Online Tracking Overview & Triplet Finder Status

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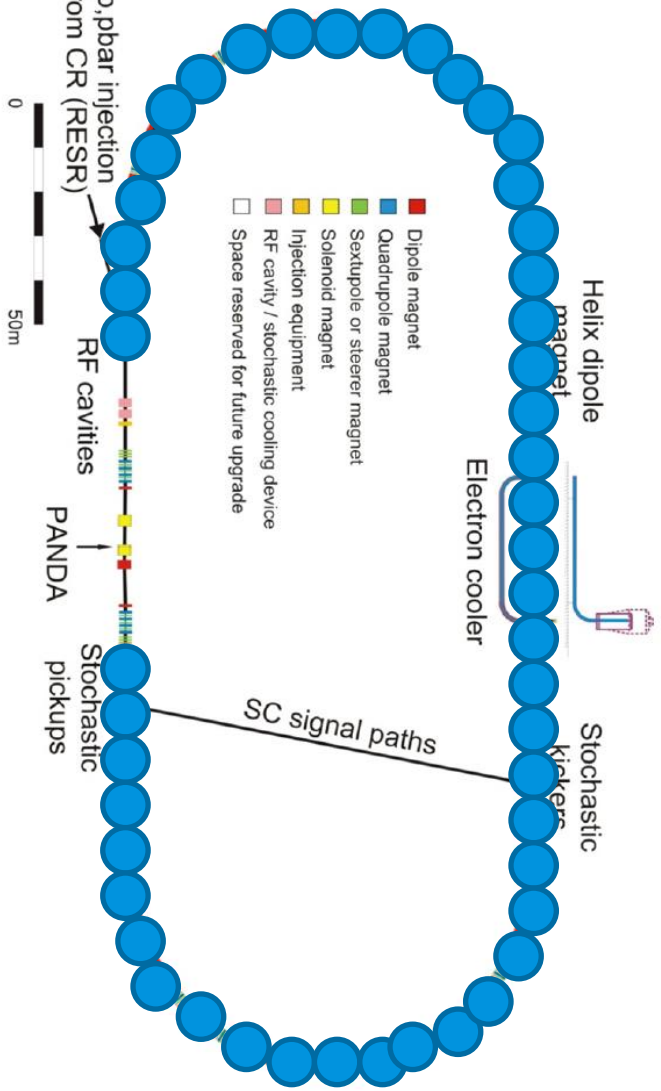
Outline

- Continuous Online Tracking Overview
- Online Manager Status (Sean Dobbs)
- Triplet Finder Status
- Key Topics for Future Investigations

PANDA Operating Conditions

- Gap estimate:
  - *Barrier Bucket: 80% Filling*
  - *HESR length: 575 m*
  - *Antiproton velocity: c*
  - *Revolution time: 2000 ns*
  - *Gap: 400 ns*
  - *Fill/Gap ratio may vary*
- Events per revolution → Burst:
  - $2 \cdot 10^7/s \cdot 2\ \mu s = 40$



