The Importance of Tracking: TPC vs. Silicon
— Some considerations for CEPC-TPC

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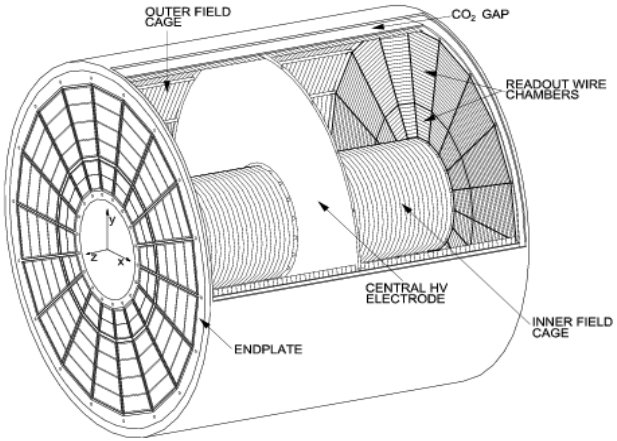
Tracker detector option

- Options of the tracker detector
  - Main drift chamber (MDC)
  - Silicon tracker detector (SiD)
  - <u>Time projection chamber (TPC)</u>
- TPC detector
  - Detector consists of
    - Chamber of working gas
    - Field Cage for the uniformity electron field
    - MPGD as readout on the two sides
  - Advantage
    - Angle of coverage: ~ 4π
    - dE/dx, Particle identification
    - Multi-hits resolution
    - Low material budget: working gas

Performance/ Design Goals

Momentum resolution at B=3.5T	$\delta(1/pt) \approx 10^{-4}$/GeV/c TPC only
δ_{point} in rΦ	<100μm (avg for straight-radial tracks)
δ_{point} in rz	≈0.4~1.4mm (for zero – full drift)
Inner radius	329mm
Outer radius	1800mm
Half length	2350mm
TPC material budgt	≈0.05X_0 including the outer field cage in r <0.25X_0 for readout endcaps in z
Pad pitch/no. padrows	≈1mm×4~10mm/≈200
2-hits resolution in rΦ	≈2mm (for straight-radial tracks)
Performance	>97% efficiency for TPC only (pt > 1GeV/c) >99% all tracking (pt > 1GeV/c)

Just one option !



TPC Detector overview
(ALICE, STAR, ILD-TPC, etc.)

