FastSim Navigation

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Old Fastsim Navigation

- Old model: particle simulation navigation loops over detector elements in a fixed order
  - order set by configuration
- Works when particles have a well defined path
  - outwards through cylindrical shells (SuperB)
- Fails when particles come from ‘unexpected’ directions, or when elements have no fixed order WRT particle direction
  - Dch endplate vs backwards Emc
  - Loss of efficiency near ‘edge’ of Dch
  - Missing dirc info for particles looping to the endplate

New Fastsim Navigation

- Detector space is divided into volumes
- Volumes are divided into voxels
  - cylindrical geometry
  - subdivisions in ρ,Z,ϕ, defined in configuration
- Voxels reference enclosed detector elements
- particles are tracked through voxels
  - deterministic
  - independent of any assumptions
- Particles interact with elements within voxels
  - No geometric assumptions about element order inside a voxel

Voxel Implementation

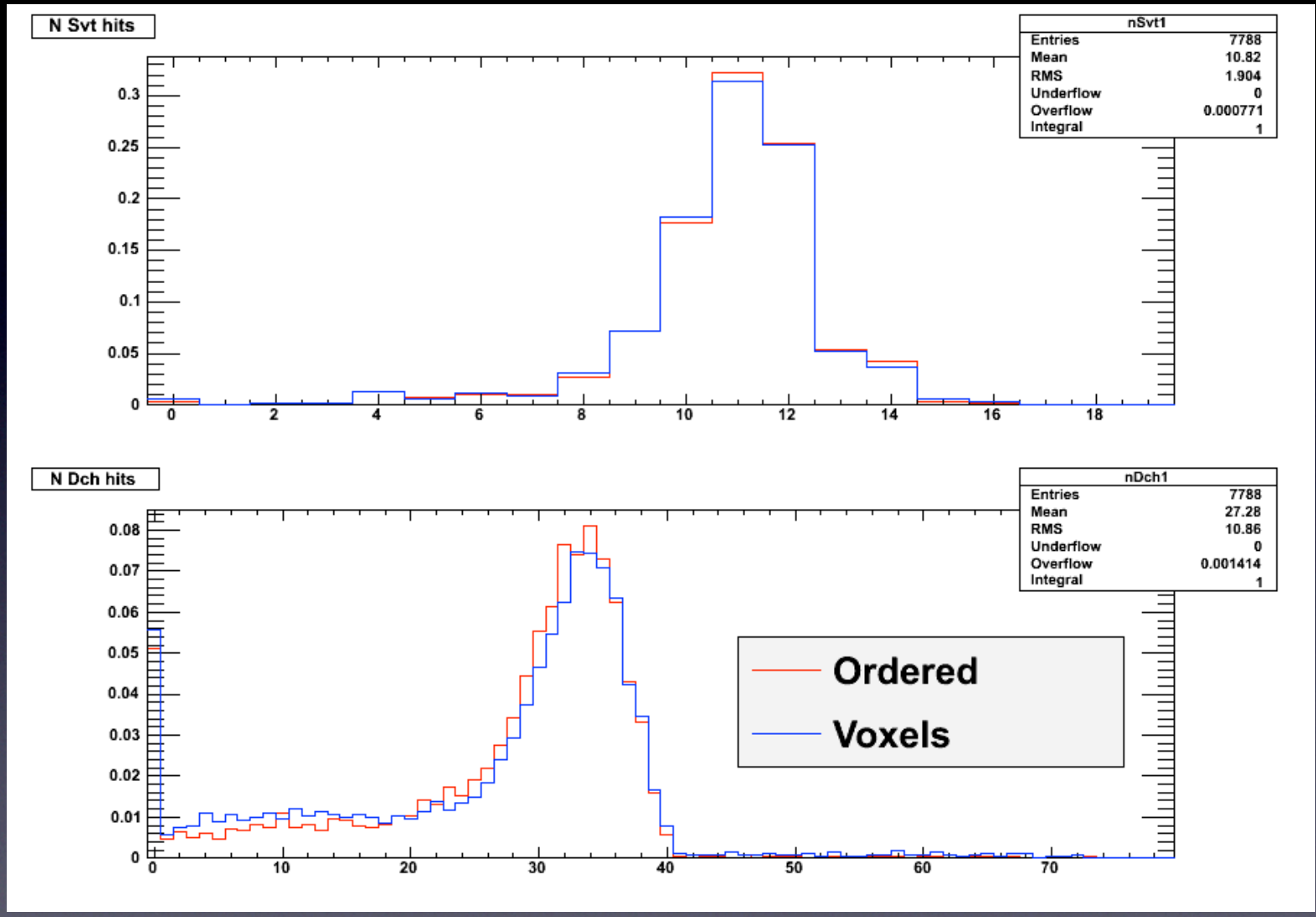
- Voxels are defined by bounding surfaces
  - Low, high bounds in rho, Z, and phi
- Voxel objects borrow their boundaries from a common ‘voxel set’
  - insures consistency
- Voxel functionality includes
  - isInside(point), findEntrance(trajectory), ...
- Voxel set functional includes
  - insertElement(PacDetElem*)
- Navigation uses existing intersection methods

