

Pattern Recognition and Event Deconvolution in the \bar{P} ANDA TPC

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- Pattern recognition on the Riemann-Sphere
- TPC reconstruction movie
- Event deconvolution in the TPC
- DAQ architecture for TPC readout

Trackfinding on the Riemann-Sphere

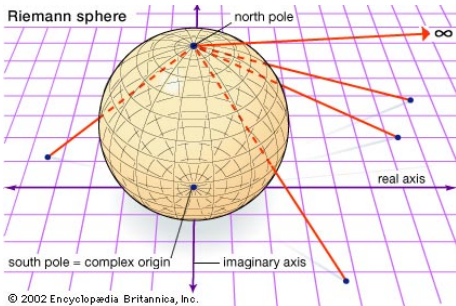
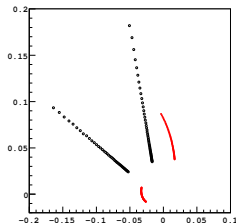
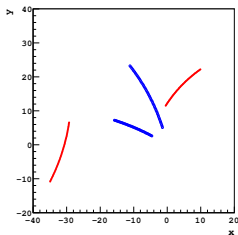
A Generalized Conformal Mapping for Circle Fits

Conformal Mapping

NIM A380(1996)582

$$x' = \frac{x-x_0}{r^2}, \quad y' = \frac{y-y_0}{r^2}$$

- Reference point (x_0, y_0)
- Different transformations
- Track merging complicated



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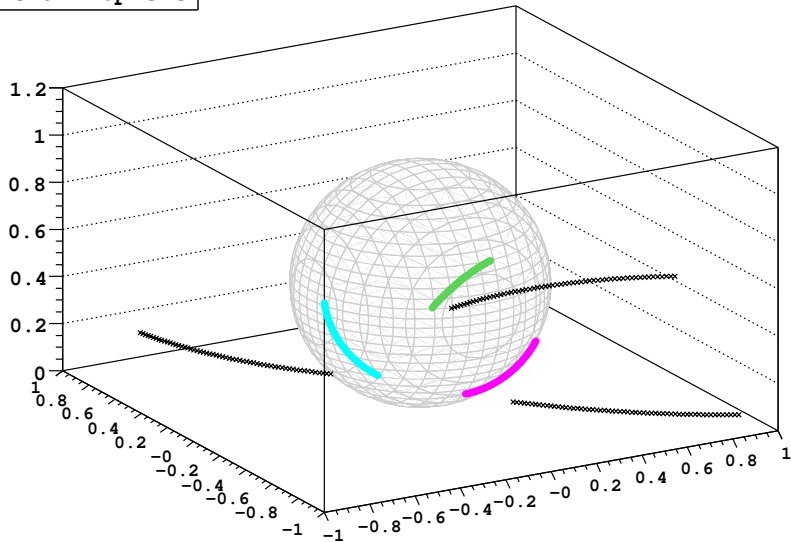
Stereographic Projection

$$x' = R \cdot \frac{\cos \Phi}{1 + R^2}, \quad y' = R \cdot \frac{\sin \Phi}{1 + R^2}, \quad z' = \frac{R^2}{1 + R^2}$$

