

Track trigger

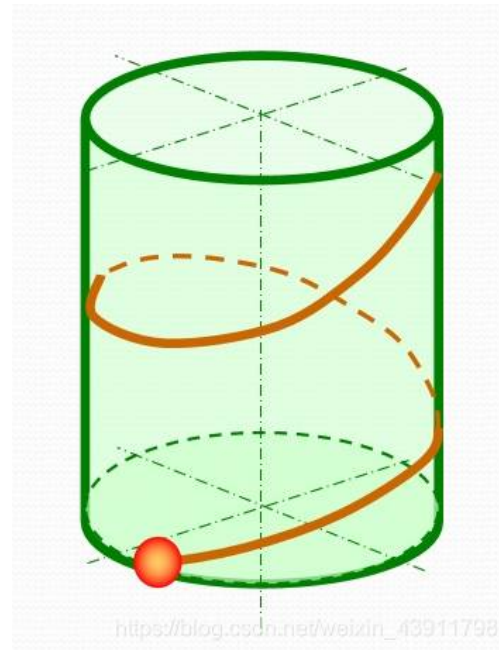


中国科学院高能物理研究所
Institute of High Energy Physics
Chinese Academy of Sciences



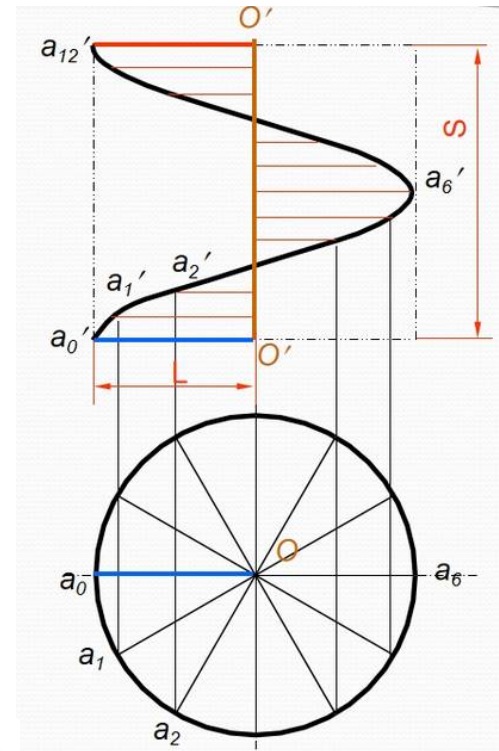
Track

- Trajectory of charge particle: helix
- Circle in xy plane
- sin/cos in xz(yz) plane
- **Equation** in the cylindrical coordinate ($r\phi z$):
 - Assuming IP at origin
 - κ : curvature of the helix,
 - Φ_0 : azimuth angle of the track at the IP
 - λ : helix angle
 - s : helix arc length from the IP to the hit
 - $s=R\theta=2R(\Phi-\Phi_0)$



$$\frac{r\kappa}{2} = \sin(\phi - \phi_0)$$

$$z = \tan\lambda \cdot s$$



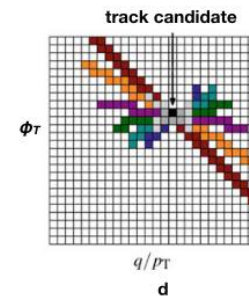
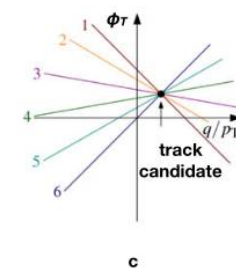
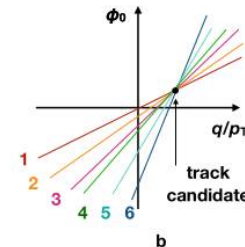
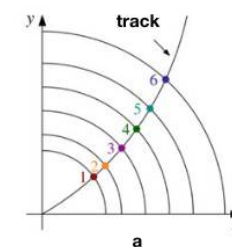
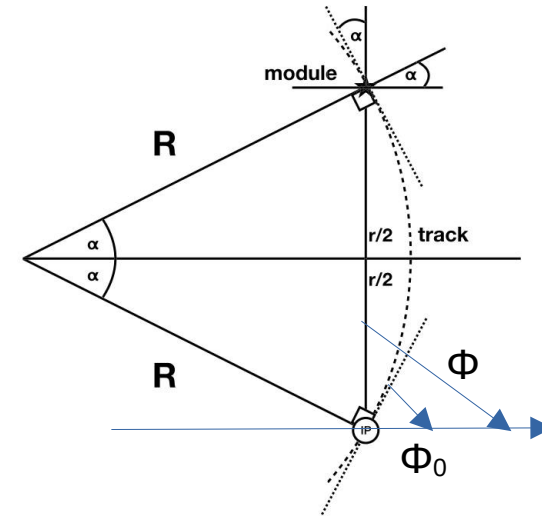
Plot