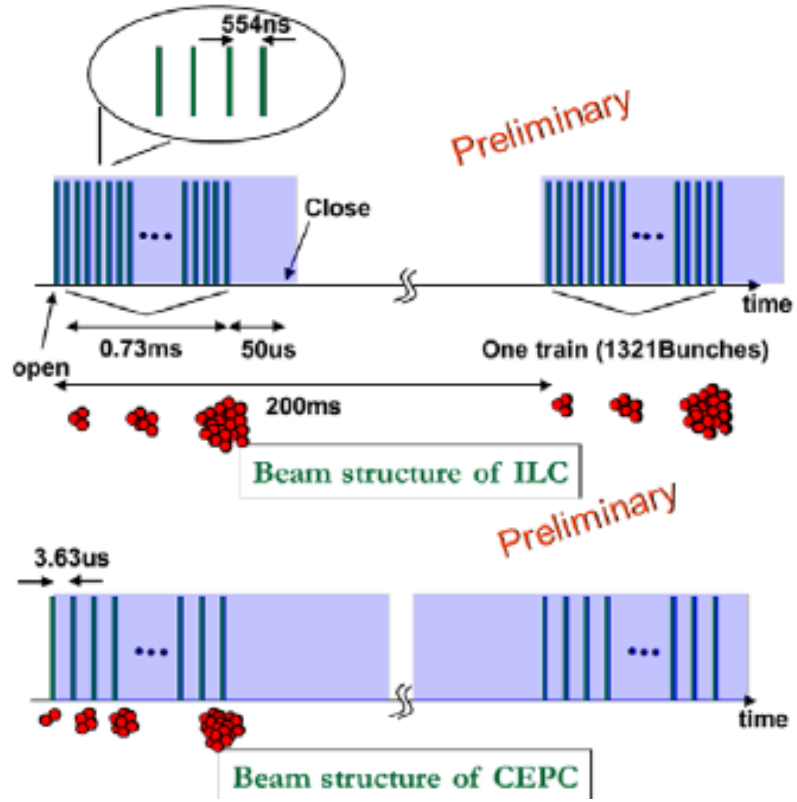
Beam structure @CEPC

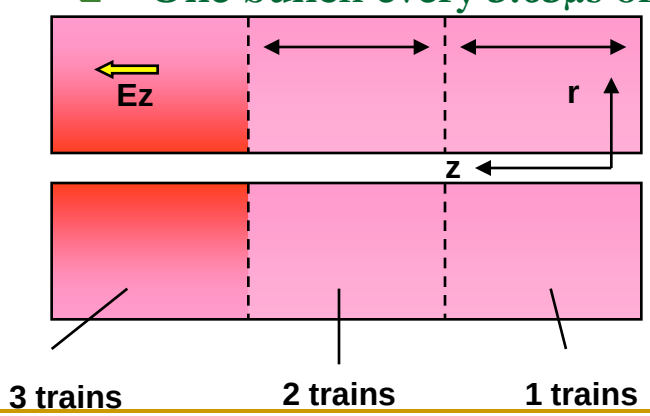
In the case of ILD-TPC

- Bunch-train structure of the ILC beam (one ~1ms train every 200 ms)
- Bunches time ~554ns
- Duration of train ~0.73ms
- Used Gating device
- Open to close time of Gating: 50μs+0.73ms
- Shorter working time

