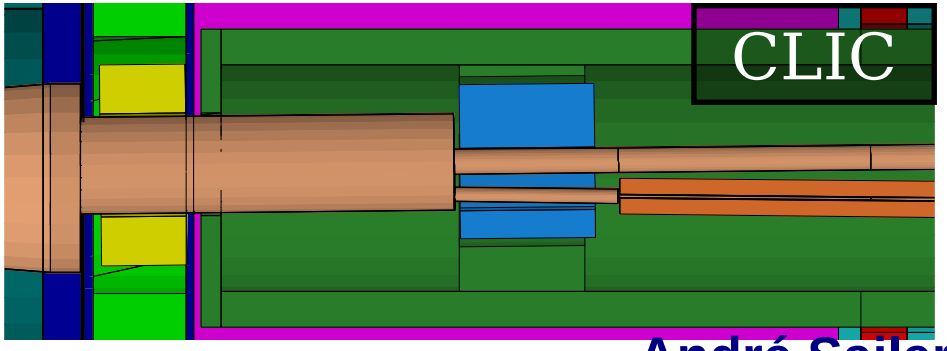

**Peter Speckmayer & C.G.**

# ILD Software

- First Model was set up with help from Paulo Mora de Freitas
- Later:
  - Some code changes to include different material for HCal, number of layers in BeamCal and HCal
  - Changes to Database to Edit: Crossing angle, vertex detector, beam pipes from IP to the end, masking
  - Also fixed some gaps/overlaps for ILD00_fwp01