Hough transform

- Transform 3D spatial coordinates(cylindrical coordinate $r\phi z$) into parameter space
- Each hit in 3D space corresponds to a curve in the parameter space
- Get track candidate parameters with most number of hits
- Assuming large track p_T ($p_T > 2\text{GeV}$)
 - Small angle approximation
- $0 < \kappa < 0.0025$, $-\pi < \Phi_0 < \pi$, $-\pi < \lambda < \pi$
- 50 bins for each parameters

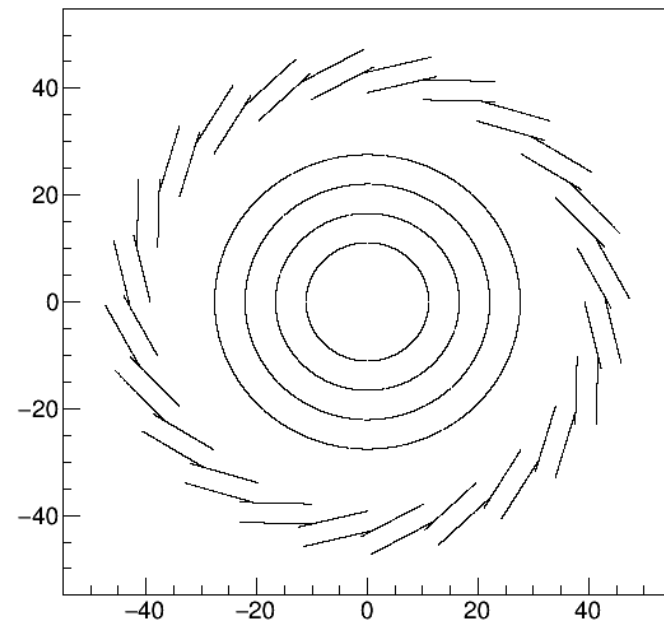
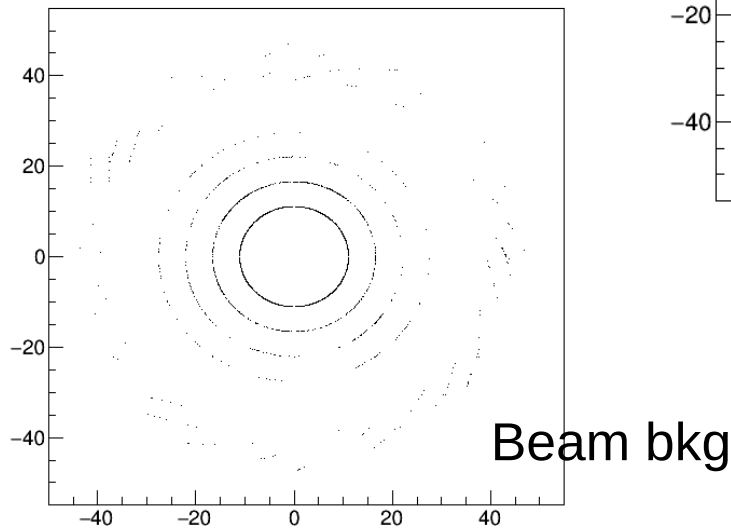
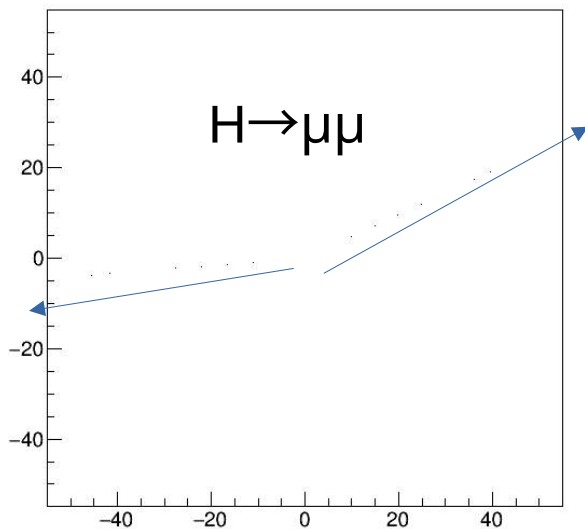
$$\frac{r\kappa}{2} \approx \phi - \phi_0$$

