

FCC-hh Full Tracking Studies

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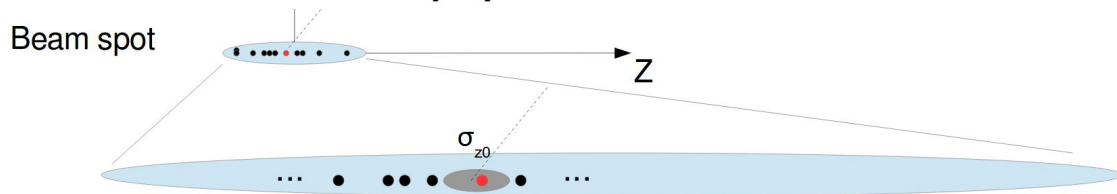
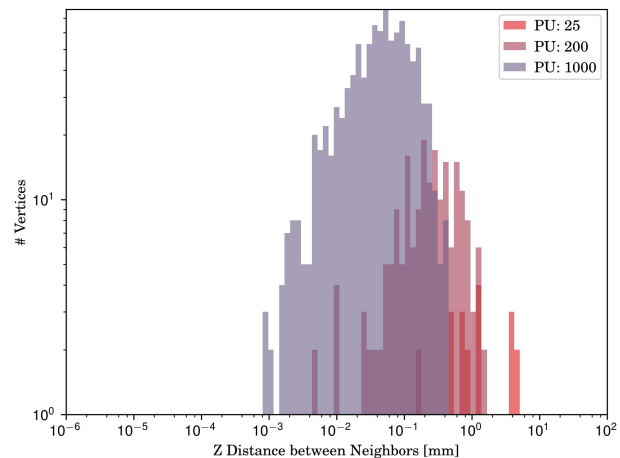
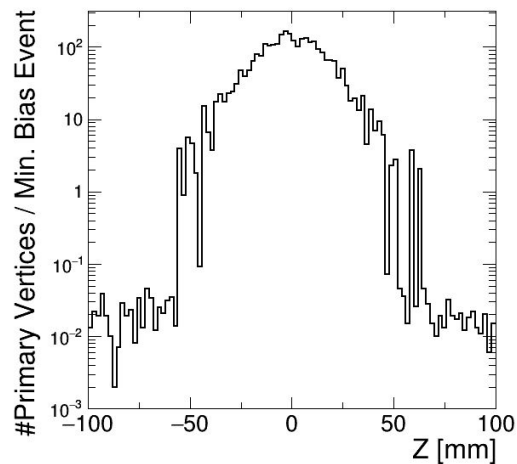
On behalf of the FCC software & tracker teams

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- Developments in TkLayout for FCC
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- Single particle momentum resolution

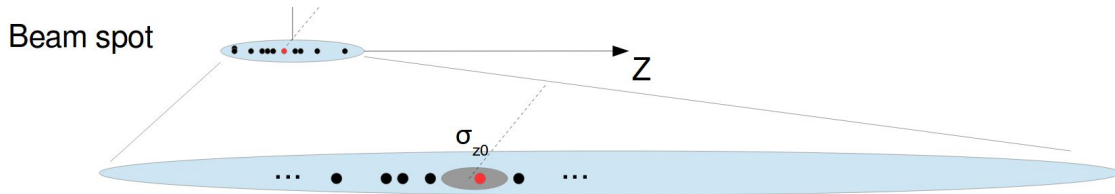
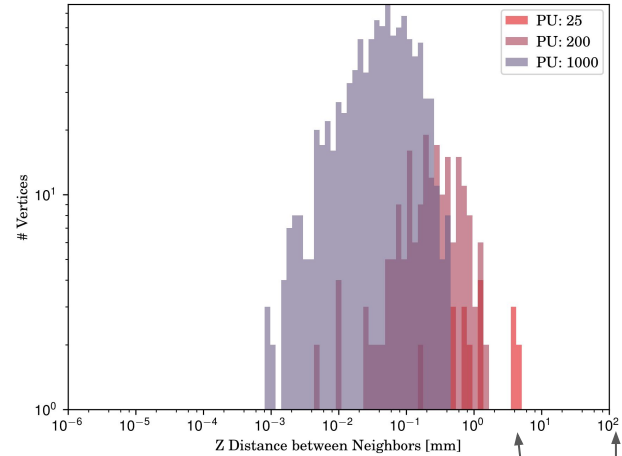
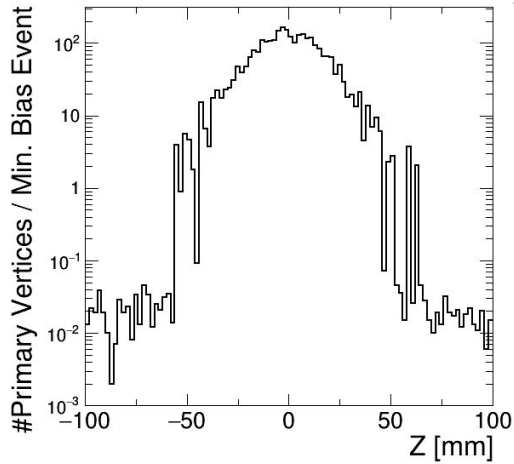
Full Simulation in FCCSW