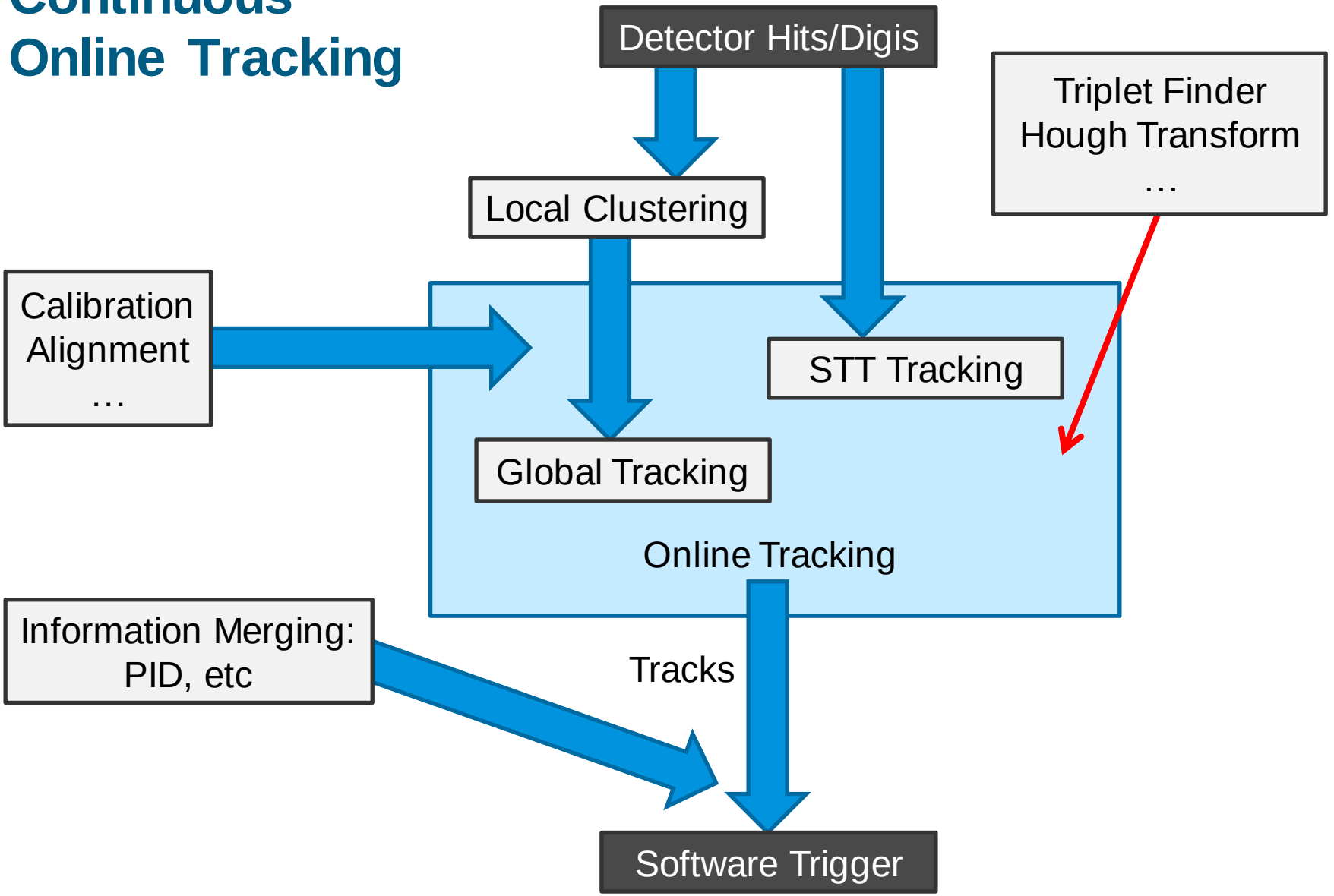
Continuous Online Tracking: Motivation/Concept

- Similar topology of signal and background
  → No simple criteria with high suppression potential

- Quasi-continuous high-rate operation of PANDA
  → Overlapping events, stateless pattern recognition started upon simple criteria may process redundant time windows