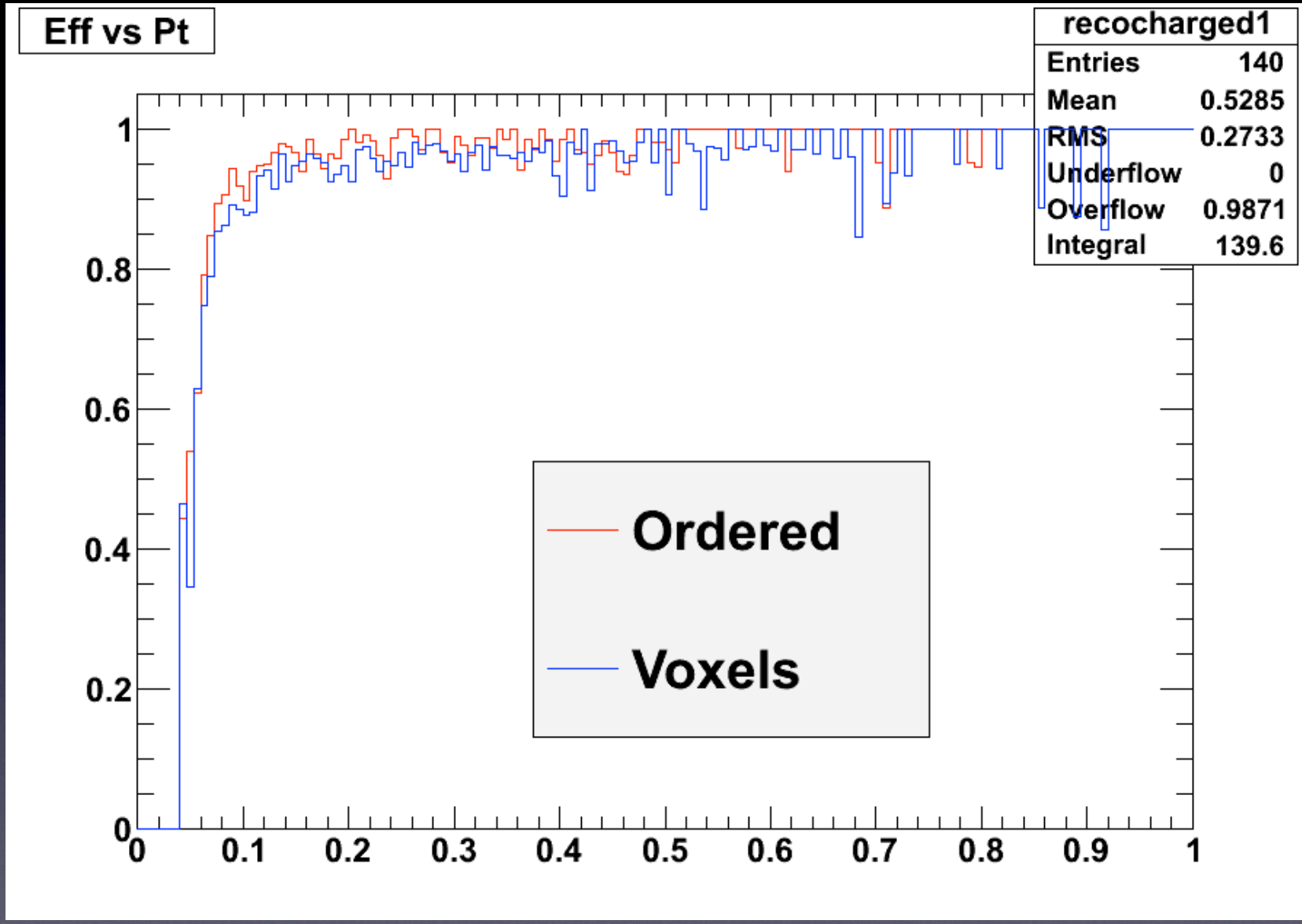
Voxel configuration

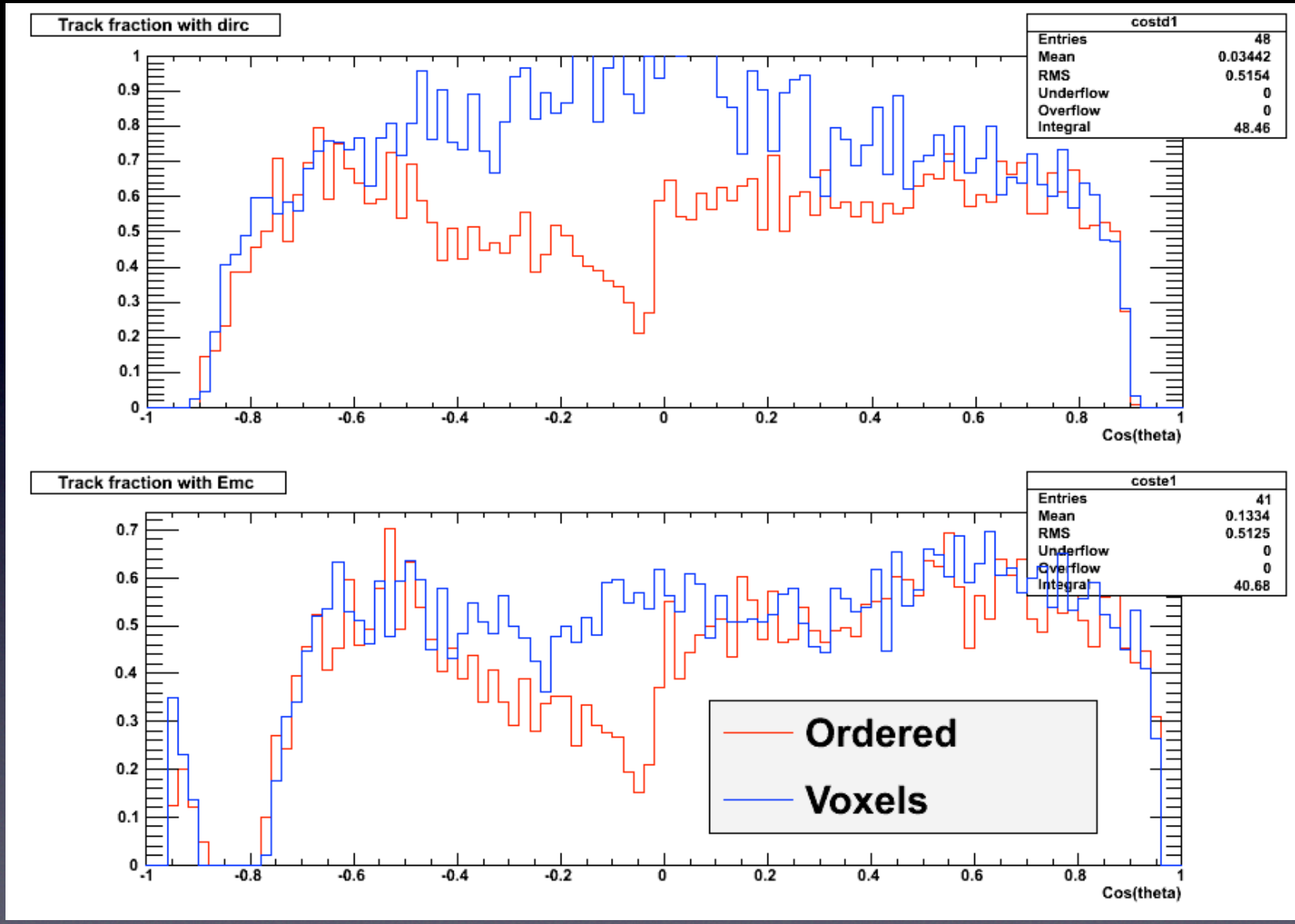
- Voxel boundaries are defined by edml config
- Each volume has a separate voxel config
  - config section name must uniquely match volume
- Rho and Z boundaries explicitly specified
  - Must be ordered, but can have arbitrary spacing
- phi segmentation can vary with rho
  - All phi segmentation must have a common multiple
  - Irrelevant for SuperB (today)

