Tracking in CMS at the HL-LHC

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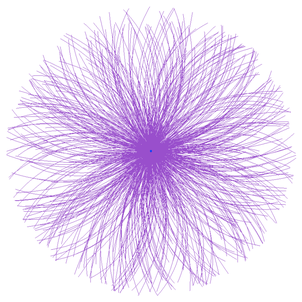
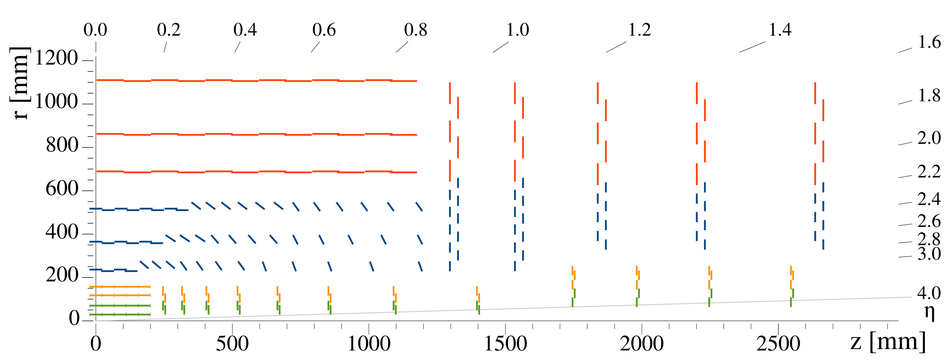
1. Introduction

- High Luminosity(HL) LHC environment at **200 nominal pileup** is very challenging
- The **tracking system** measures the particle momentum → crucial role
  The Compact Muon Solenoid (CMS) experiment proposed the following tracker:
  - **Inner Tracker**: pixel extended detector
  - **Outer Tracker**: Pixel + Strip sensors & 2 Strip sensors

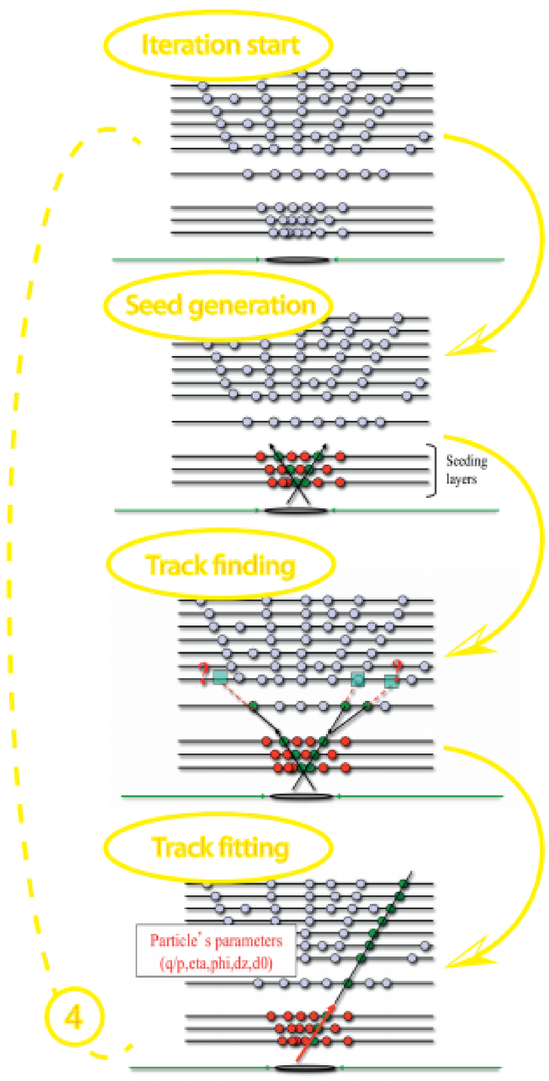




2. CMS Tracking

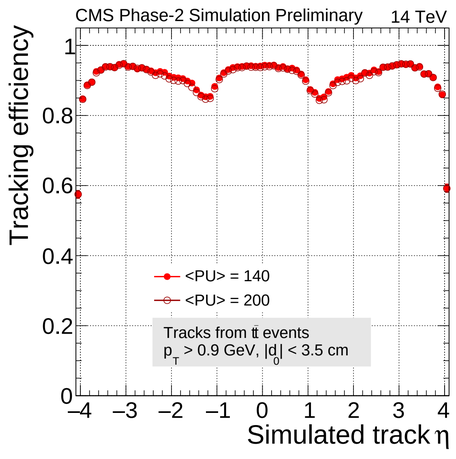
- Several iterations of the **Combinatorial Track Finder**:
  1) **Seed generation**
  2) **Track finding**
  3) **Track fitting**
  4) **Track selection**

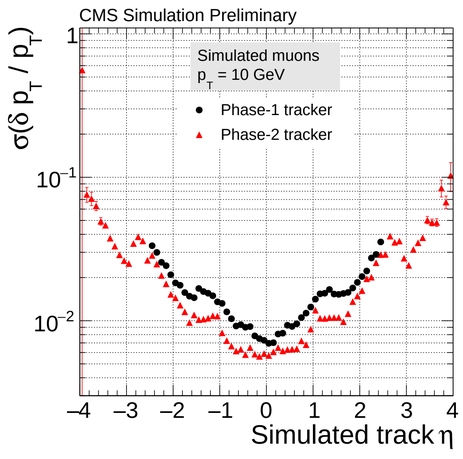
  After each iteration the hits associated to the tracks tagged as "High Purity" are masked.