- No reference point needed
- Primaries and secondaries treated equally

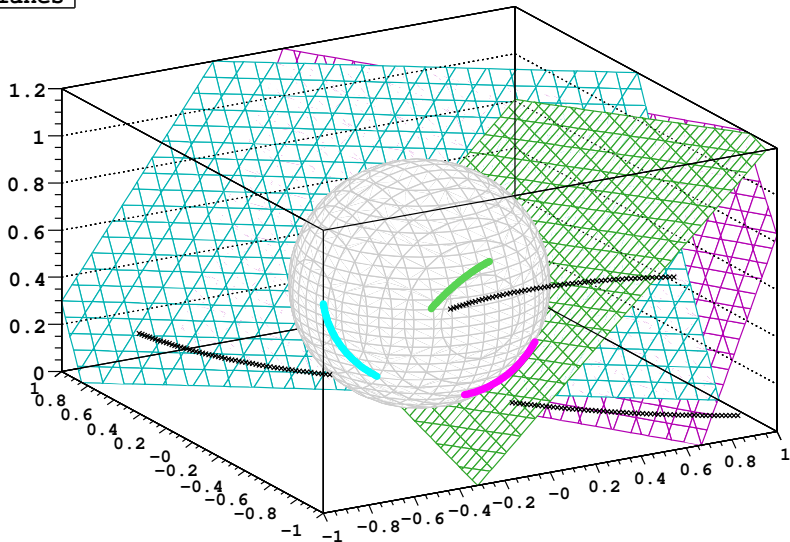
Trackfinding on the Riemann-Sphere

Riemann Sphere



Trackfinding on the Riemann-Sphere

Planes



Trackfinding on the Riemann-Sphere

Linear Fitting of Helices

Extended Riemann Fit

ATLAS TRT: Strandlie et Al., Comput. Phys. Commun. 131 (2000); NI M A 490(2002) 366

Stereographic Projection describes an **Isomorphism** between **circles** in (x, y) and **planes** in (x', y', z')

- Fitting plane is **linear** and **noniterative**
- 3×3 matrix Eigenvalue - problem
- Plane parameters $(n_1, n_2, n_3, c) \Rightarrow \text{circle}(R, x_0, y_0)$
- Helix-Dip: Straight-line fit in (s, z)

TpcRiemannTrackFinder

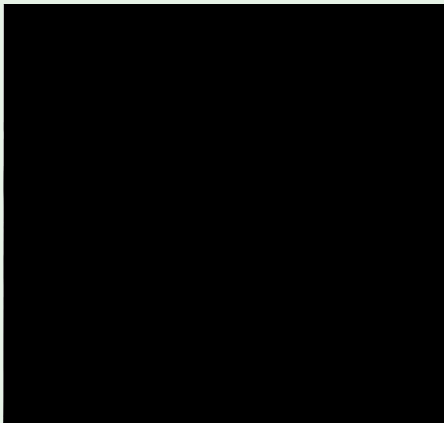
- **Track following** on Riemann-Sphere and sz-plane
 - ▶ Proximity cuts
 - ▶ "Best match" classification
- For now: No error treatment

Potential improvements

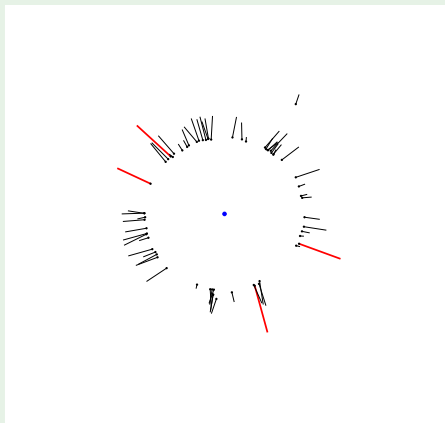
- Sphere \rightarrow Paraboloid
- Error treatment (NIM A 480(2002) 734)
- Include MS (NIM A 488(2002) 332)
- Track merging straight forward