- Most channel selections require tracking information

Continuous Online Tracking



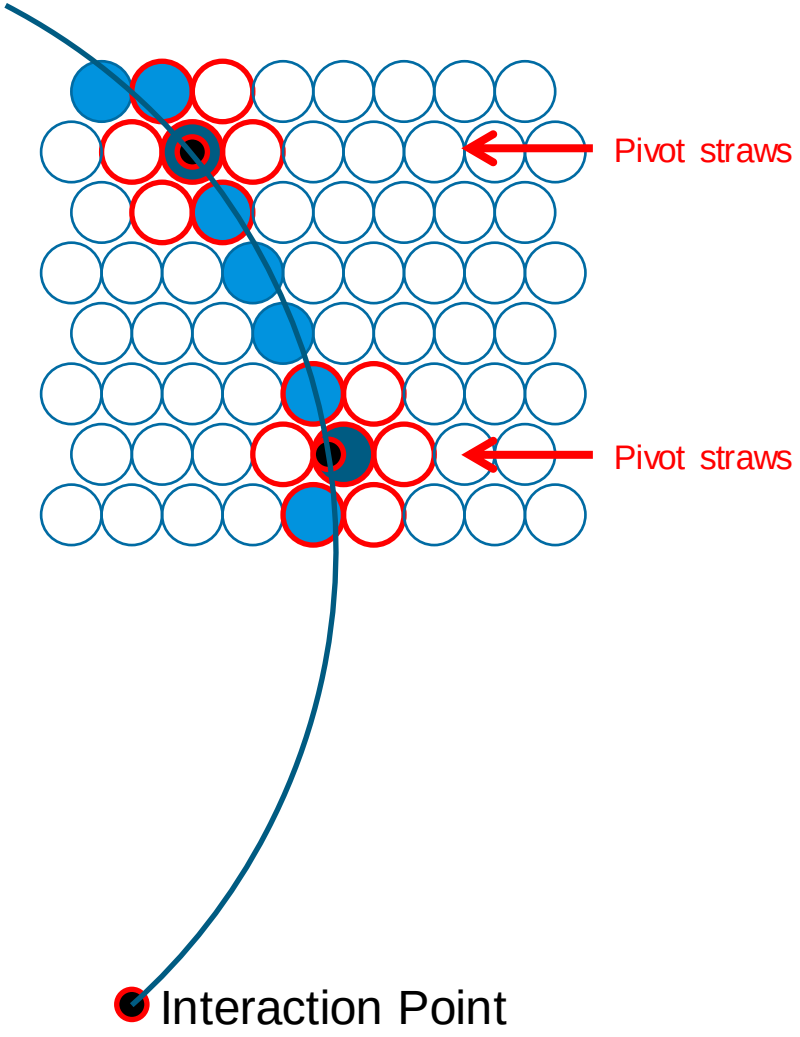
Online Manager Status

- New/faster interface to simulation data implemented
- Fully operational for algorithm testing
  → Triplet Finder benchmarks
- Under construction:
  - *Output to ROOT tree*
  - *Event reconstruction*
- Release to public as soon as ROOT file output is implemented

Big thanks to Sean for his developments!

Triplet Finding in Axial Straws

- Find Triplets within pivot straws
  → Calculate center of mass around pivot straw and adjacent straws with hits
- Once two Triplets are found, calculate circle through origin
- Associate nearby hits with track candidate