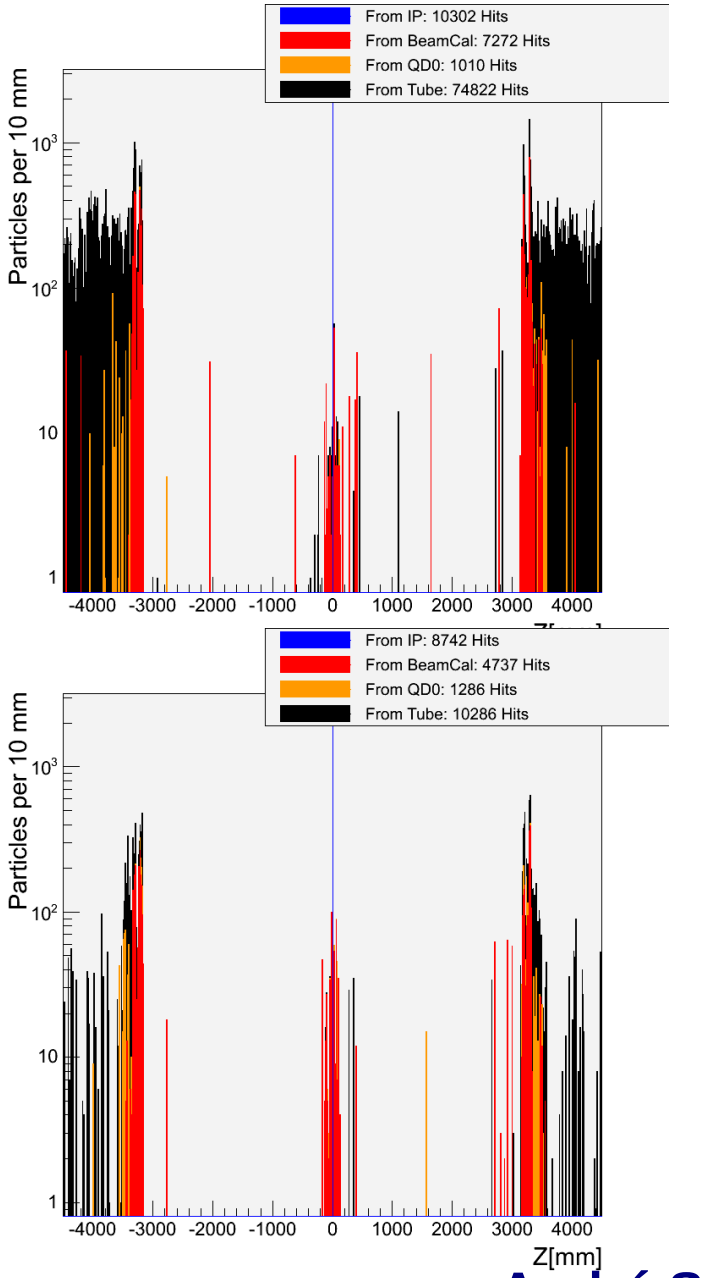




André Sailer

# Beam-Beam-Background Simulations

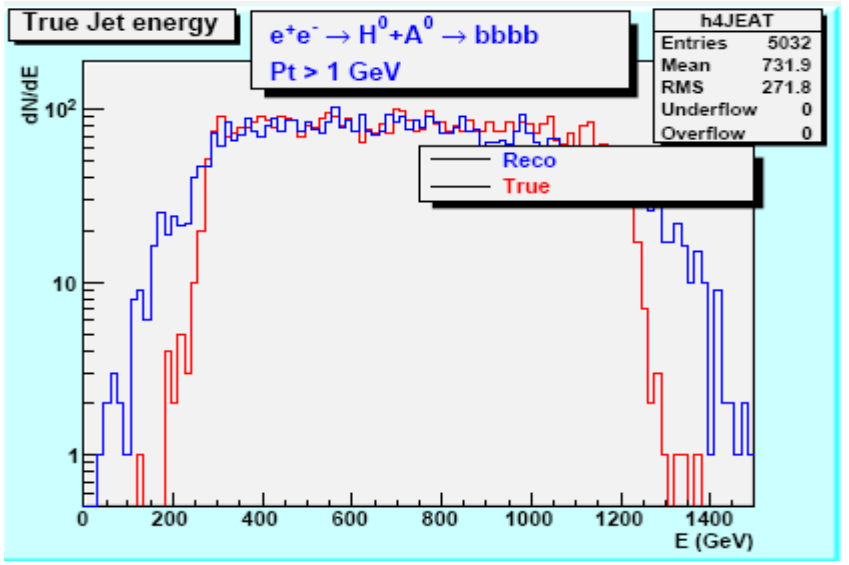
- Simulate e+e- pairs from beam-beam-background
- Analyse with self-made Marlin processor
- Places were particles back-scatter into detector identified (top)
- Geometry changed to reduce back-scattering into detector (bottom)
- Currently all BeamCal and LumiCal studies are done using Mokka & Marlin

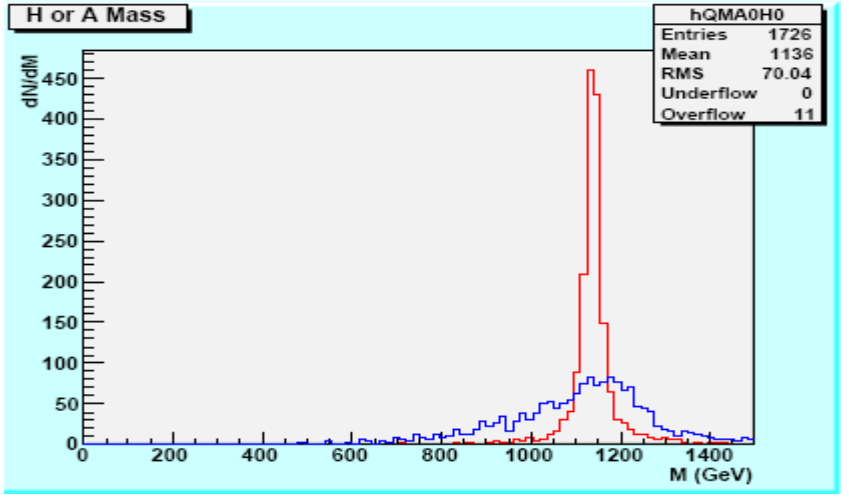



André Sailer

# Full Simulation & Reconstruction @ 3 TeV

- Works in principle
  - Minor PFA fix by Mark Thomson
  - Needed to remove upper limit of 500 GeV per Track
- Issues because of $\gamma\gamma$-background
  - When overlaying background 50 Bx is maximum
  - Need to remove background before using jet-finder ($p_t$ > 5 GeV)
  - Tracking efficiency needs to be improved
- Need to improve lepton id, especially $\tau$