- Approximations and assumptions used in fast simulation studies need to be checked with full simulations



Full Simulation in FCCSW

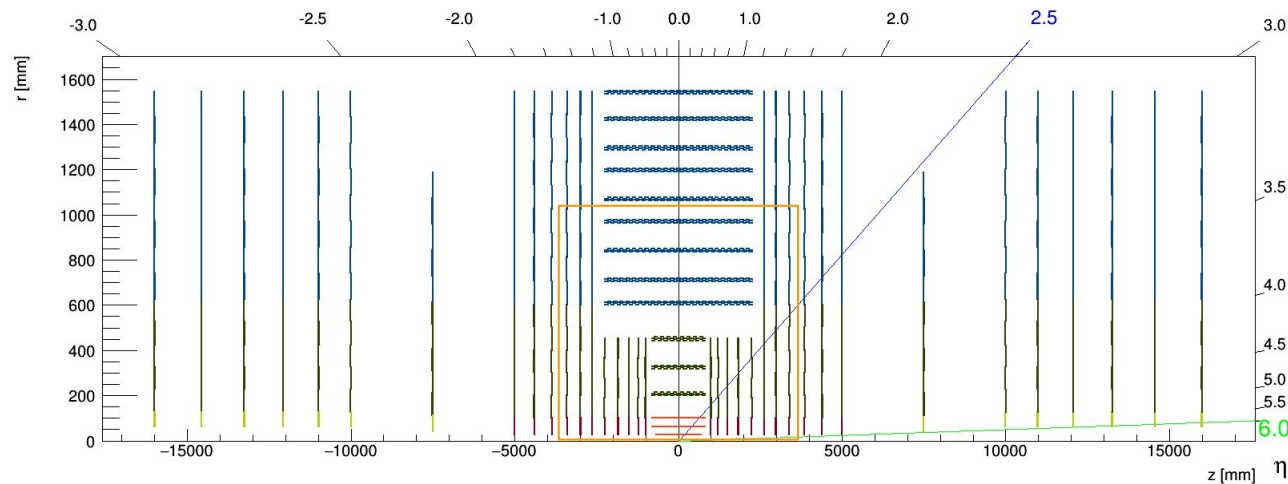
- Approximations and assumptions used in fast simulation studies need to be checked with full simulations



LHC: 5 mm
HL-LHC 0.8 mm
FCC-hh Phase2
0.05 mm

Detector Layout -- FCChh Option 3v2

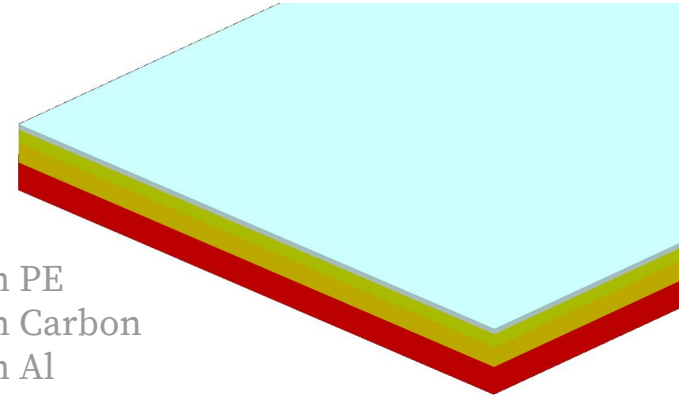
- $\sim 2000 + 13\,000$ modules in 12 barrel layers
- $\sim 1500 + 10\,000 + 10\,000$ modules in inner / outer forward endcaps (18 layers)
 - Efficient detector description crucial for performance of simulation and tracking



