First Look at Electron Beam Gas

Cheuk-Ping Wong

04-21-2025

Beam Gas Background

- Beam electron – hydrogen gas interaction

    - For hadron beam gas: "We use Charles Hetzel's vacuum simulation after **10000Ahr** (All pumps on option), the range of the beam gas we consider is from **-5.5m to 5m**, the average beam gas pressure **is 2.56e-09mb**, this is the most optimistic case." [https://wiki.bnl.gov/EPIC/index.php?title=Hadron_Beam_Gas]

- Frequency = 3.2M Hz (10x100GeV)
  → 1 Bremsstrahlung every 0.315 us

- With an integration time of 5us,
  there are 5/ 0.315~15 Bremsstrahlung

- ~300,000 simulated beam-gas events
  One event = 1 Bremsstrahlung

          = Off momentum electron + photon

Brookhaven
National Laboratory

Detector Setup

TPC
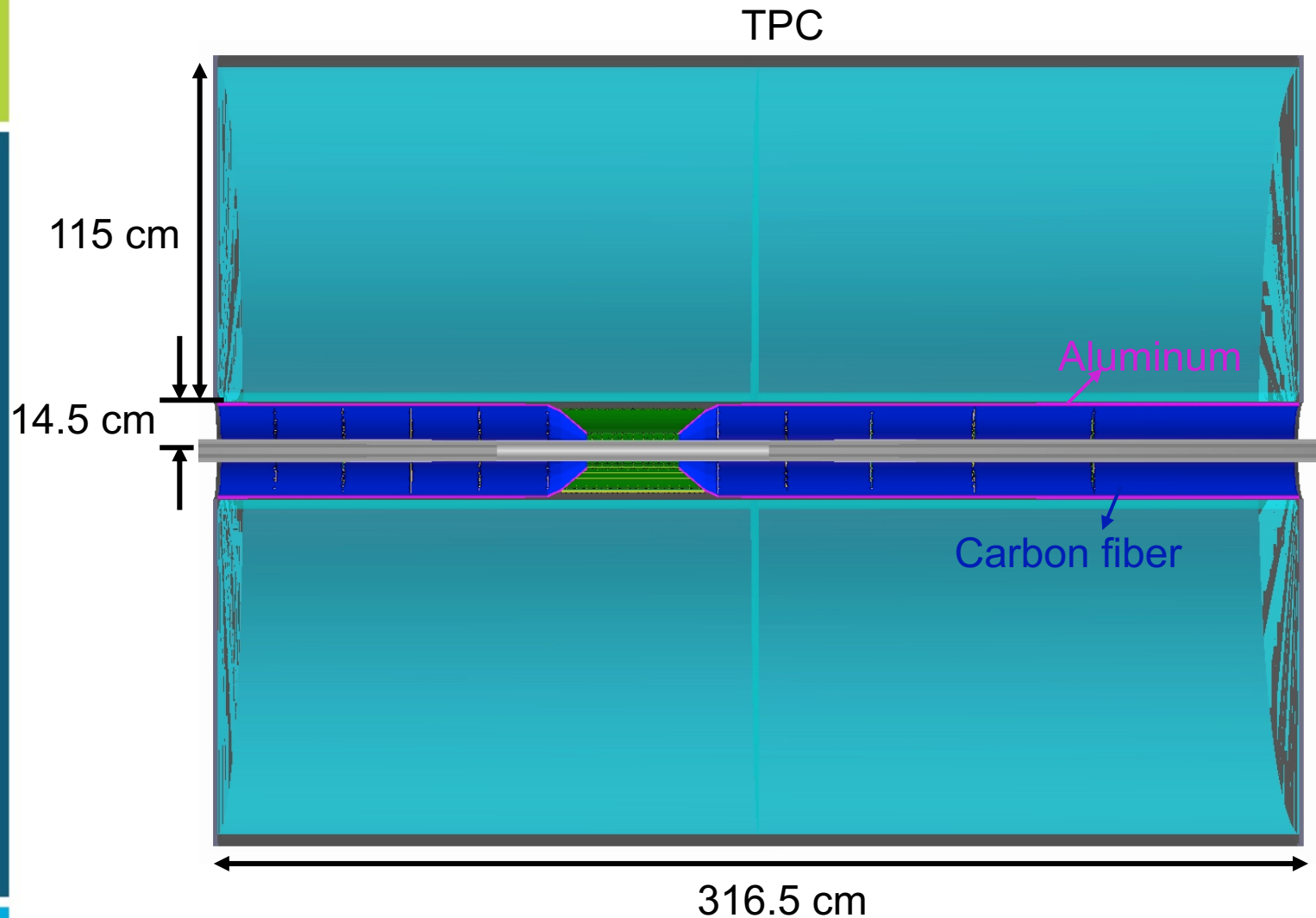
TPC
- Gas: Ar:CF4:iC4H10 (95:3:2)
- Field cage
  - carbon fiber
    inner cage t=2.62mm
    outer cage t=9.28mm
  - Kapton t=150um
  - Aluminum t =50um
- Central membrane: Kapton t=100um
- Endcaps:
  - aluminum t=13.4mm