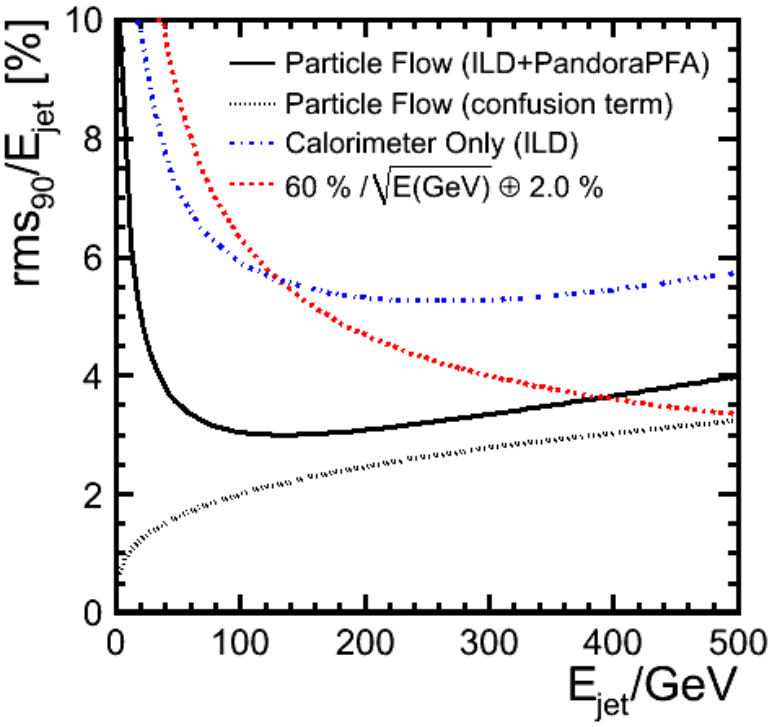



**Jean-Jacques Blaising, Marco Battaglia**

# General Issues

- Also for CLIC energies PFA seems to be a viable option (see talk by Mark Thomson)




- Status @LoI ILC-detectors:
  - SiD: uses Iowa PFA
  - ILD: uses PandoraPFA
- Both PFAs optimized for ILC energies 0.5-1 TeV e+e-
  - IowaPFA works at 3 TeV, but presently too slow
  - PandoraPFA works at 3 TeV but,
    - some speed issues
    - some memory issues
    - resolution for 3 TeV can most likely be optimized

# New Pandora PFA Design Goals

- decoupled from detector and analysis framework
  - connection to outside world via API
  - independent from Marlin, org.lcsim, ...
  - Independent from detector particularities (TPC, Si-Tracker, ...)
- flexible framework
  - "Algorithms"
    - for clustering
    - for producing particle flow objects
    - independent from other algorithms
    - user can add new algorithms
    - easily configurable
- use "lessons learned" from existing PFAs (in particular Pandora)
  - first re-program the Pandora functionality and performance, then enhance with new algorithms

**Mark Thomson, John Marshall & Peter Speckmayer**

# Common Geometry Description

- Description of shapes, materials and sensitive regions
- Needs to interface to
  - Full simulation programs
  - Fast simulation programs
  - Reconstruction algorithms
  - Visualization tools
- Allow for detector misalignment

- Long term project
  - CERN fellow since September 09 working on this project

# Computing Infrastructure

- Current Status
  - Generator Files: AFS repository with http access (hard to maintain) http://lcd.web.cern.ch/LCD/Documents/GeneratorFiles.html
  - Simulation Files: CASTOR
  - DST: AFS
  - Computing: CERN batch sytem
- Future Plans
  - Move to Grid: Computing and storage
  - Set up central file catalog
- Technical student starting in November 09

# Conclusion

- The ILC software frameworks are quite mature
- Helped us greatly to start working right away
- Wide range of studies ongoing looking at critical issues for CLIC
- Some issues to be solved
  - Mostly in high occupancy environments when overlaying many Bx
- Most important is to get PFA working for both frameworks with reasonable performance in order to have comparable benchmark studies for the CLIC CDR in 2010
  - Iowa group is aware of and working on the problem, we are looking forward to this

# Acknowledgements


- Thanks to ILD and SiD collaborations for their support
  - Accessing and setting up of their simulation and reconstruction tools
  - Software modifications necessary to use the tools at 3 TeV events
  - Stimulating discussions


**We hope this good collaboration will continue!**