Status and plan of Hybrid Module for CEPC-TPC

Huirong

2015.07.10

Outline

- Status of CEPC-TPC
- Status of Hybrid Module
- Plan and Critical R&D

Requirements for TPC

Performance/ Design Goals

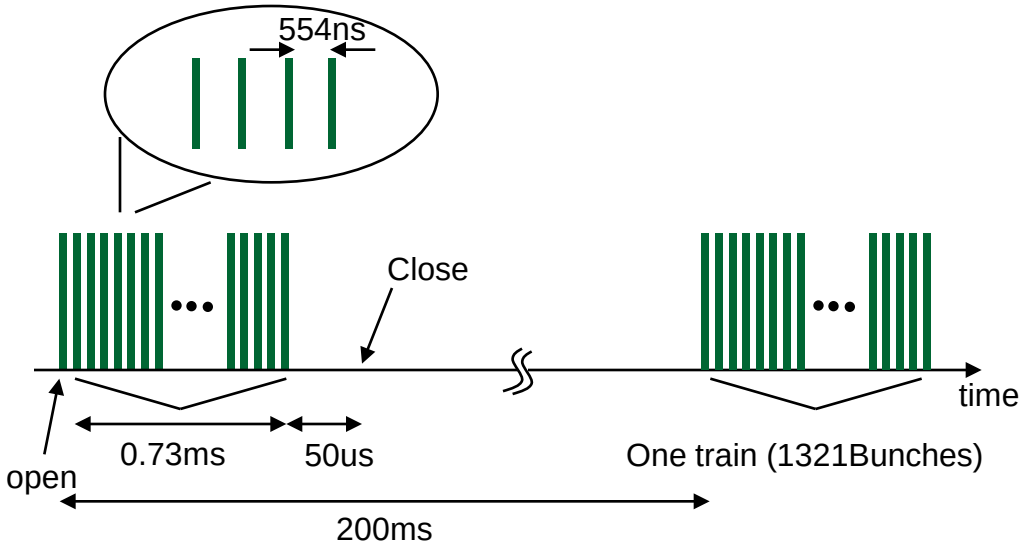
Momentum resolution at B=3.5T	**$\delta(1/pt) \approx 10^{-4}$/GeV/c TPC only**
δ_{point} in rΦ	**<100μm (avg for straight-radial tracks)**
δ_{point} in rz	**≈0.4~1.4mm (for zero – full drift)**
Inner radius	**329mm**
Outer radius	**1800mm**
Half length	**2350mm**
TPC material budgt	**≈0.05X_0 including 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)**

Similar requirements as for the ILD-TPC

Beam structure (different)

