Tracking: VXD and Forward

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Problem Statement

- **We wish to develop track-finding strategies for the forward (disk) regions and the central region in SD (axial-only measurements).**
- **For full understanding of the systematics we need to include realistic detector simulations.**
  - **Hit merging and ghosting!**
- **Occupancies need to include beam backgrounds**
  - **Largest source of hits in VXD!**

Central Tracking in SD

- **Find tracks in the 5-layer CCD pixel VXD, extrapolate outwards to pick up hits in the silicon μ-strip barrel.**
  - **Prompt tracks OK.**
- **Can also work back from clusters in the EM calorimeter**
  - **Know direction (and energy for EM showers)**
- **Attempt to find 2D tracks in outer system.**
  - **Small impact parameter tracks OK.**

Tracking in VXD

- **Pattern recognition for well-measured, separated 3D points is not a problem.**
- **Five layers provide sufficient redundancy.**
- **Need systematic studies of occupancies in high hit-density environments!**
  - **➔Need to study backgrounds!**
  - **➔Need to study hit merging!**

Hit-Merging in VXD

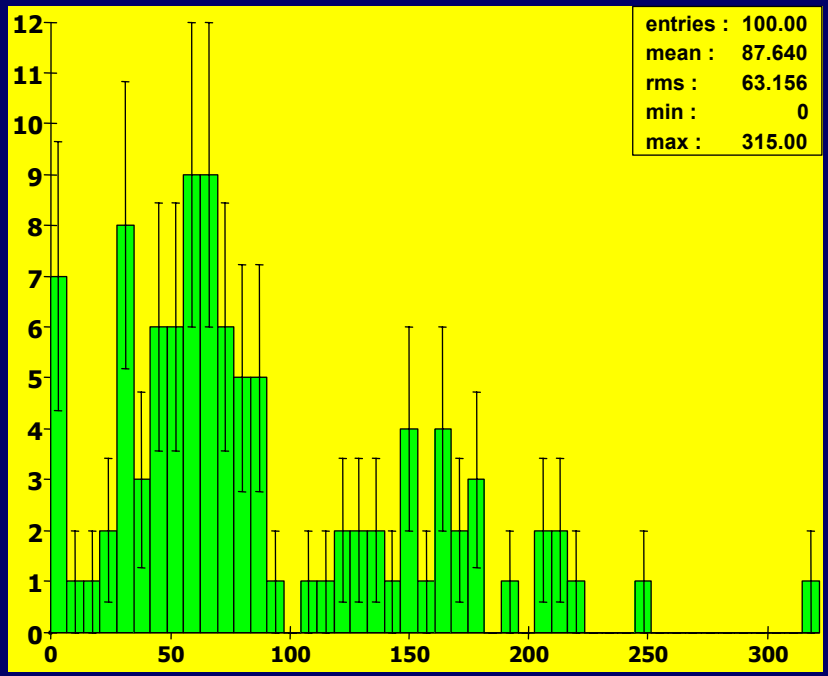
- Currently record exact position of MC track's intersection with sensitive volume in simulations.
- Smear with expected measurement resolution
  - Default is 5 microns.
- Hits are currently distinct, even when they are within a pixel (20 microns!).
- Real hits populate ~3×3 set of pixels.
- Needs further study to parameterize this!