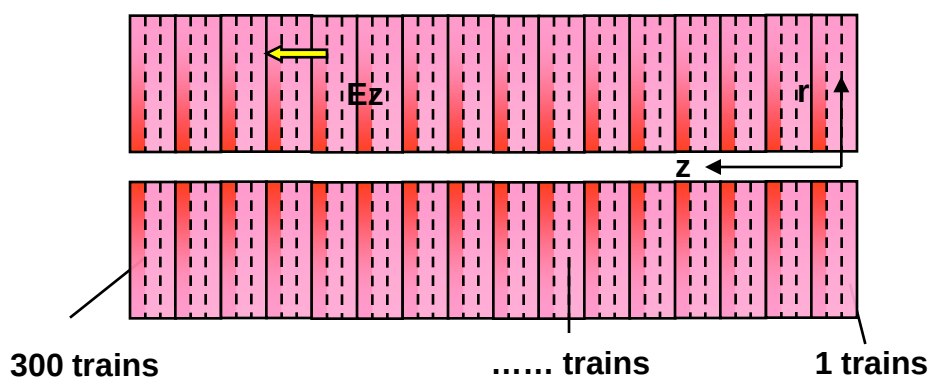
In the case of CEPC-TPC

- One bunch every 3.63μs or smaller





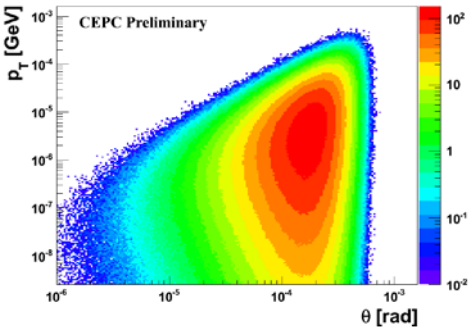
Primary ions@ILC



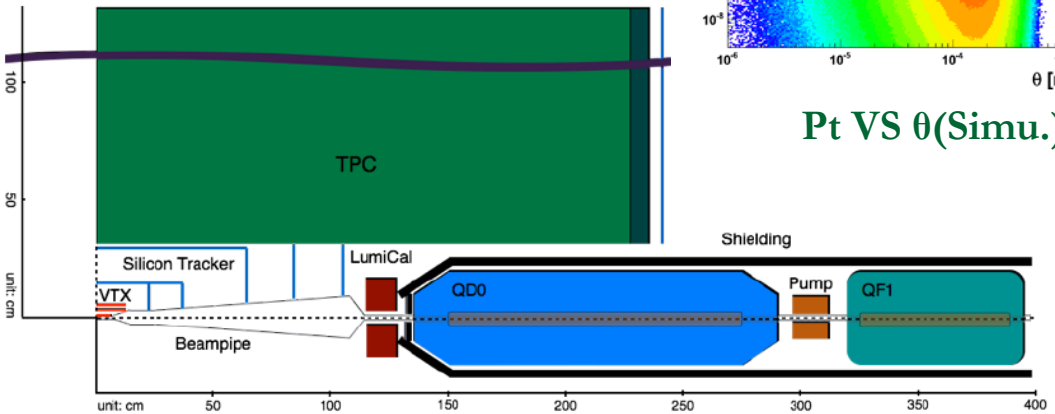
Primary ions@CEPC

Estimation of backgrounds at CEPC

- Beamstrahlung
  - Pair production
  - Hadronic background
- Lost Particles
  - Radiative Bhabha
  - Beamstrahlung
  - Beam-Gas Scattering
  - …
- Synchrotron Radiation
  - More than 100keV of Gamma
  - Just consider at endcap (readout and modules for TPC)
- From Dr. Zhu Hongbo and Xiu Qinglei



Pt VS θ(Simu.)



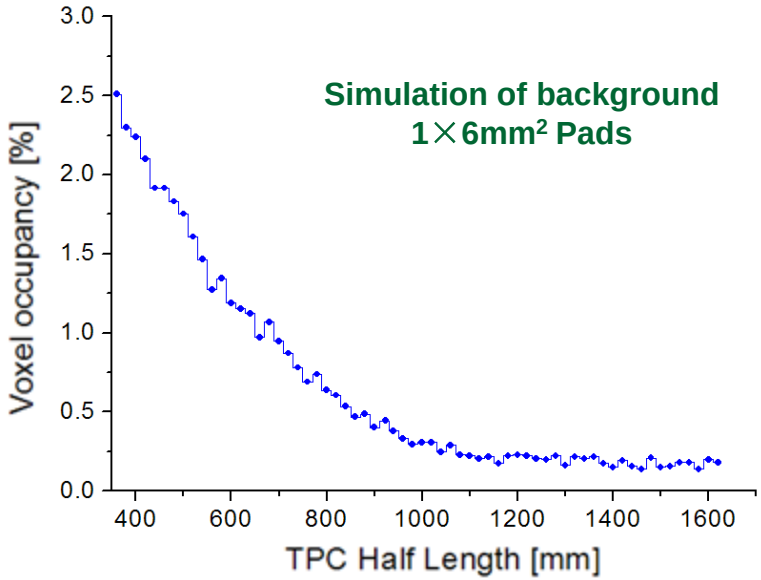
Overview of the MDI Design@ CEPC

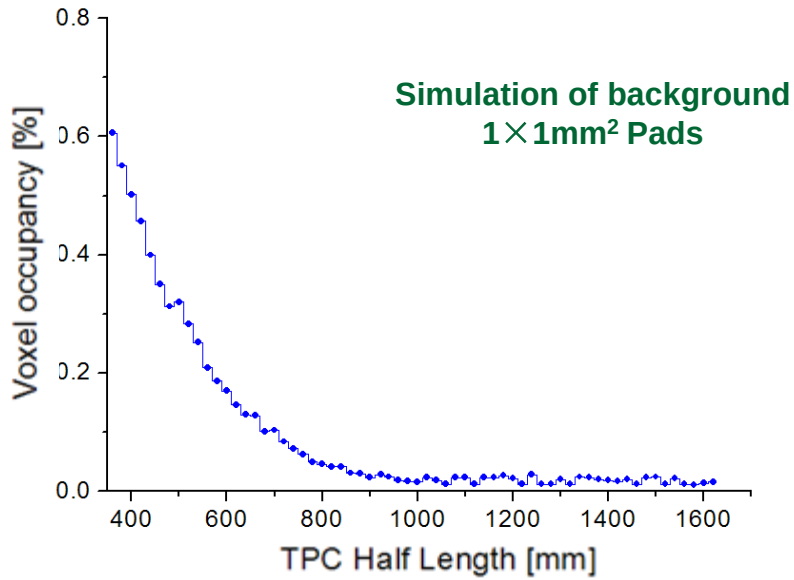
- Photon energy due to beamstrahlung at CEPC is smaller than that of ILC
- The pole angle of the photons is below 1 mrad
- Most of photons will leave the IP along the beam pipe