$$z \approx \tan\lambda \cdot r$$



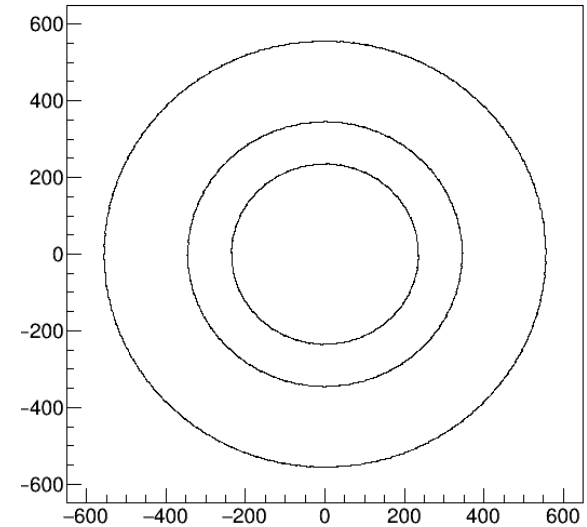
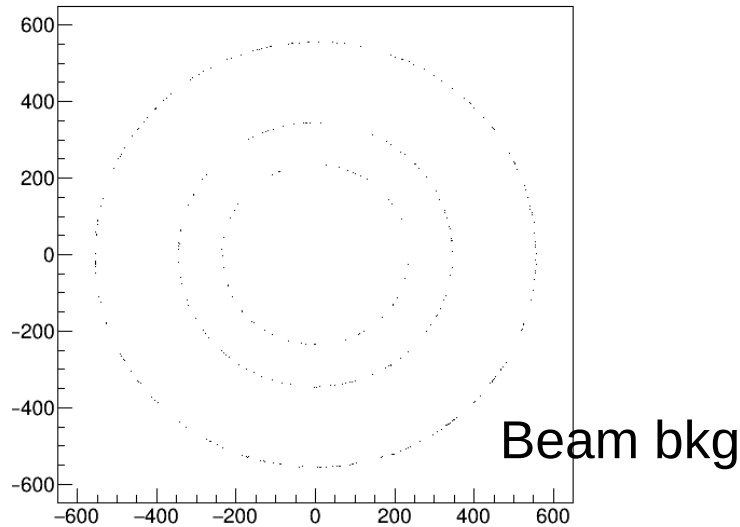
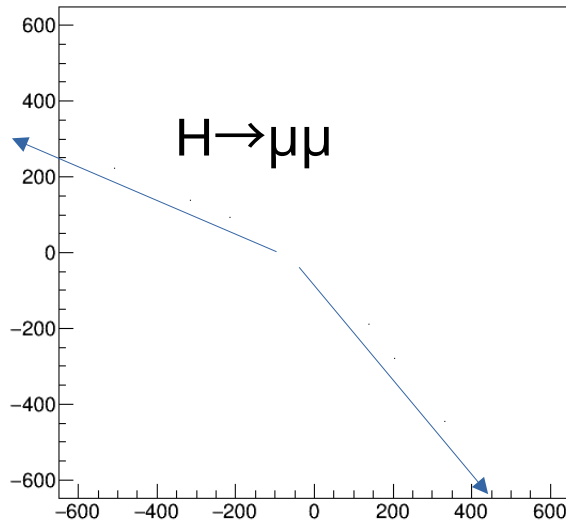
Tracker: Vertex

- Left: $Z(\nu\nu)H(\mu\mu)$; Right: Beam background
- Too many hits from beam bkg for the innermost two layers
- Use outermost four layers for track



Tracker: ITK

- Left: $Z(\nu\nu)H(\mu\mu)$; Right: Beam background
- Less hits than vertex
- Combine Vertex(outermost 4 layers)/ITK/OTK for track



Hough transform

- 1: Use only ITK+OTK (>2 ITK hits && >0 OTK hits)
 - Use 10x
 - Barrel(or)Endcap: Bkg: 100%;
 - Only Barrel: Bkg: 100%;
 - Use 1x
 - Barrel(or)Endcap: Bkg: 84%; Z(vv)H($\mu\mu$): 96%; Z(vv)H(bb): >99%
 - Only Barrel: Bkg: 40.5%; Z(vv)H($\mu\mu$): 89.5%; Z(vv)H(bb): 98%
- 2: Use Vextex 4 layers+ITK+OTK (>2 VXD hits && >2 ITK hits && >0 OTK hits)
 - Use 10x
 - Barrel(or)Endcap: Bkg: 100%;
 - Only Barrel: Bkg: 29.5%;
 - Use 1x
 - **Barrel(or)Endcap(tdr):** Bkg: 1.2%; Z(vv)H($\mu\mu$): 93.5%; Z(vv)H(bb): >99%
 - Only Barrel: Bkg: 0.3%; Z(vv)H($\mu\mu$): 88.0%; Z(vv)H(bb): 97.5%

Next

- Input: hits $\rightarrow$ clusters
 - One track may generate many hits around
 - Merge hits
- Duplicate removal
 - More than one bin pass selection