Service/support for the inner silicon tracker
- Forward/backward disks
  - Carbon fiber tube thickness=2mm
  - Aluminum cone thickness=0.5-1.03mm
- Barrel
  - Carbon fiber tube thickness=2m
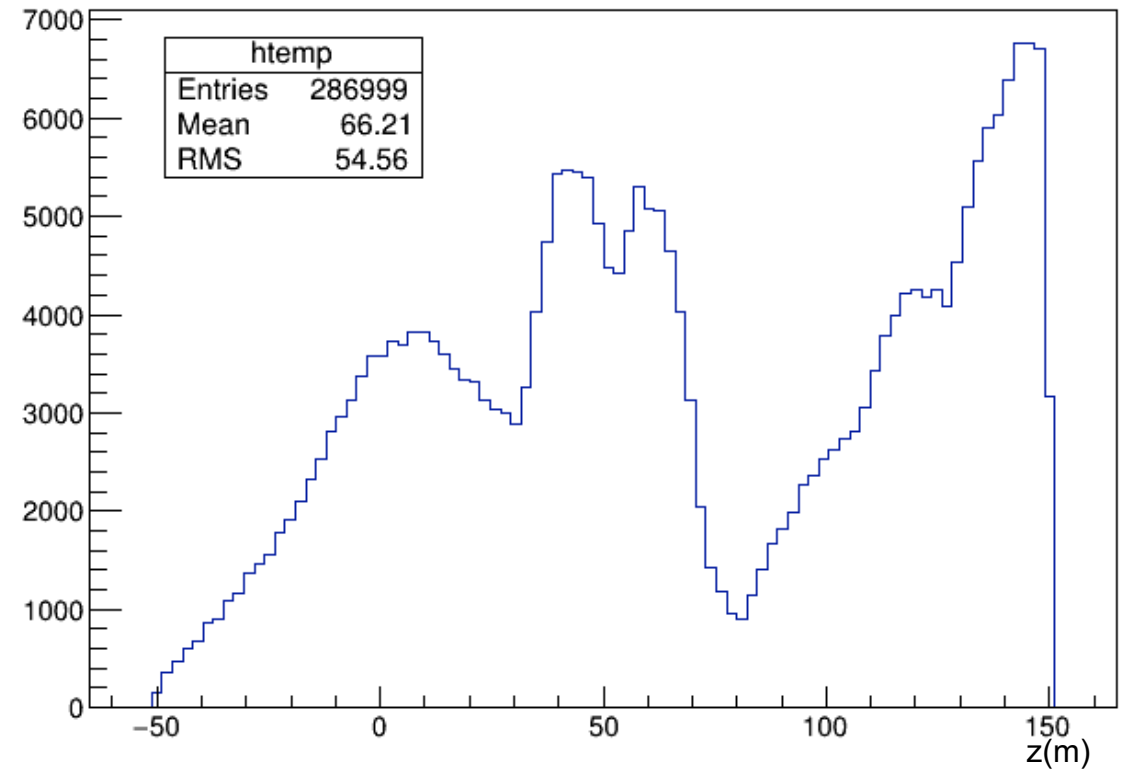 - Aluminum thickness= 0.1-0.44 mm

