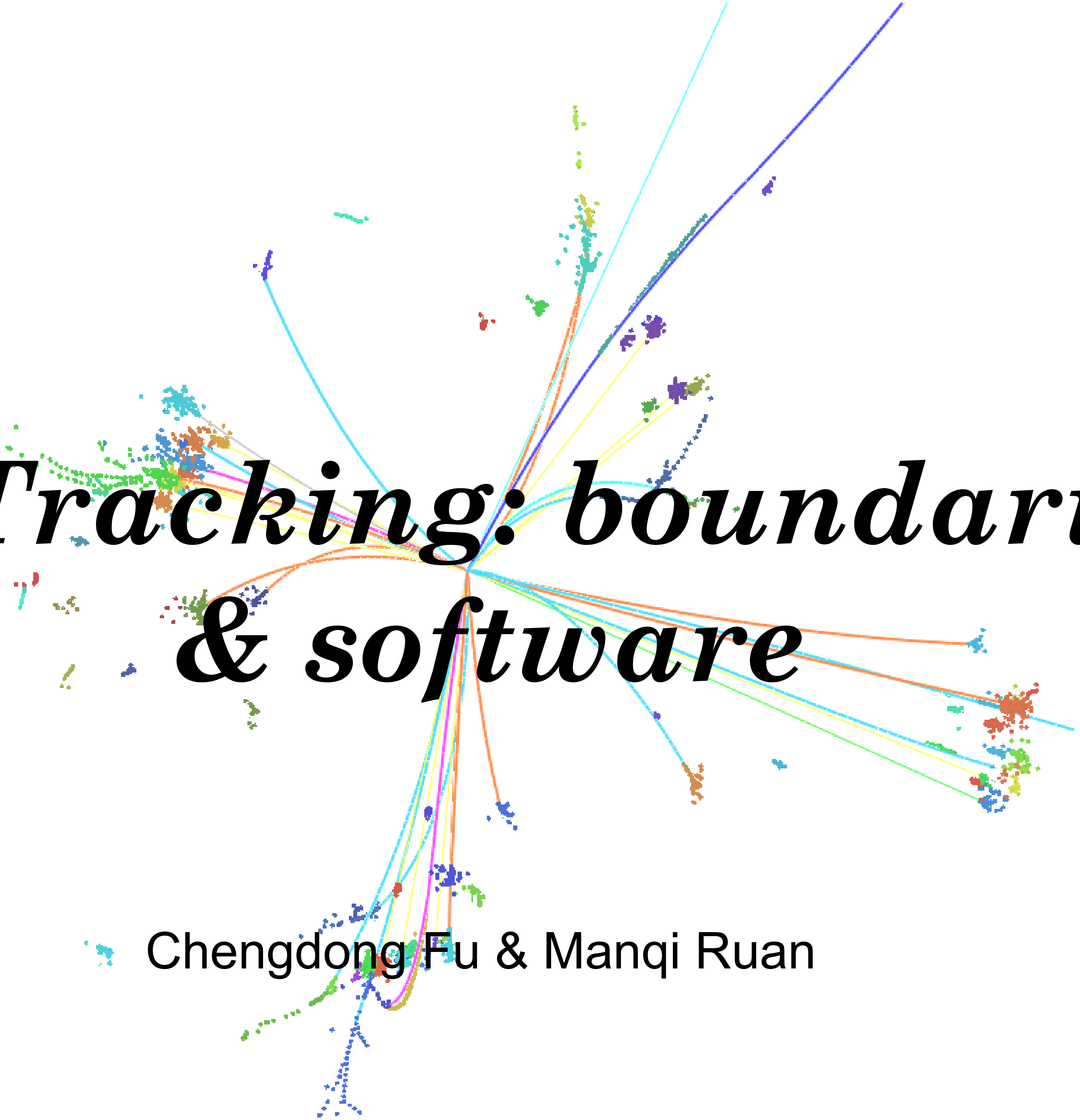
Si-Tracking: boundaries & software



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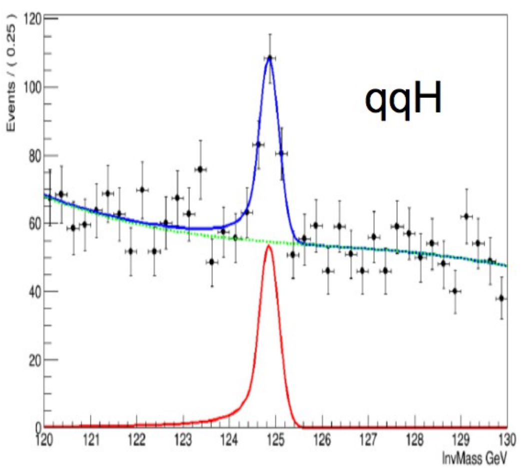
Boundaries