CMS dimensions for comparison

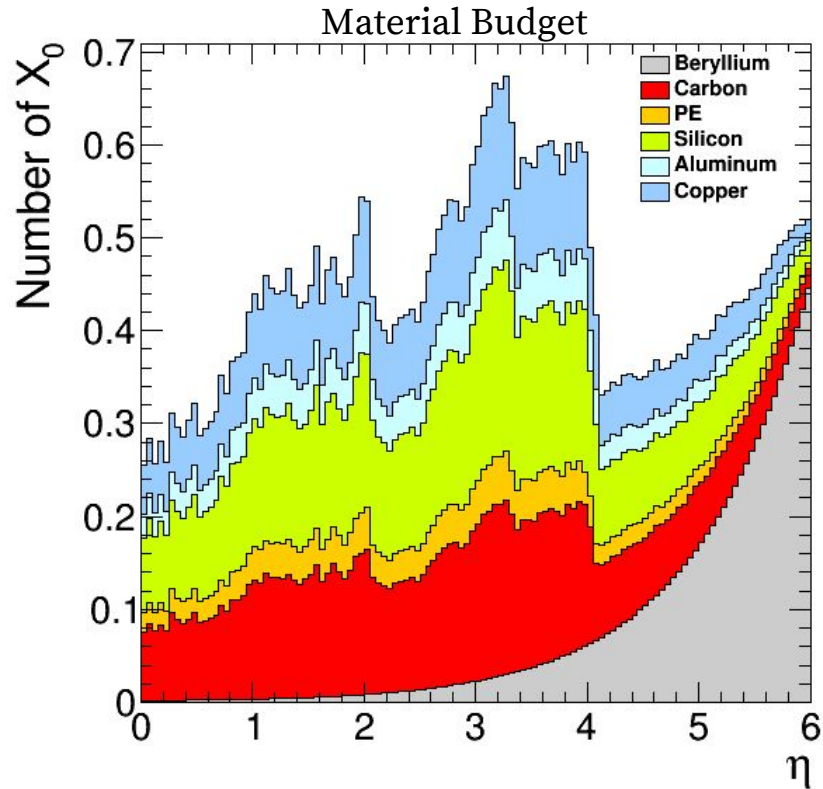
Future Tracking Silicon Modules

- Also for full sim studies modules **simplified** and **idealised**
- Services and cabling missing, to be added in future iterations of the tracker
- Spatial and temporal **resolutions:** to be determined!
 - Inner Barrel RPhi: $7.5 \mu\text{m}$ / Z: $15 \mu\text{m}$
 - Outer Barrel RPhi: $9.5 \mu\text{m}$ / Z: $30 \mu\text{m}$
 - Timing: $< 100 \text{ ps}$
- Noise omitted, Digitization approximated with Gaussian Smearing