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

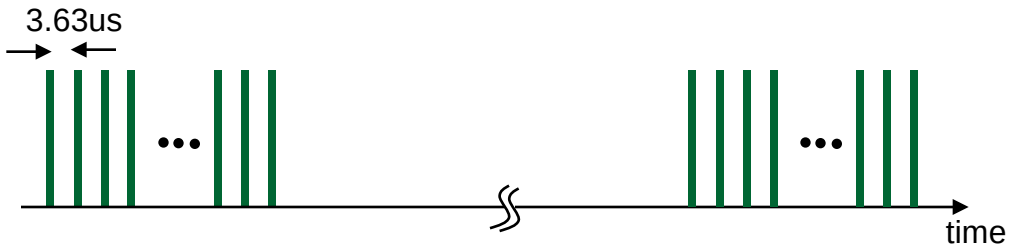


Beam structure of ILC

Preliminary

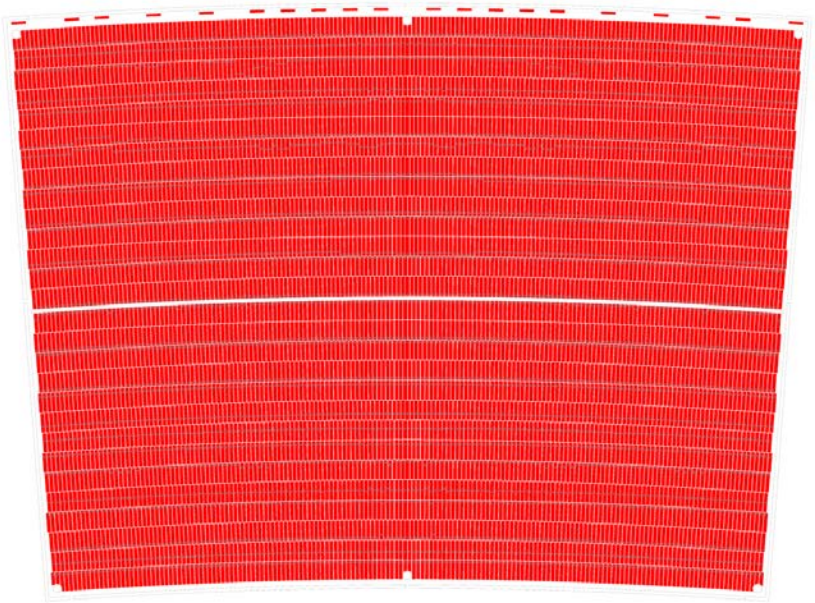
In the case of CEPC-TPC

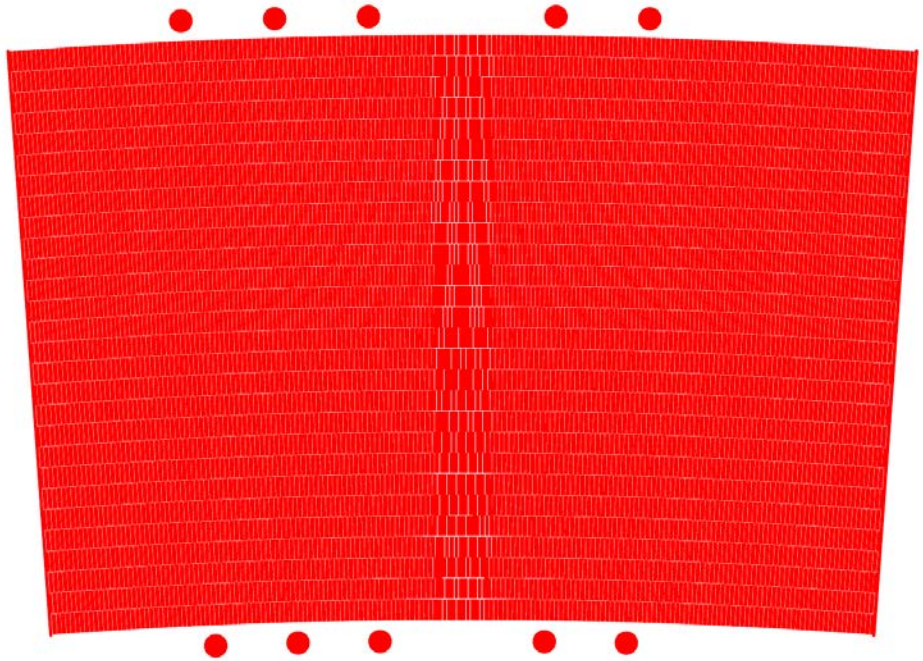
- Bunch-train structure of the CEPC beam (one bunch every 3.63μs)
- No Gating device with open and close time