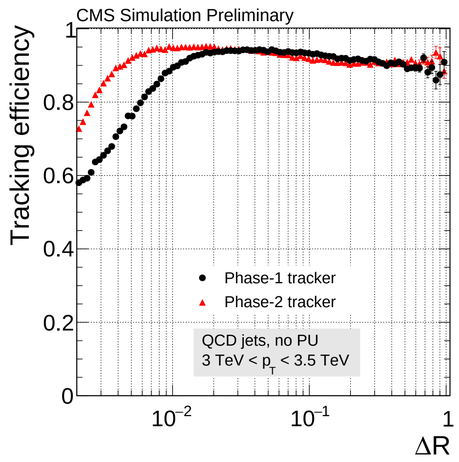


3. HL-LHC tracking results

- **Iterative tracking** with some optimization
- HL-LHC CMS tracking has **performance** similar or better to the present CMS tracking:
  - High efficiency while keeping low fake-rate
  - Excellent momentum and vertex resolution
  - Very good track separation in the core of a jet

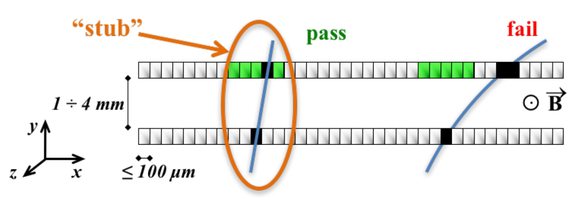






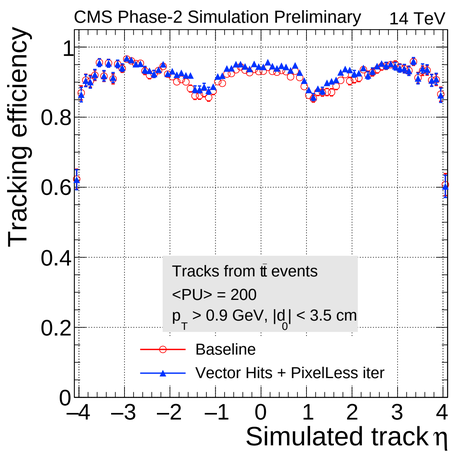
4. Developments

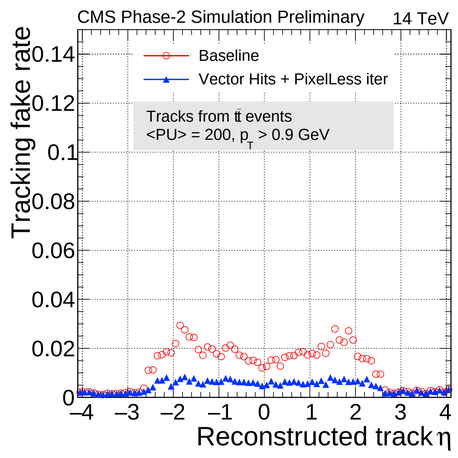
- Full optimization of the algorithm
- Adapt to work on new hardware technologies
- Exploiting Outer Tracker possibilities:
  1) **Vector Hits** (offline stubs) contain not only position but also **direction**
  2) Adding a new iteration targeting **displaced tracks**

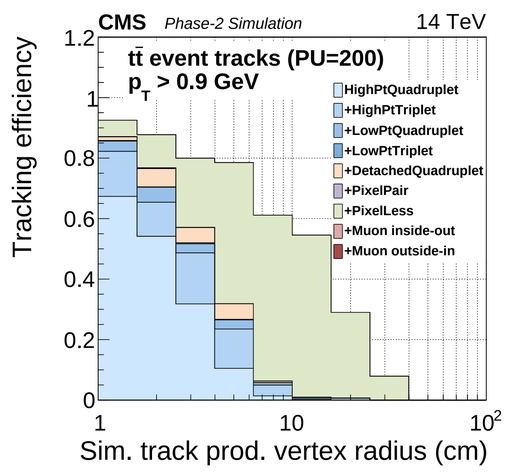


5. Preliminary results using Vector Hits

- The baseline is **compared** with track reconstruction using Vector Hits and including the Outer Tracker seeded iteration:
  - Improved efficiency
  - Reduced fake-rate
  - Reconstructed displaced tracks
  - Studying CPU memory and timing







6. Summary and References

- CMS tracking is **ready** to face HL-LHC conditions
- **Improved performance** using Vector Hits with respect to the HL-LHC baseline tracking
- **Ongoing work** and ideas for further improvements

[1] CMS collaboration, Description and performance of track and primary-vertex reconstruction with the CMS tracker, JINST 9 (2014) P10009
[2] CMS collaboration, The Phase-2 Upgrade of the CMS Tracker, CERN-LHCC-2017-009 / CMS-TDR-014
[3] CMS collaboration, Phase-2 tracking with Vector Hits, CMS DP-2017/044