0.43 mm PE
0.61 mm Carbon
0.08 mm Al
0.02 mm Cu
0.28 mm Si

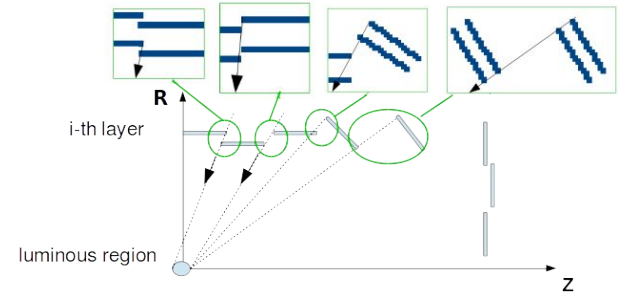
Future Tracking Silicon Modules



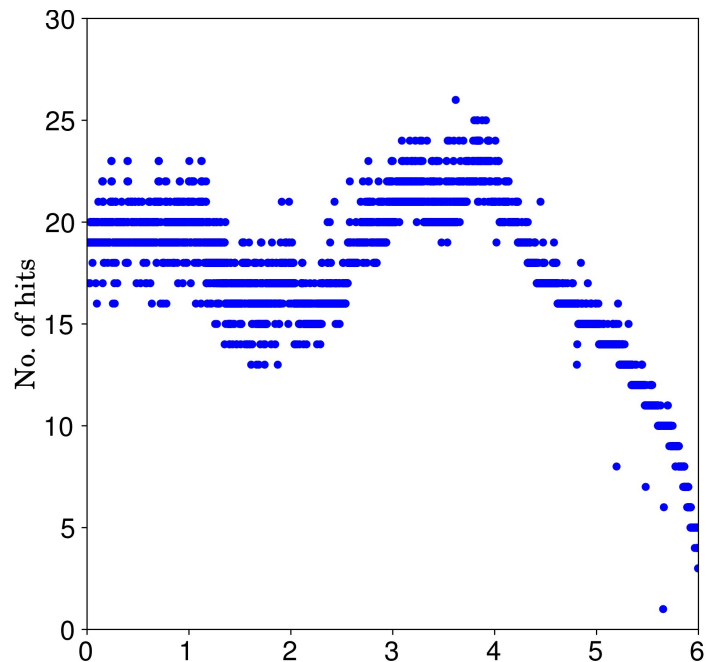
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TkLayout Software Efforts

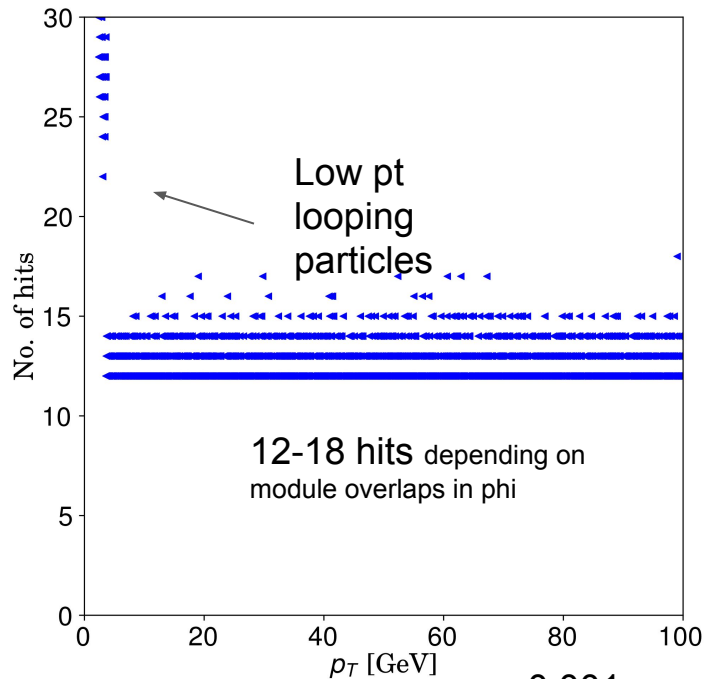
- TkLayout: fast detector simulation and layout design tool
 - Developed for CMS Phase-2 Upgrade
 - Analysers for
 - material budget
 - resolution
 - pattern recognition
 - Creates optimised, hermetic layout, optional services
 - Export of geometry to DD4hep
- Ongoing Effort to refactor and adapt TkLayout Code to FCC needs (Z. Drasal)