Simulation of occupancy

CLIC_ILD ~30%@3TeV
1×6mm² Pads
CLIC_ILD ~12%@3TeV
1×1mm² Pads
NO TPC Options!

- Occupancy@250GeV
  - Very good for Silicon pixel tracking
  - Very important parameter for TPC
  - Size of the detector structure used ILD-TPC
  - ADC sampling 40MHz readout
  - Time structure of beam:·4us/Branch
  - Beam Induced Backgrounds at CEPC@250GeV(Beam halo muon/e+e-pairs)+γγ→hadrons with safe factors(×15)

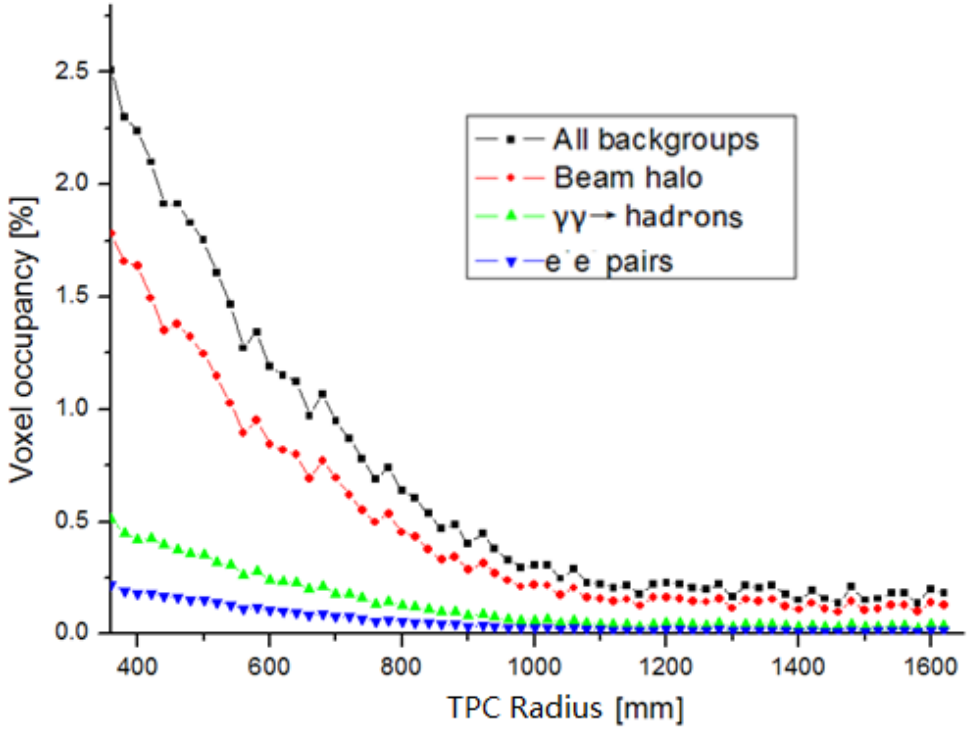




Preliminary of occupancy

Occupancy@250GeV

- Voxel occupancy
  - Pad size: 1mm×6mm
  - No consideration for the beam collimator , the value of occupancy might larger
  - No consideration for Synchrotron Radiation



TPC voxel occupancy simulated in TPC radius

- **NO conclusion …**
- **TPC Detector could be as one option for CEPC …**

Thanks!