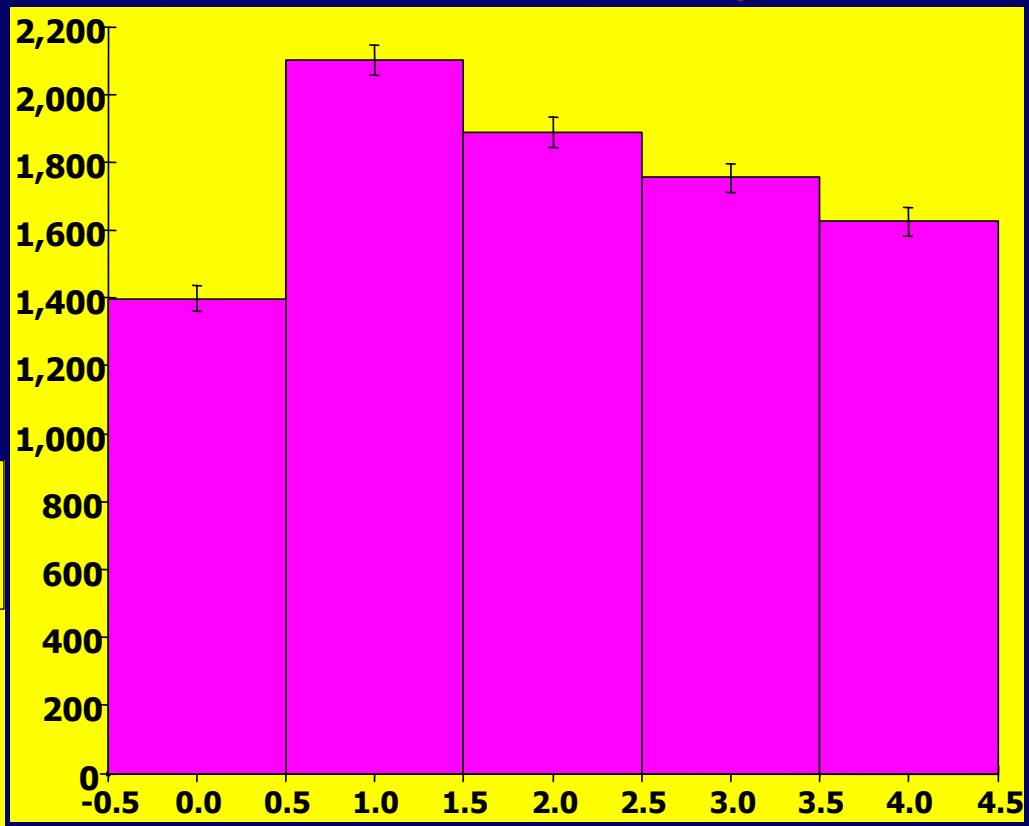
Adding Backgrounds

- Backgrounds arising from pairs hitting the beampipe have been generated and passed through the full simulation packages.
- One can overlay such events from 192 beam crossings onto signal events.
- Highest hit densities expected from $e^+e^- \rightarrow$ light quarks.