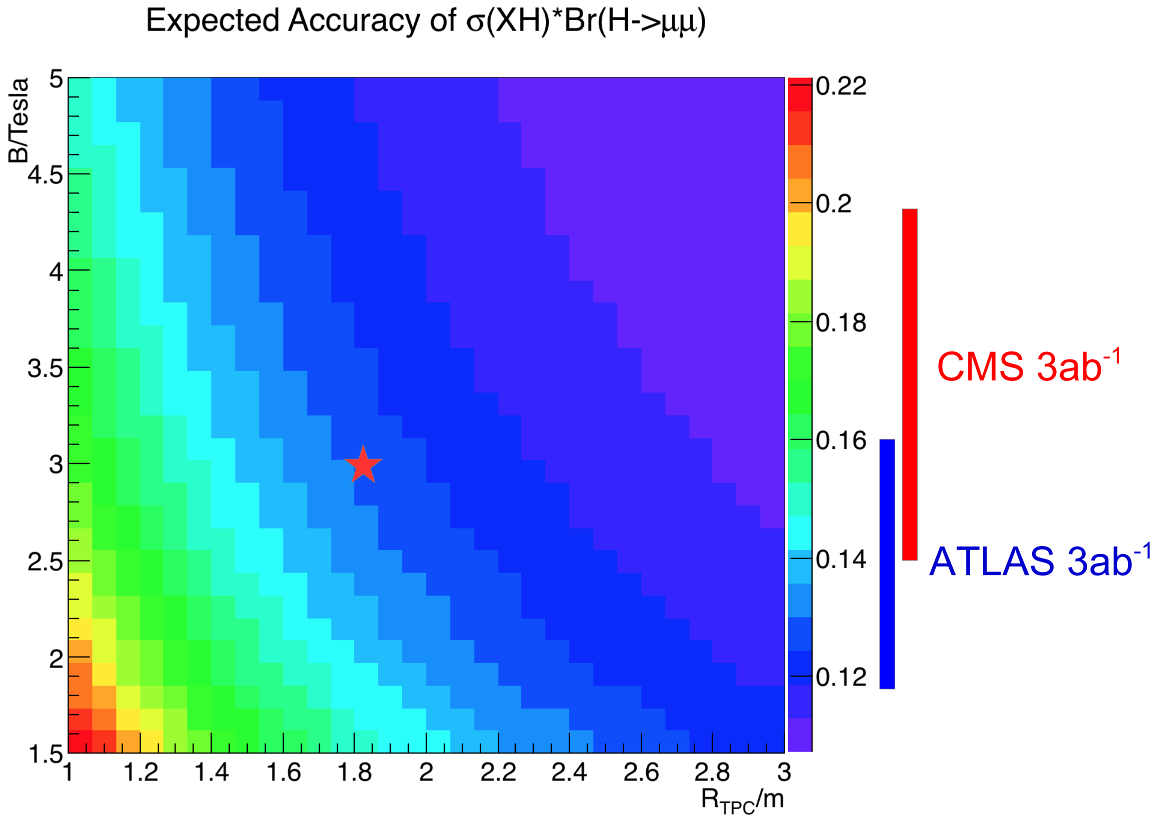
- From Physics Requirement at H->di muon:
  - Delta(1/Pt) ~ 2E-5 is a must, which means
    - the TPC radius > 1.8 meter
    - Silicon design to Xcheck the performance

- Geometry
  - Modification of Forward region: Marginal impact on Silicon Tracking
  - B Field reduced to 3 Tesla

Tracker Radius: the optimized value

- Detector cost is sensitive to tracker radius, however, I recommend TPC radius >= 1.8m:
  - Better separation & JER
  - Better dEdx
  - **Better (H->di muon) measurement**