Beam structure of CEPC

ILD-TPC Modules



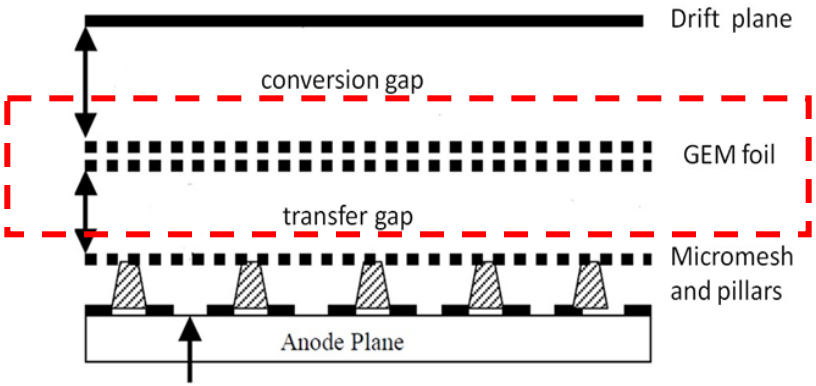


- **DESY modules:**
  - Size: 220mm×170mm
  - 1.26mm×5.85mm/Pad，Staggered
  - 28 pad rows, 4829 channels per module
  - Thin frames – 1mm all around
  - 20 HV connected at top
- **KEK module:**
  - Size: 220mm×170mm
  - 1.2mm×5.4mm/Pad，Staggered
  - 28pad rows（176-192 pads/row）
  - 5152 pad per module
  - 10mm wide frame3 at top/bottom
  - No frames at sides

Plan to design the common pad plate in 2015

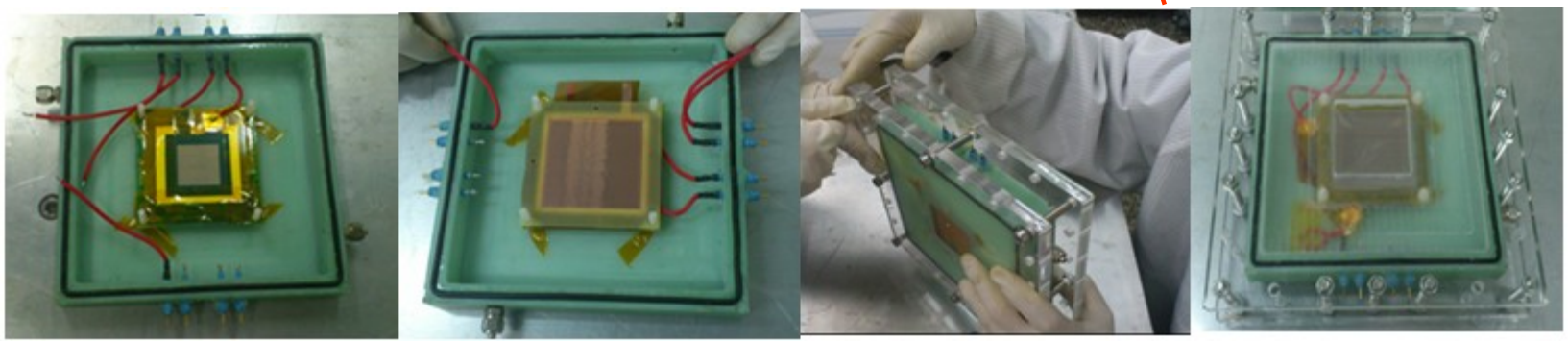
Hybrid Module for CEPC-TPC

- One GEM as the pre-amplifier device
- GEM as the device to reduce the ion back flow
- One resistive Micromegas as the main amplifier device
- Low material budget modules
- Active area:50mm×50mm
- Considered the ion feed back