Geometric Acceptance



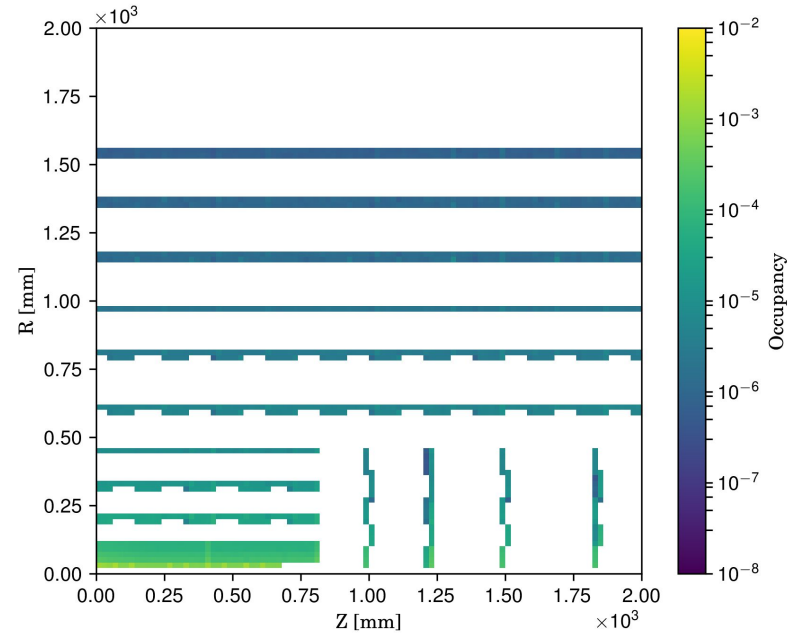
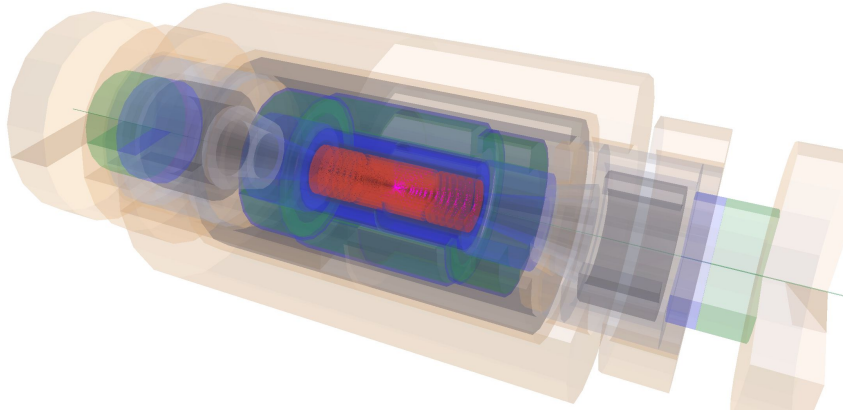
$0 < \eta < 6$
 $|p| = 100 \text{ GeV}$
500 events



12-18 hits depending on
module overlaps in phi

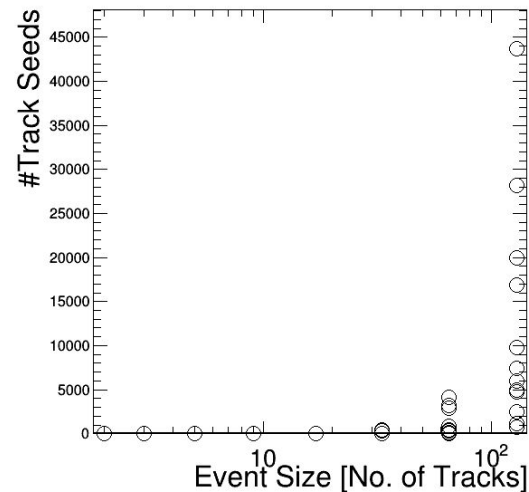
$\eta = 0.001$
 $1 \text{ GeV} < |p| < 100 \text{ GeV}$
500 events

Full Sim Results / Occupancy



Combinatorial Seeding results

- Combinatorial Seeding with geometric cuts scales poorly with pileup
- High timing resolution needed to keep offline reconstruction feasible!



Summary & Outlook

- **Full Simulation Studies** required to go beyond analytical approximations
- Only way to check feasibility of pattern recognition
- Development tightly coupled to **ACTS** (see J. Hrdinkas talk today)
- Ongoing effort on integrating timing information in fitting and pattern recognition, urgently needed esp. in forward region (see Z. Drasals talk this afternoon)