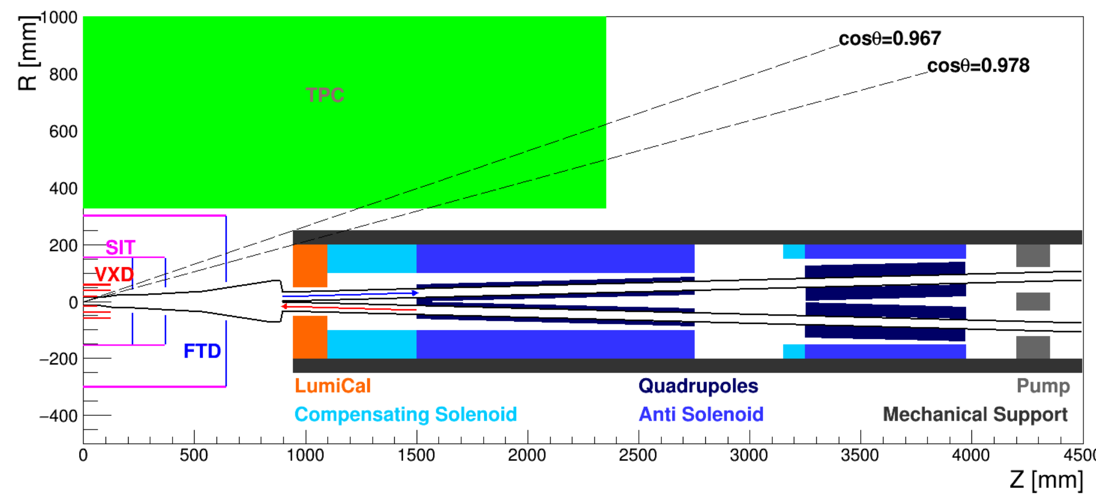
Feasibility & Optimized Parameters

Feasibility analysis: TPC and Passive Cooling Calorimeter is valid for CEPC

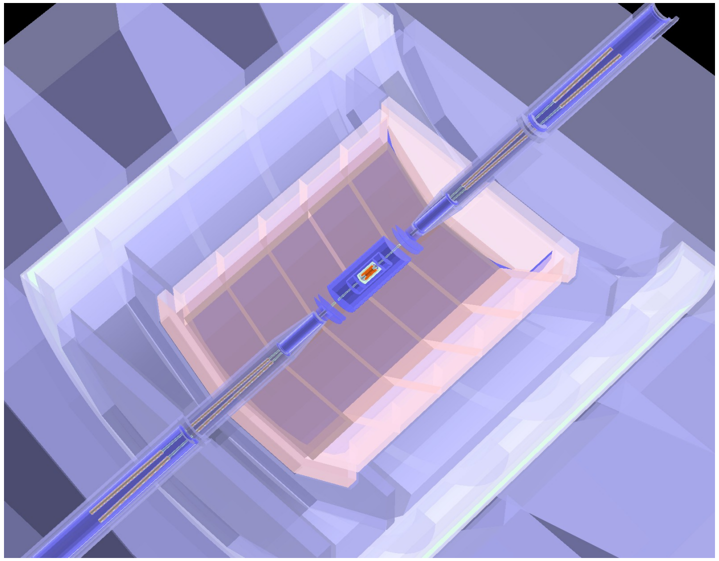
	CEPC_v1 (~ ILD)	Optimized (Preliminary)	Comments
Track Radius	1.8 m	>= 1.8 m	Requested by Br(H->di muon) measurement
B Field	**3.5 T**	**3 T**	**Requested by MDI**
ToF	**-**	**50 ps**	**Requested by pi-Kaon separation at Z pole**
ECAL Thickness	84 mm	84(90) mm	84 mm is optimized on Br(H->di photon) at 250 GeV; 90mm for bhabha event at 350 GeV
ECAL Cell Size	5 mm	10 – 20 mm	Passive cooling request ~ 20 mm. 10 mm should be highly appreciated for EW measurements – need further evaluation
ECAL NLayer	30	20 – 30	Depends on the Silicon Sensor thickness
HCAL Thickness	**1.3 m**	**1 m**	-
HCAL NLayer	**48**	**40**	Optimized on Higgs event at 250 GeV; Margin might be reserved for 350 GeV.

CEPC Forward Region

MDI parameters	***old***	***new***
L^* (m)	1.5	2.2
Crossing angle (mrad)	30	33
Strength of QD0 (T/m)	200	150
Strength of detector solenoid (T)	3.5	3.0
Strength of anti-solenoid (T)	13	7.0



- Physics Requirements
  - Adequate to CEPC collision environments & Works coherently with all sub-systems
  - 1.0E-3 relative accuracy at the Higgs;
  - 1.0E-4 relative accuracy at the Z pole;
  - Provide on-situ information for Beam Energy/Luminosity monitoring...