PacTrk/Si_SuperB_Geom.xml

```
<?xml version="1.0" encoding="UTF-8" ?>
<edml>
   <included>
      <detector>
         <volume name="Si_Tracking">
            <include file="PacTrk/Si_Inner_SuperB_Geom.xml"  />
            <include file="PacTrk/Si_Outer_SuperB_Geom.xml"  />
            <include file="PacTrk/Si_SupportCones.xml"  />
         </volume>
      </detector>
      <!-- voxel parameter config section must have the same section name as the volume -->
      <config>
         <sect name="Si_Tracking">
            <param name="rbounds"    type="vector"        >
               1.5 1.7 1.9 3.0 3.5 3.8 4.5 5.0 6.0 8.0 9.0 10.0 11.0 12.0 12.5 13.5 14.5 15 </param>
            <!-- no phi segmentation needed, as all elements are perfectly cylindrical -->
            <param name="nphivoxels"    type="vector"         >
               1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 </param>
            <param name="zbounds"   type="vector"        >  -40 -20 -13 -6 6 13 25 40   </param>
         </sect>
      </config>
   </included>
</edml>
```


N Svt hits
nSvt1
Entries 7788
Mean 10.82
RMS 1.904
Underflow 0
Overflow 0.000771
Integral 1
N Dch hits
nDch1
Entries 7788
Mean 27.28
RMS 10.86
Underflow 0
Overflow 0.001414
Integral 1
Ordered
Voxels


Eff vs Pt
recocharged1
Entries 140
Mean 0.5285
RMS 0.2733
Underflow 0
Overflow 0.9871
Integral 139.6
Ordered
Voxels
0
0.2
0.4
0.6
0.8
1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Track fraction with dirc
costd1
Entries 48
Mean 0.03442
RMS 0.5154
Underflow 0
Overflow 0
Integral 48.46
Cos(theta)
Track fraction with Emc
coste1
Entries 41
Mean 0.1334
RMS 0.5125
Underflow 0
Overflow 0
Integral 40.68
Ordered
Voxels
Cos(theta)

Status and Conclusions

- New Fastsim navigation solves element ordering problem
- Comparisons with old navigation look promising
  - some discrepancies still need explaining
- Testing and improvements still in progress
  - Need to voxelize DG, alternative geometries
- Deploy for (Physics) production next week?