ee → udscb √s=500GeV

Number of VXD Hits

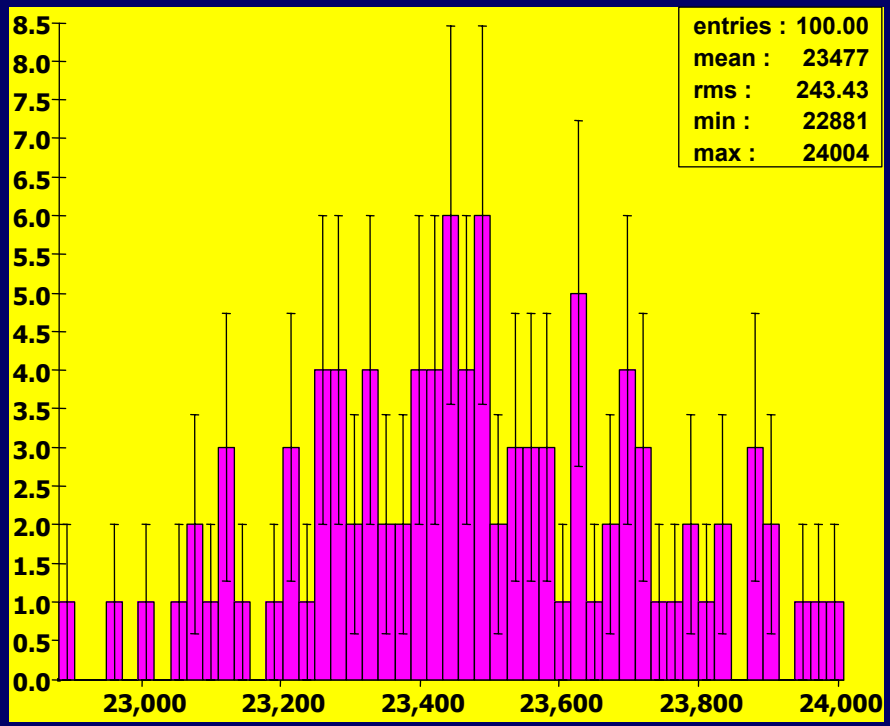


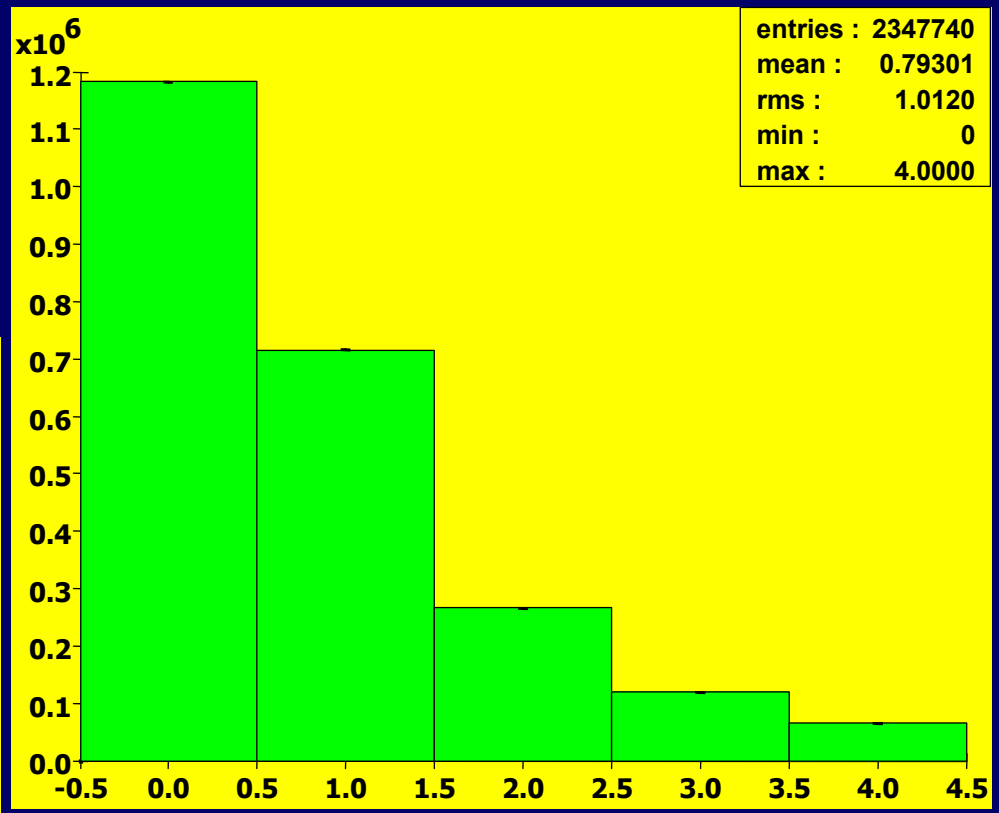


VXD Hits by Layer

ee→udscb + bunch train

Number of VXD Hits





VXD Hits by Layer

Forward Tracking

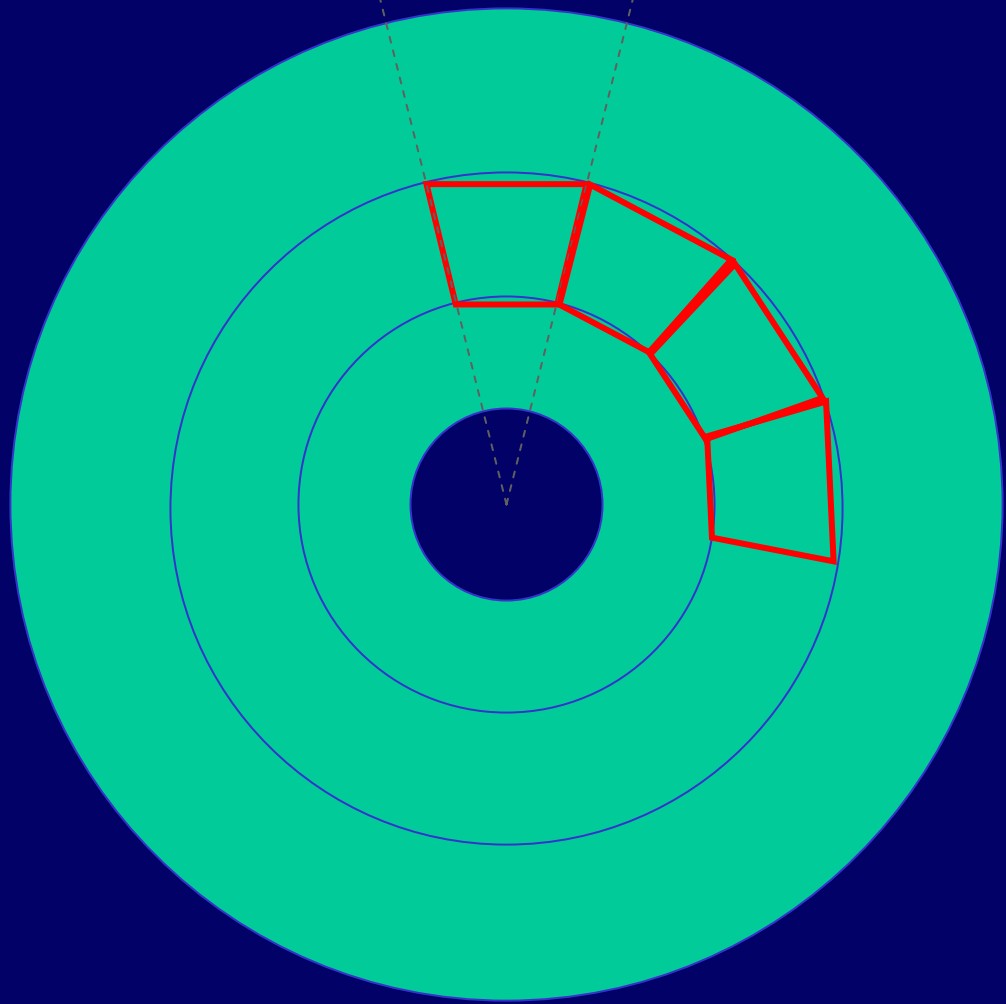
- **Associate strip hits (either double-sided or back-to-back single-sided) in wedges of z-disks to form 3D spacepoints.**
  - **Need systematic study of occupancies for various designs.**
  - **Can we survive the ghosts? Grow as ~n^2-n.**
- **Use pixel hits if available.**
- **Detailed backgrounds needed!**