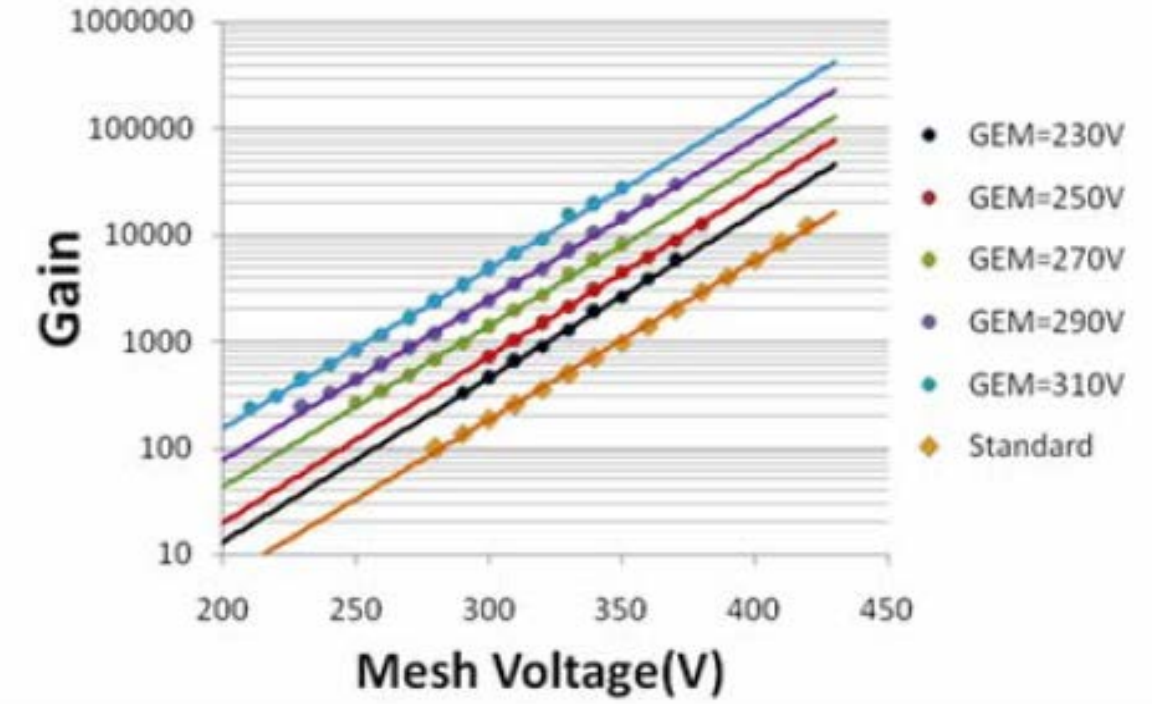
GEM+Micromegas detector

Preliminary



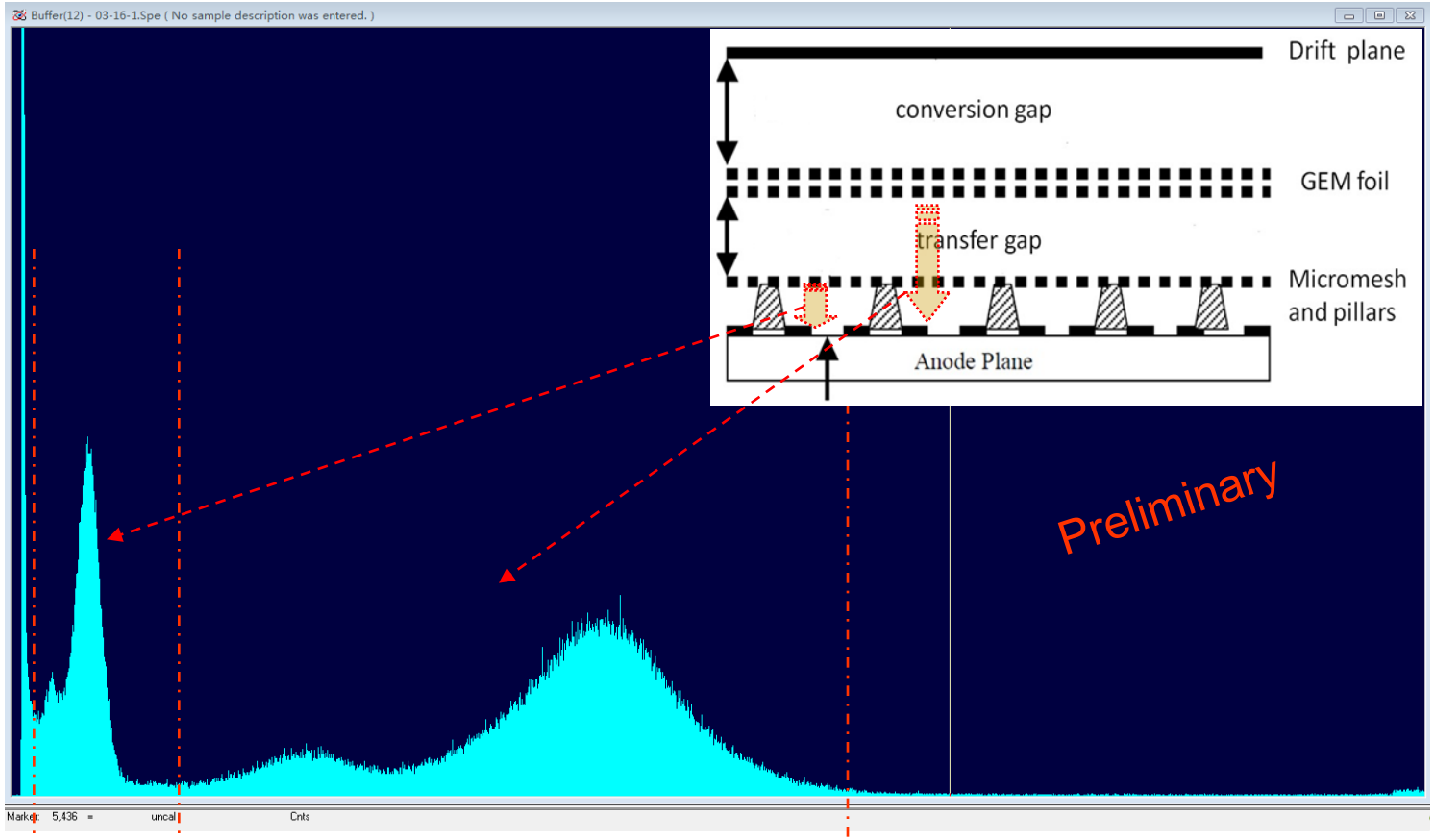
GEM+Micromegas assembled

Hybrid Module for CEPC-TPC



Gain of GEM+Micromegas VS Standard Micromegas

CEPC-TPC Hybrid Module



Energy spectrum@55Fe

Status of CEPC-TPC

In the case of CEPC-TPC

- Funding support from IHEP
- Three years program
- Low material budget modules design and R&D
- Active area:100mm×100mm
- Based on the existing research
- Considered the ion feed back

In the case of ILD-TPC

- Participation ILD-TPC cooperation group
- Simulation and beam test …
- Involved in common module design

Plan and critical R&D

- Reconsider performance parameters; need input/check from CEPC performance studies:
  - Simulation of single point resolution RΦ and point resolution z
  - Checked and optimized detector geometry
  - Two-hit sepration (i.e. of occupancy in the beam structure)
  - dE/dx
    - What is needed?
  - Pad size and Hybrid detector test
- Gas selection and simulation
  - Long drift gas studies
  - Fast drift velocity
  - Low electric field
- ILD-TPC cooperation
  - ILD-TPC Large prototype (understanding, learning, joining?)
  - Beam test and data analysis

Things to be done
Short time scale 1~3 years
To CDR of CEPC

Plan and critical R&D

- Ion back flow
  - Optimized of Hybrid detector with pre-amplifier GEM detector
  - Optimized of the resistive Micromegas
  - Hybrid detector performance
- UV laser test for modules
  - Calibration in the working gas
  - Alignment in the modules
- Electronics and DAQ (~?)
  - Common
  - …
- Gas Supply and HV supply
  - Long HV stability
  - Overall temperature uniformity and stability
- …

Thanks !