- Dipole magnetic field for IP8
- Just the field, not geometry implemented
- No shield

Bremsstrahlung Event Vertex in Z

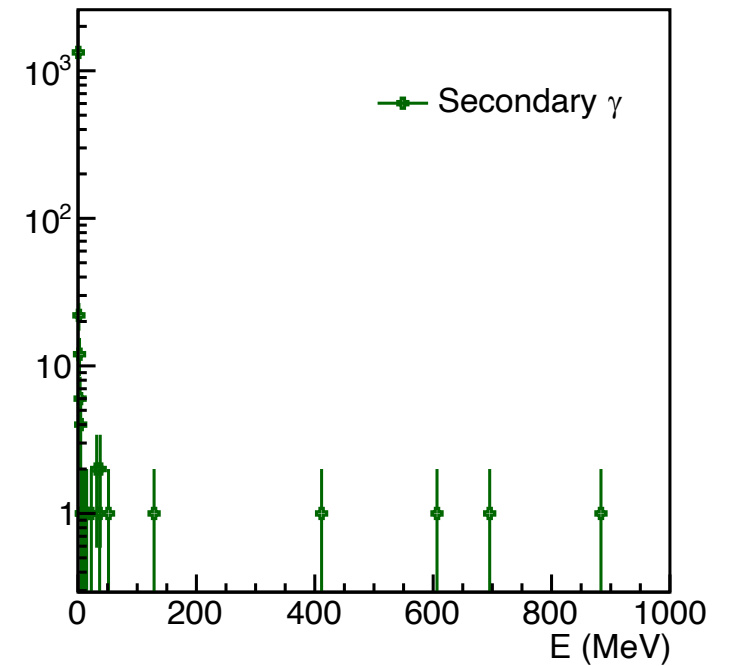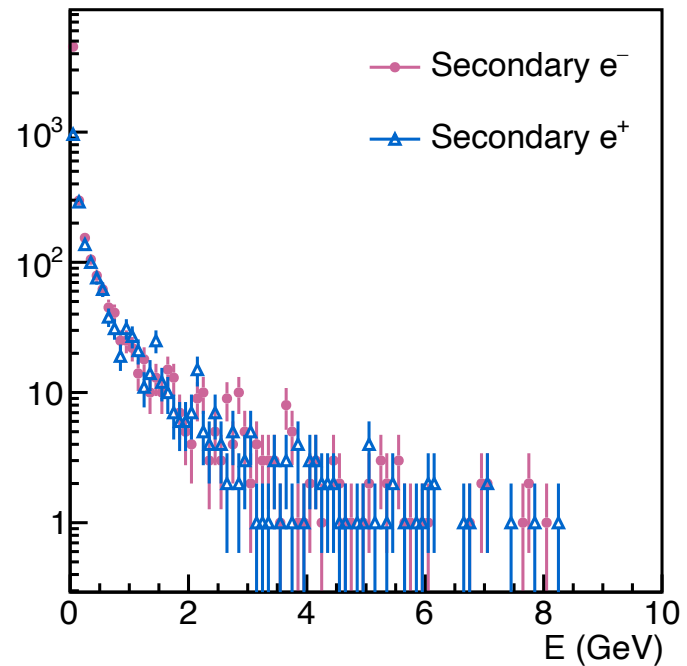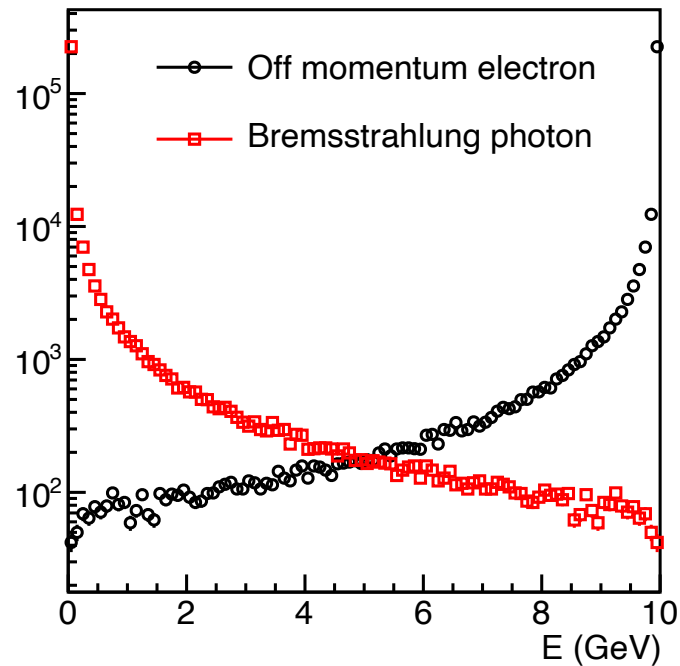https://wiki.bnl.gov/EPIC/index.php?title=Electron_Beam_Gas
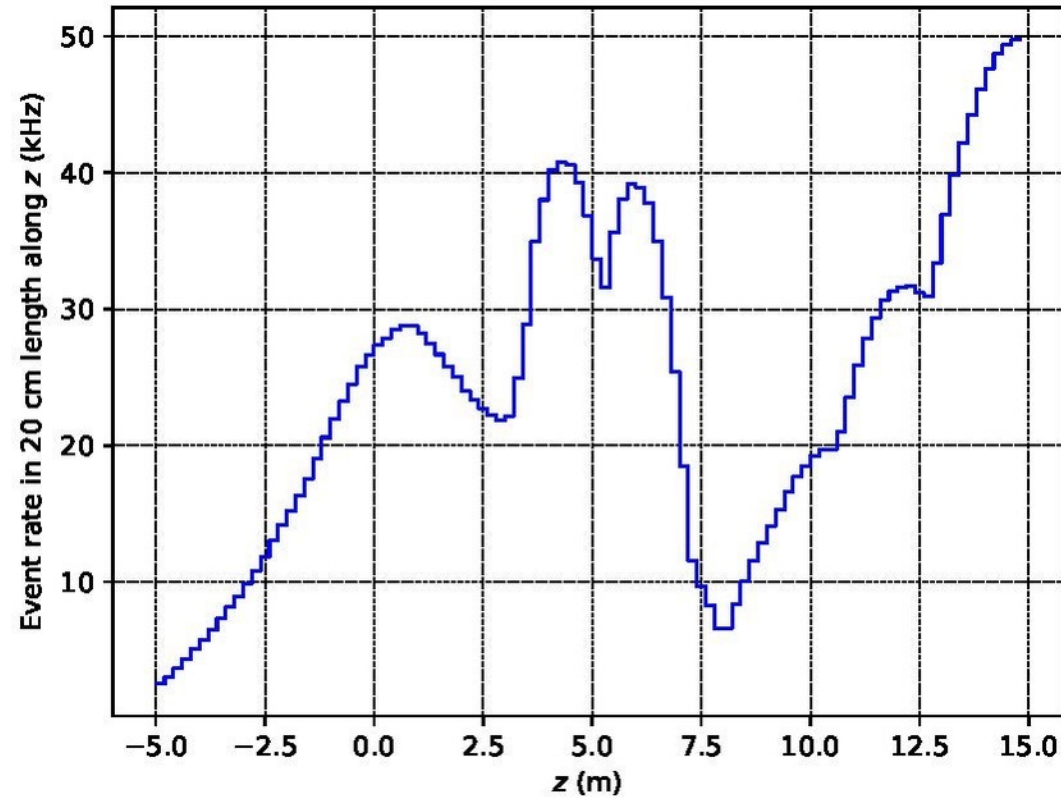