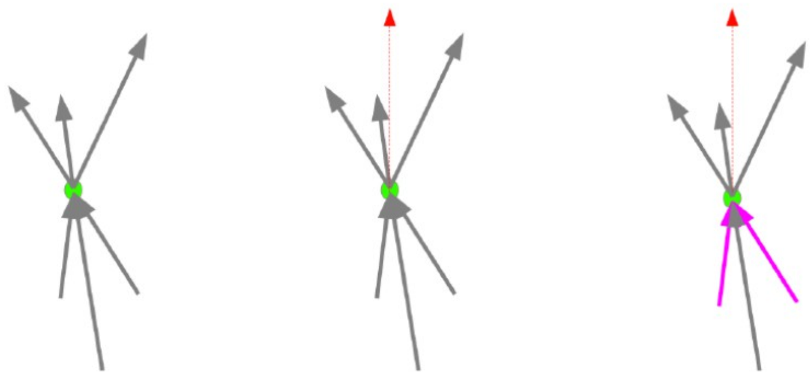
Software

- Si Tracker Geometry optimized at fast simulation level & Implemented to full simulation
- Digitization study framework set – no validation
- Arbor based Track finding is under development
  - Comparable result at TPC
  - Cleaning & Validation, Maybe applicable to Silicon Tracking

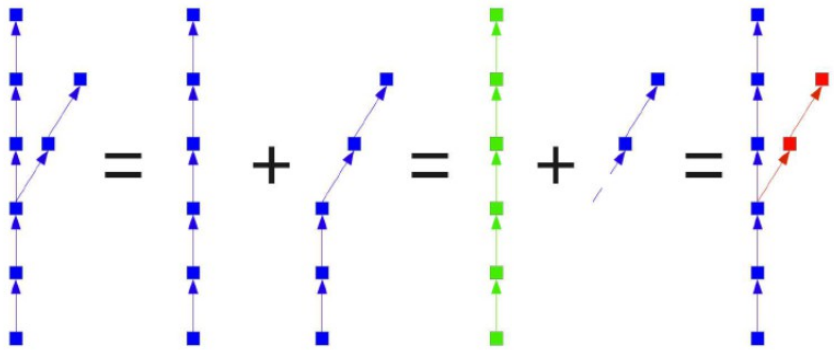
Arbor

- Arbor link any two closed (distance smaller than threshold) hits by connector (orientated arrow) first

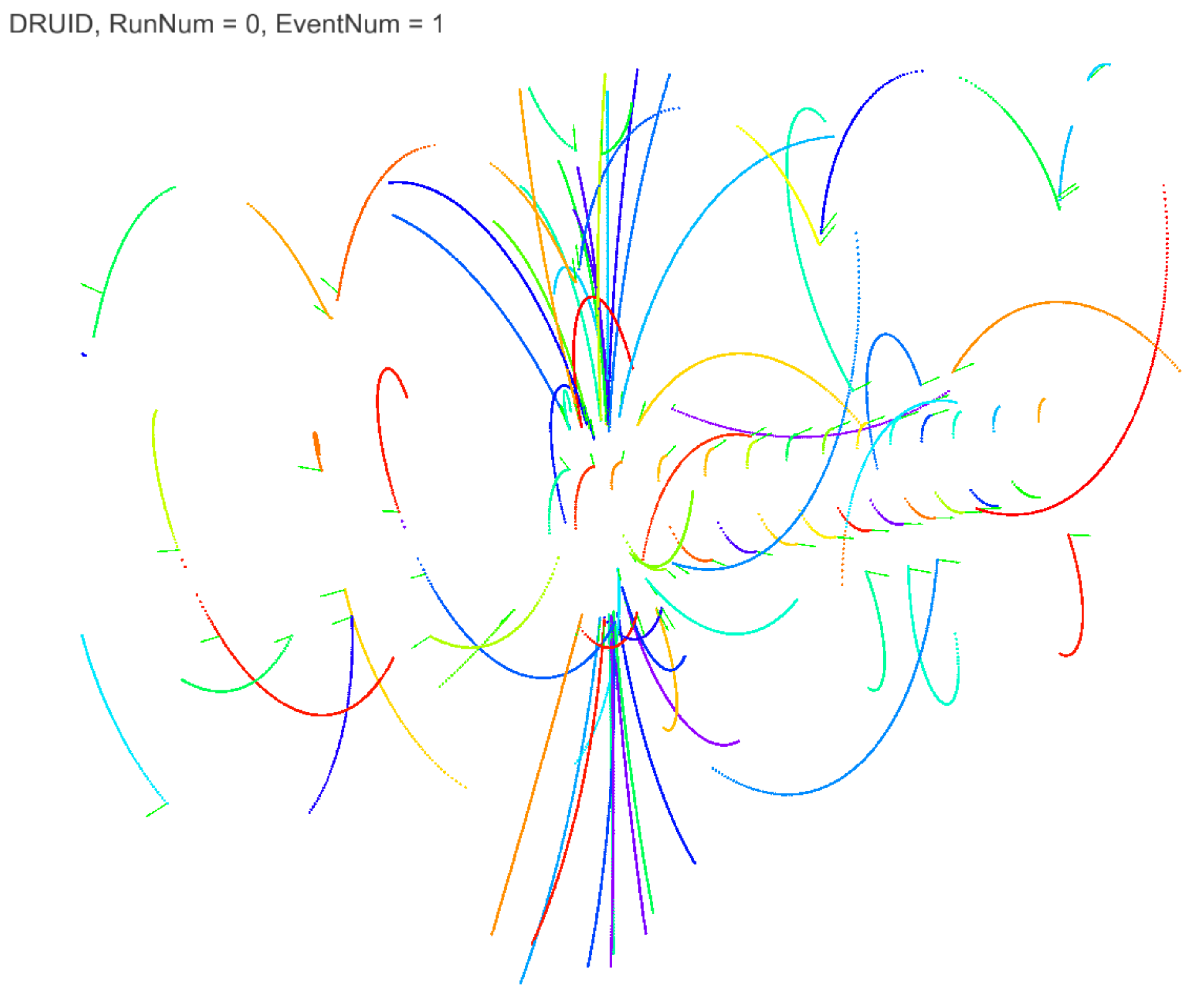
- Clean connectors of hits⇒tree
  - One connector for each hit