➔ **Detailed hit merging and ghosting needed!**

Forward Disk Detectors

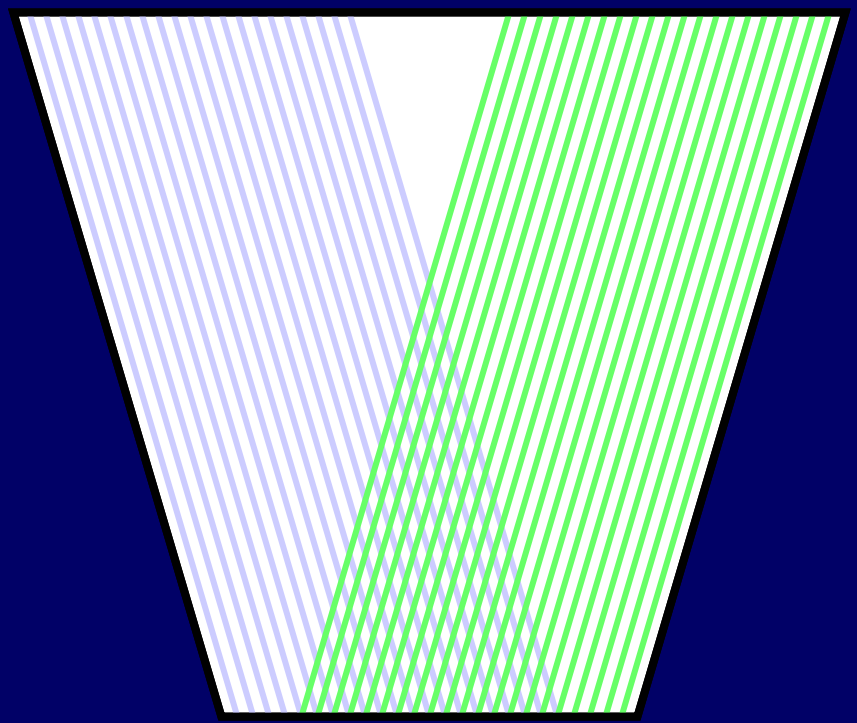
- **Many open issues:**
  - **Mix of Si pixel and μ-strip detectors?**
    - **If pixel, APD or CCD?**
  - **Tiling of disks with wafers.**
    - **Phi segmentation?**
    - **Radial segmentation?**
  - **If μ-strip, double-sided or back-to-back?**
  - **Strip orientations within wedges.**
    - **Shallow- or large-angle stereo?**