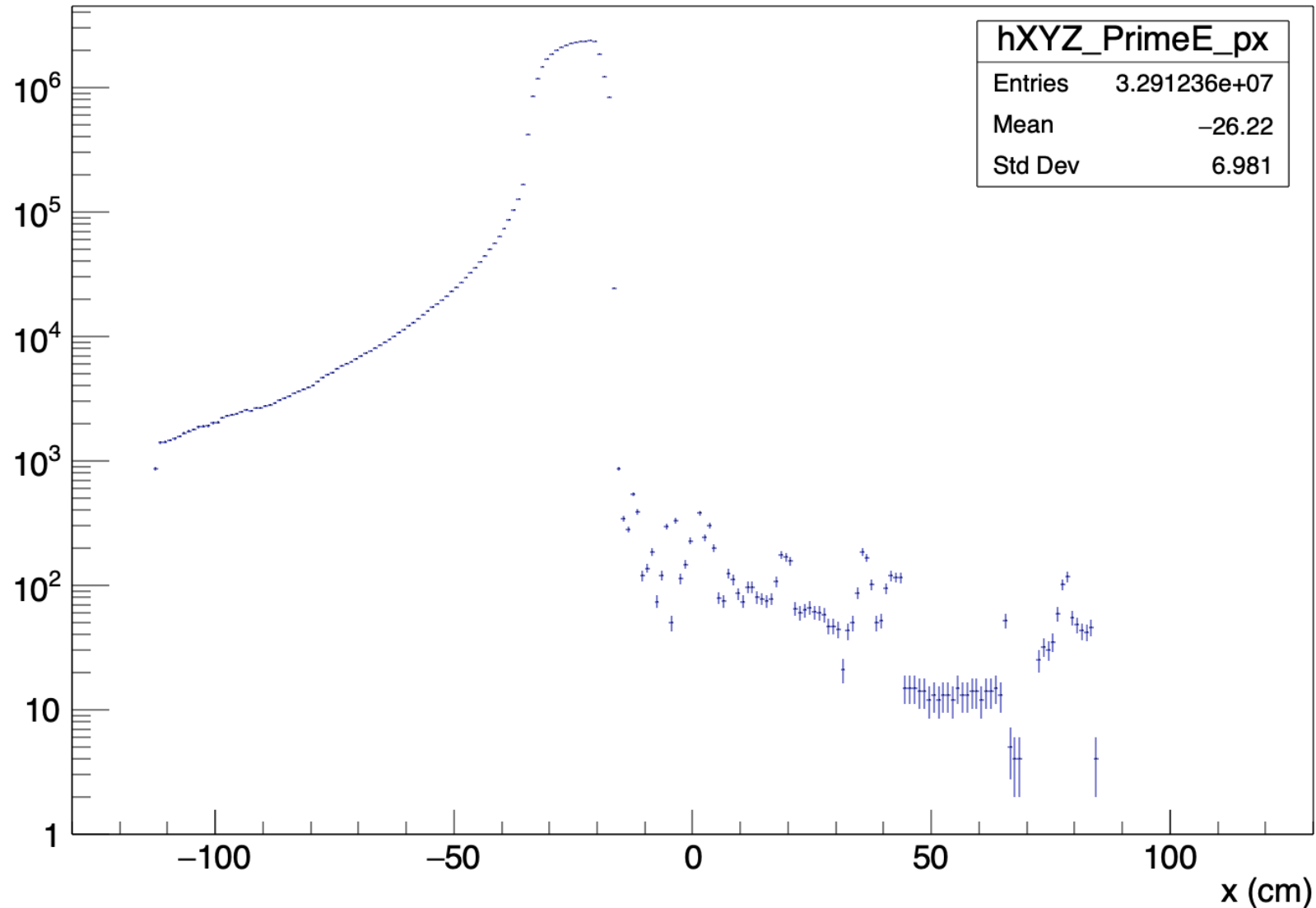Root files from Alex

The shapes match, but the scale is wrong.

Brookhaven
National Laboratory

Energy Distributions

Assumptions for later electron cloud density study:
- E <10 keV (x-ray), 1 track = 1 electron cloud
- E > 10 keV, 1 hit = 1 electron cloud

Off-Momentum Electron Hit Distribution in X

Cheuk-Ping Wong

Summary

- Bremsstrahlung event vertex$_z$ distribution
  The shape looks good, but the scale is off

- Energy distributions look reasonable

- Only the Bremsstrahlung photon generate secondary particles

- The hit$_x$ distribution of the off-momentum electrons agrees with the observation in Alex's simulation