- Separate tree⇒branch



The branch composed by hits in TPC will just be candidate track.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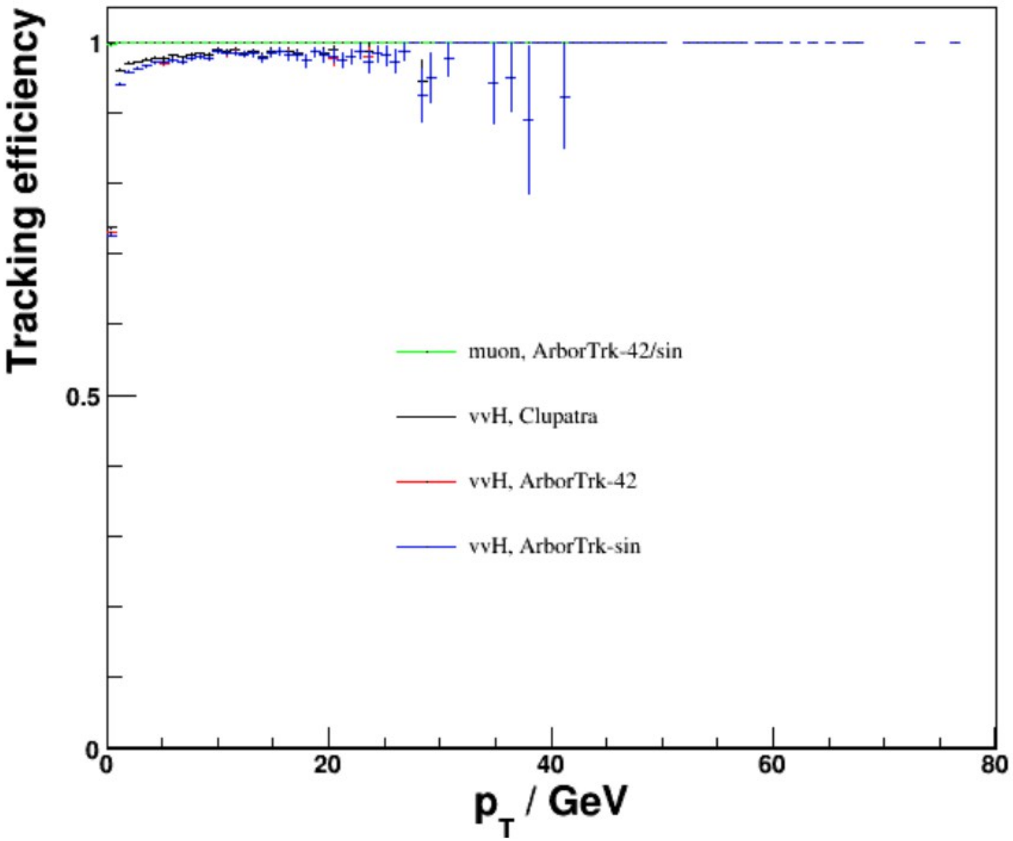
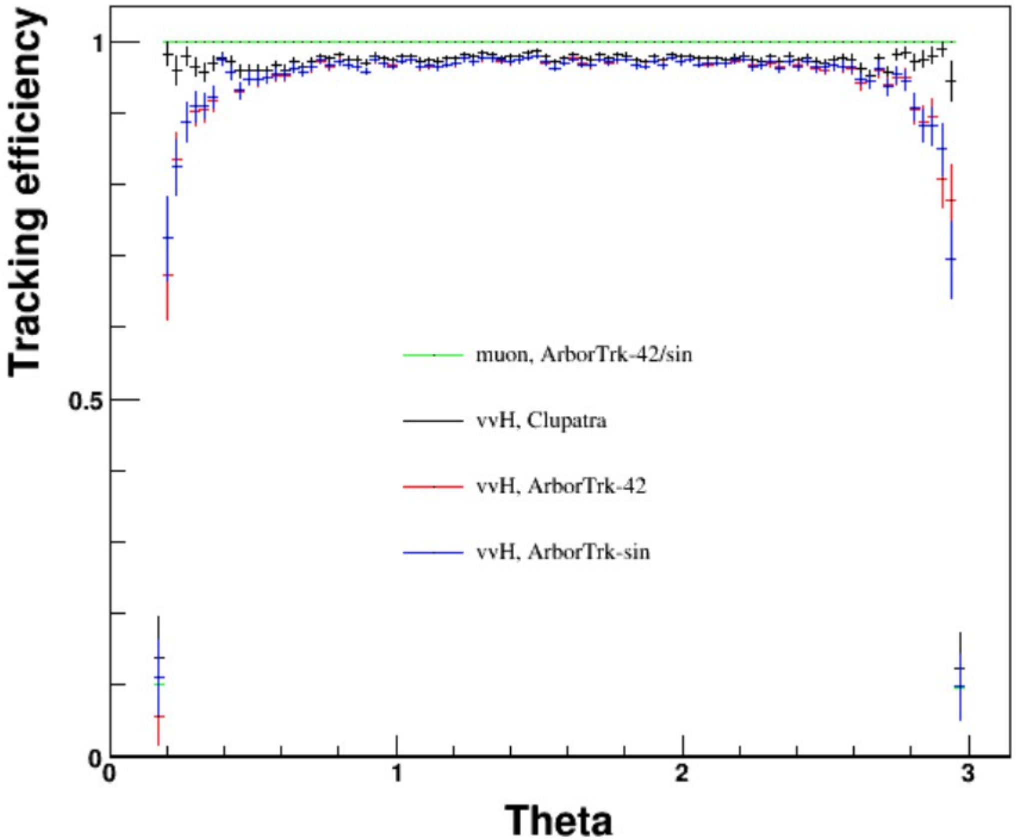
Finding efficiency





Open questions

- Remark: To be partly addressed in CDR... but more for future studies

- Adaptation to the CEPC environment
  - Power Budget & Consumption
  - Cooling & Material budget
  - Required accuracy & methodology for Alignments & Stability
  - Radiation Hardness
  - Time responses: Hit rates & Integration times

- Physics benchmarks...
  - H->di muon
  - JER @ vvH, H->gg

Open questions

- Pro & Con with respect to TPC (alternative)
  - Pro:
    - Stable, Widely used,
    - maybe able to on-site monitoring of B-Fields
  - Con:
    - No, or limited dEdx;
    - Potentially limited performance for low momentum tracks. limits
      - Tau performance (Br(tau->3 prong)) at Z pole?
      - Jet resolution
  - Unclear: Materials & Impacts to other benchmarks

- Candidate technology and comparison: CMOS, SoI, 3D, HV-CMOS? ...

To do

- Properly summarize what had already been understood
- Software
  - Combine the Silicon Tracker & CEPC_v4 Geometry together... into a CEPC_v4_Si_Tracking scenario
  - Test/Develop the tracking reconstruction algorithms
  - Applied to possible physics benchmarks
- Constrain: limited man power.