X-Cutting - Status Tracking Simulation

U.S. Higgs Factory Planning
SLAC
Christoph Paus
MIT, December 19, 2024

Known Contributors

Institutes

- Brown, FNAL, MIT, SLAC, SCIPP
- Requested personnel*

Effort	Detector systems	Institutions	Requested Support
Simulation efforts	Overall Detector Optimization	Brown, FNAL, MIT, SLAC	$27.5k, 0.25 FTE grad (SLAC) $27.5k, 0.25 FTE grad (Brown) $27.5k, 0.25 FTE grad (MIT) $40k, 0.25 FTE RS (MIT)

- SCIPP added recently (interest: LC-LGAD for the wrapper)

* From SUNY, Stony Brook meeting

Level of Studies

Parametric simulation (Delphes)

- Very fast and flexible
- Resource needs are limited
- Mostly for performance studies: general resolutions, tagging and physics analyses
- also for overall tracker design
- .. but it is not very precise

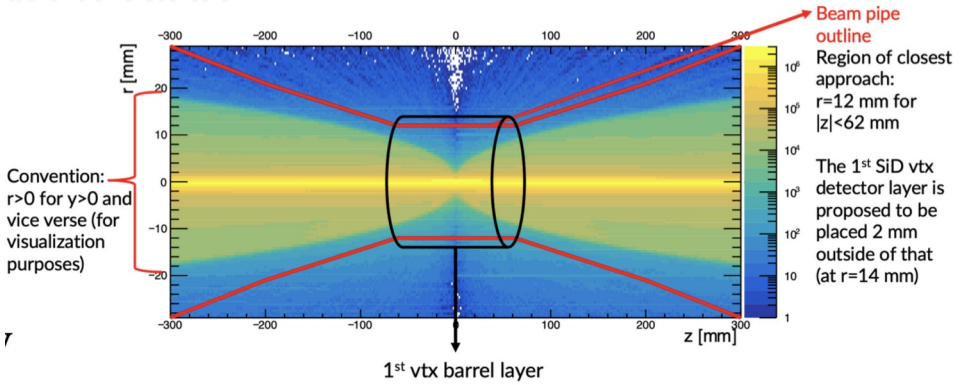
Full simulation: GEANT level (Key4HEP)

- Slow and not too flexible (GEANT geometries, electronics etc.)
- Needs a lot of resources
- Beam background needs GEANT and special generators
- “Glue it” to the Delphes studies to verify Delphes studies really work

Ex. why we need this now?

Occupancy

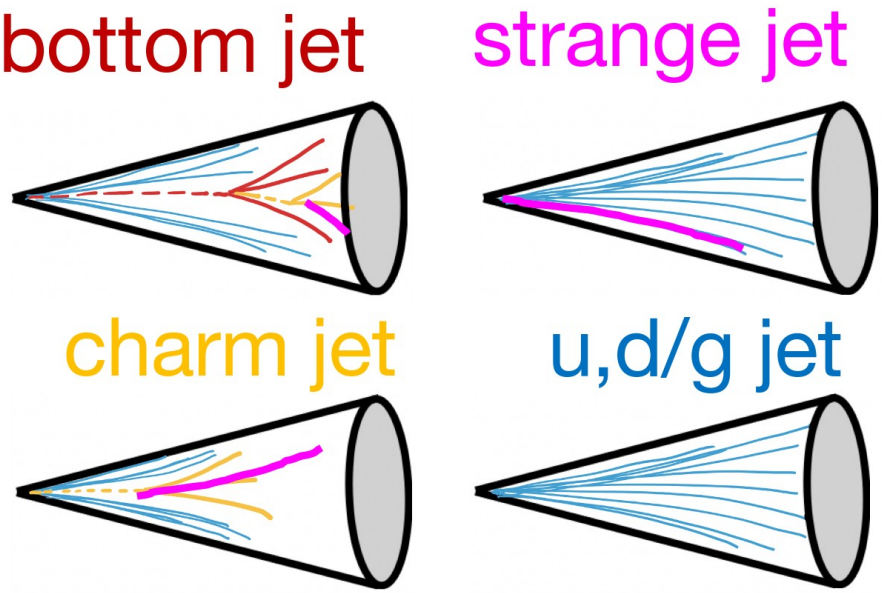
- Detailed generator including beam effects (guineapig)
- Requires GEANT
- Essential for innermost layers
- Directly connected with MDI



Detector's occupancy
→ impact detector design

Physics performance

- Many analyses: charm and strange tagging for Higgs
- Flavor physics at Z pole
- Delphes should be fine for the beginning
- Follow up with GEANT



Where are we now?