TPC Reconstruction Movie

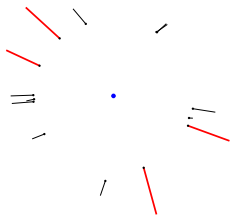
Event + bkg



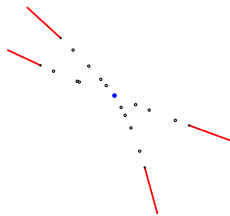
Target pointing $2\mu\text{s}$ cut



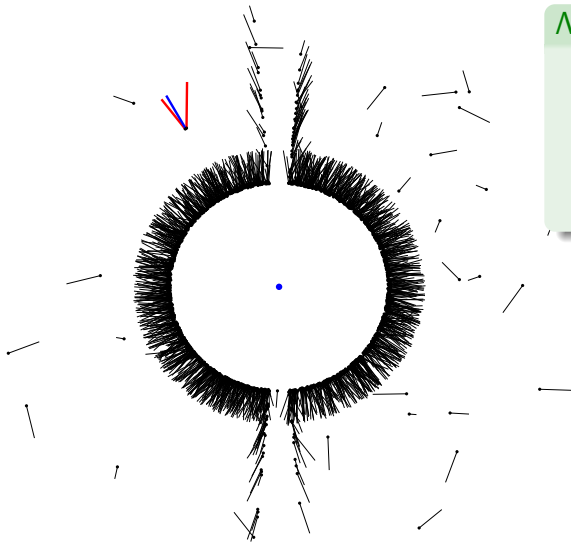
Target pointing 200ns cut



Correlation with MVD

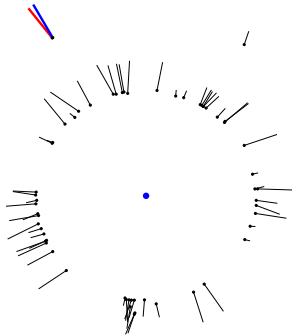


V0s decaying in the TPC



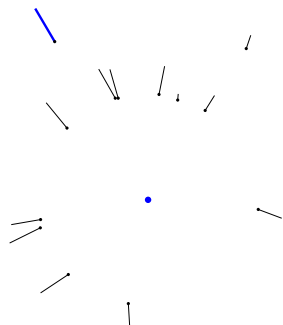
$\Lambda \rightarrow p\pi$

- 2 charged tracks
- Build V0 candidate
 - ▶ “Vertex” position
 - ▶ Flight direction
- No real vertexing yet



V0-Target-Pointing

- extrapolate to z-axis straight line
- $z_0^{track} \Rightarrow t_0^{track}$
- Cut around t_0^{event}
- $\Delta t_0 = 1\mu s$



V0-Target-Pointing

- extrapolate to z-axis straight line
- $z_0^{track} \Rightarrow t_0^{track}$
- Cut around t_0^{event}
- $\Delta t_0 = 200ns$

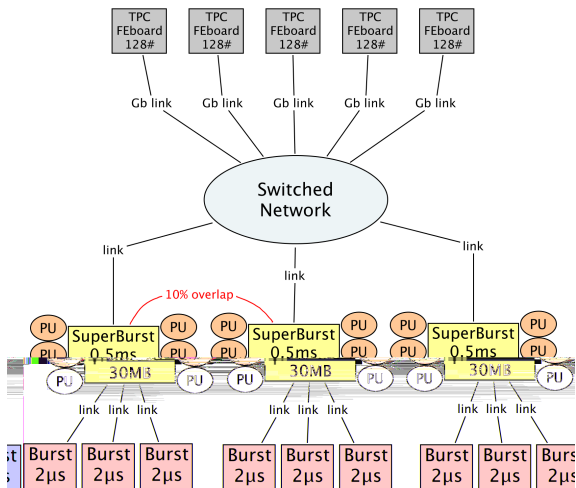


Vertex quality

- Distance of track endpoints
 $DOCA < 5mm$
- No real vertexing yet

Bursts and Superbursts

- HESR burst structure: $2\mu\text{s}$ bursts + 400ns Silence \leftrightarrow TPC drift time: $55\mu\text{s}$



Summary:

- Prototype Pattern Reco based on Riemann Fitter implemented
- Works well for high track densities (10^7 evt/s) (DPM2GeV/c)
- Event deconvolution with target pointing
 - ▶ Charged tracks from IP:
 - ★ Efficiency > 95%
 - ★ Purity > 98%
 - ▶ V0s decaying in TPC or MVD (without vertexing):
 - ★ Efficiency > 80% (100% for V0s inside TPC)
 - ★ Purity > 90% (100% for V0s inside TPC)

Outlook:

- Combine track finding with event deconvolution algorithm