Tiling Forward Disks

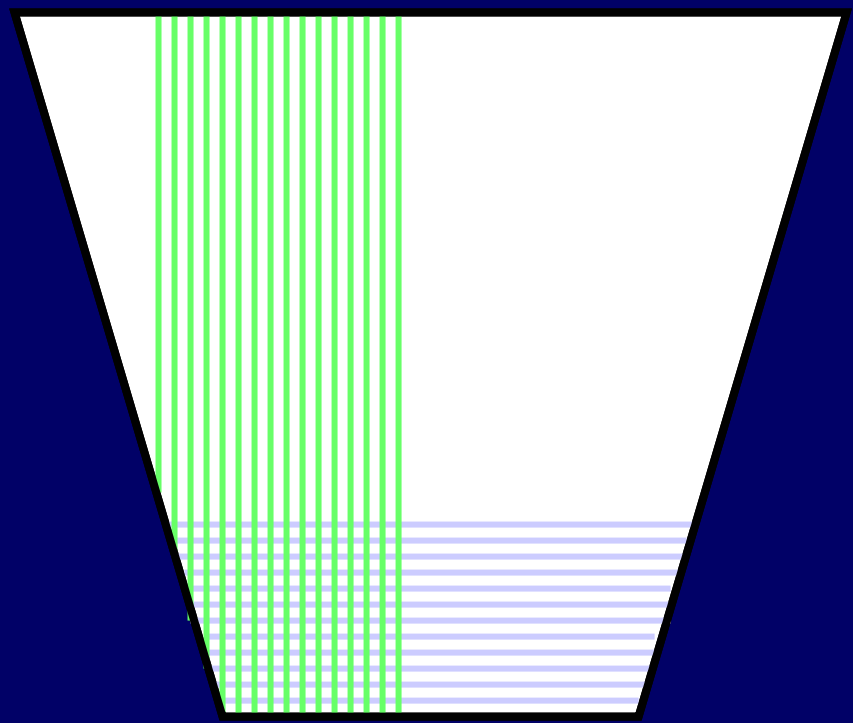


Strip Orientations

Shallow Angle Stereo



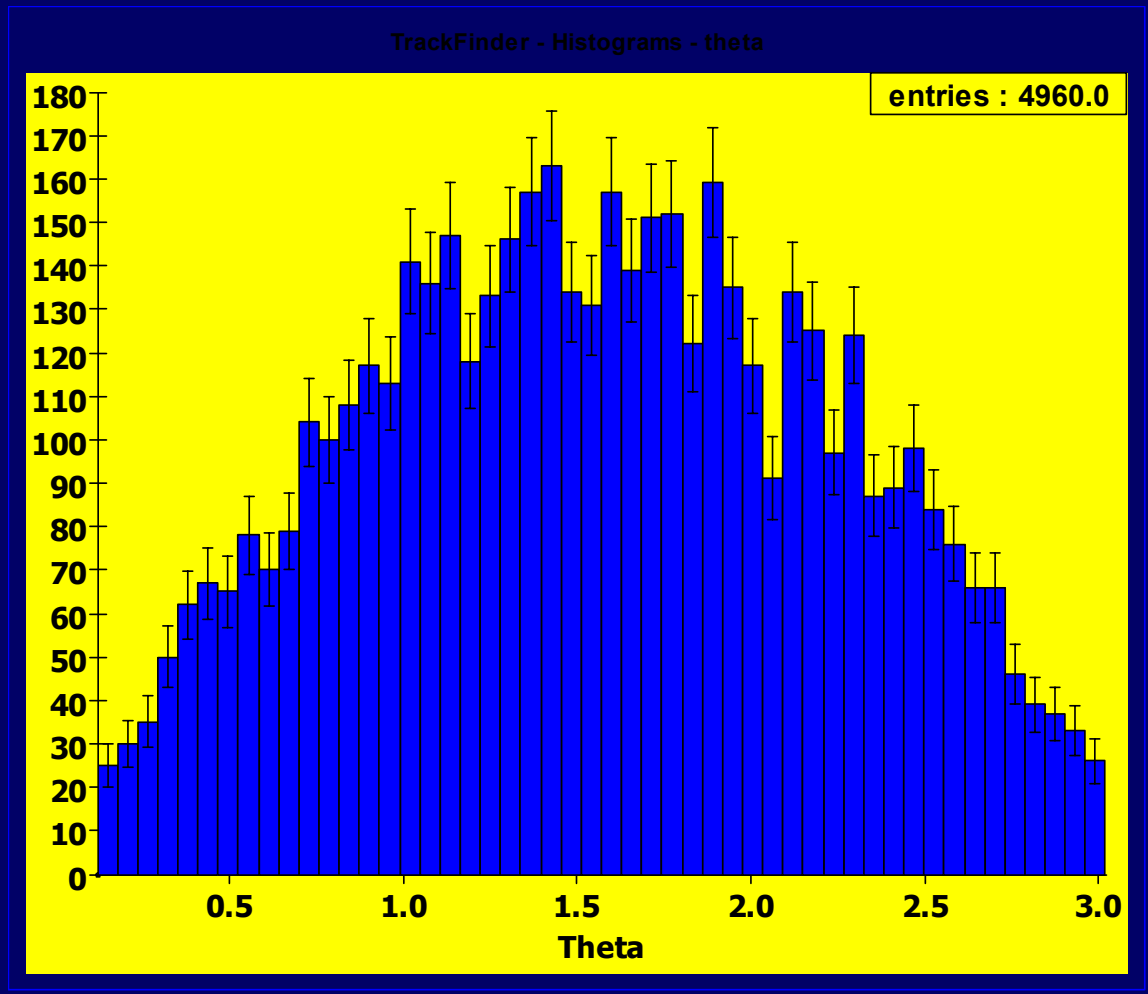
Large Angle Stereo



Pattern Recognition

- **Conformal-mapping technique applied to 3D hits in VXD and forward disks.**
  - **Hits smeared by expected resolutions:**
    - **5μ in rφ and z for CCD**
    - **7μ in r and rφ for FWD**
  - **No hit merging!**
  - **No ghosts!**
- **Treat as combined system:**
  - **Find VXD-only tracks in central region.**
  - **Find VXD+FWD tracks in forward region.**

5000 single μ, 50GeV



Missing 40 tracks missed the detector.

Next Steps

- Will study increasingly more complicated events with increasingly more realistic detector layouts.
- Currently developing flexible tools to study effects of disk tiling and strip orientations.
- Volunteers needed!

Summary

- Strategies are being developed to handle pattern recognition in the forward disk regions and barrel axial-only detectors.
- Detector digitization infrastructure is still needed before systematic studies can be finished.
- Recognize that detector design requires reconstruction input.
- Aim for flexible framework to allow iteration.