The majority of studies carried out in FastSim

- great for fast turn around

Need Full chain: DIGI→SIM→RECO→Analysis

- Only for 2 analyses in CLD: mH and tau polarization
- IDEA and Allegro:
  - Some parts are FullSIM
  - Much less for RECO
- e.g., tracking for Drift Chamber → very preliminary
  - IDEA, Allegro FullSim: Effectively not usable for analysis

From Loukas talk earlier

What is needed urgently?

Simulation and Reconstruction: next steps

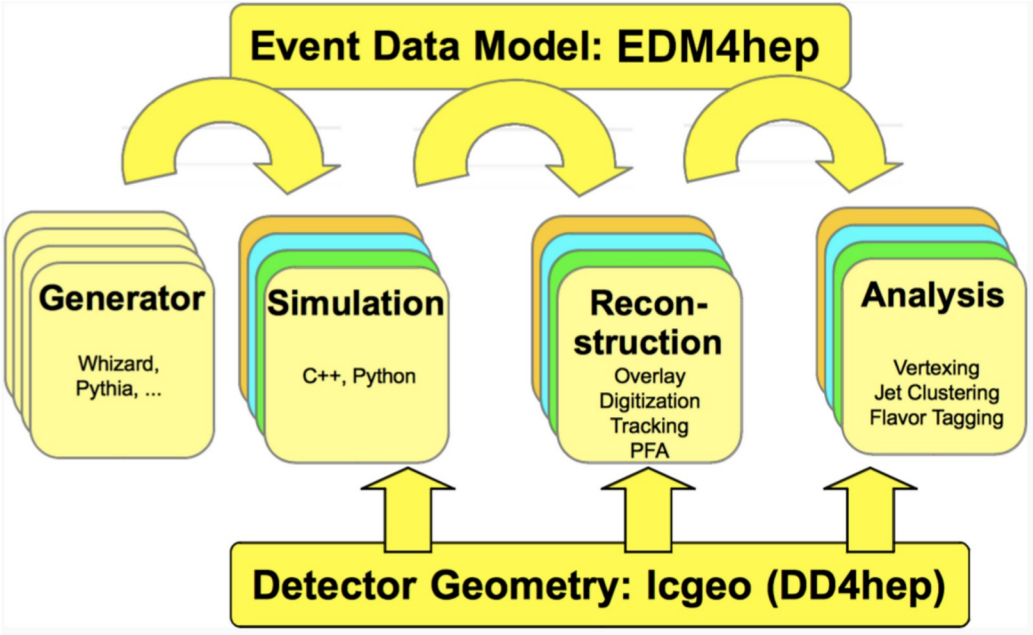
- Those are areas that US has definitely expertise
  - We are involved but we can make even more impact
- IMHO: No need to start from scratch

Key4HEP

→ Ecosystem where various components "talk" to each other

→ Consistence across detectors/machines

Talk at S&C parallel session by J. Carceller



From Loukas talk earlier

Close collaboration with people in Europe ….

Computing resource needs

Delphes

- Order of 100 computing cores can do a lot

Full simulation: GEANT level (Key4HEP)

- Can require several orders of magnitude more
- General production environment is ‘almost’ required to optimally benefit from large time investments for the simulations
- Use of opportunistic resources: ex. OSG

Conclusion

New personnel power needed to

- GEANT samples to determine radiation environment (detector occupancy) as a function of radius/beampipe/detector geometry design
- Delphes samples to determine tracker requirements from physics driven studies
- Delphes samples to optimize components of the tracker to get the best overall design with given budget
- GEANT samples: verify in detail that preferred design ‘really work’

Next level

- Full production system and grow computing resources