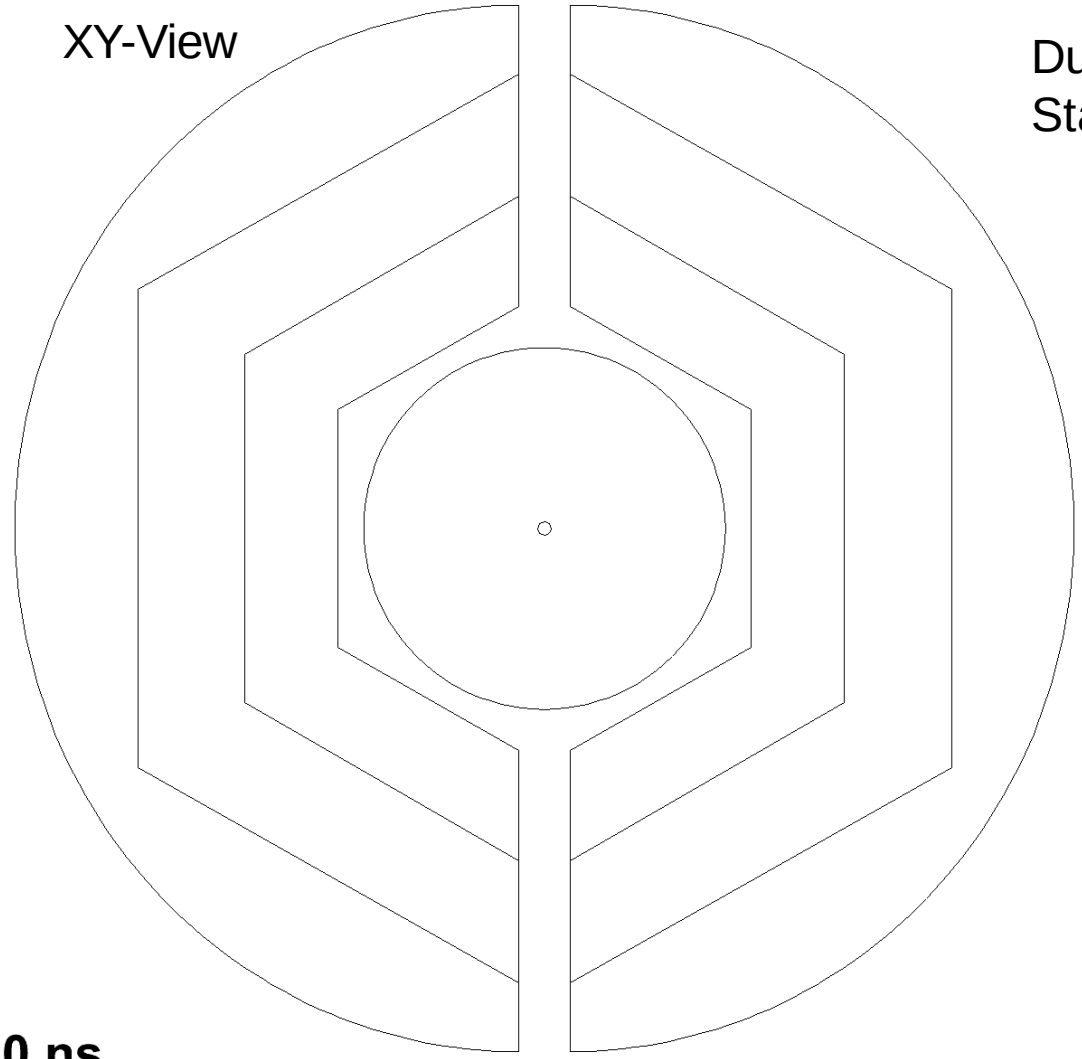
Triplet Finder Status

- First quantitative test with 15 GeV/c DPM
  - *Full burst processing: 2000 ns*
  - *Animated display in finer granularity: 5 ns*
- Raw data results:

```
Total reconstructed track count: 100179
Reached MC ID: 5130
Reconstructable MC track count: 10679
MC Tracks reconstructed: 5993
Reco Status Good: 13790
Reco Status Bad: 86389
Secondary Tracks: 475
```

- Results:
  - *> 50% reconstruction efficiency*
  - *$\Delta\varphi$: < 100 mrad*
  - *Δp_t: < 10% (below 450 MeV/c)*

Hitstream Display: 15 GeV/c DPM, 50 ns Mean Time



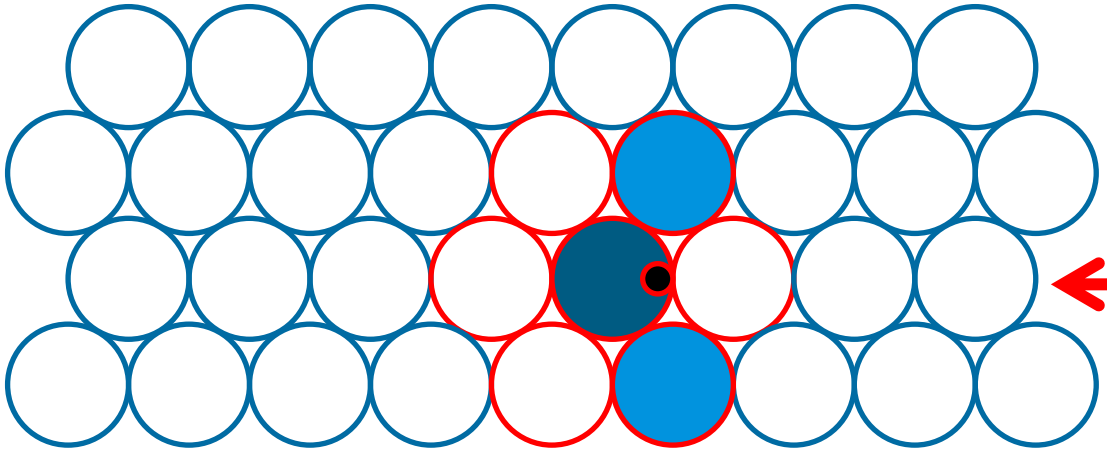
0 ns

Dual Parton Model (DPM):
Standard $\bar{p}p$ background generator

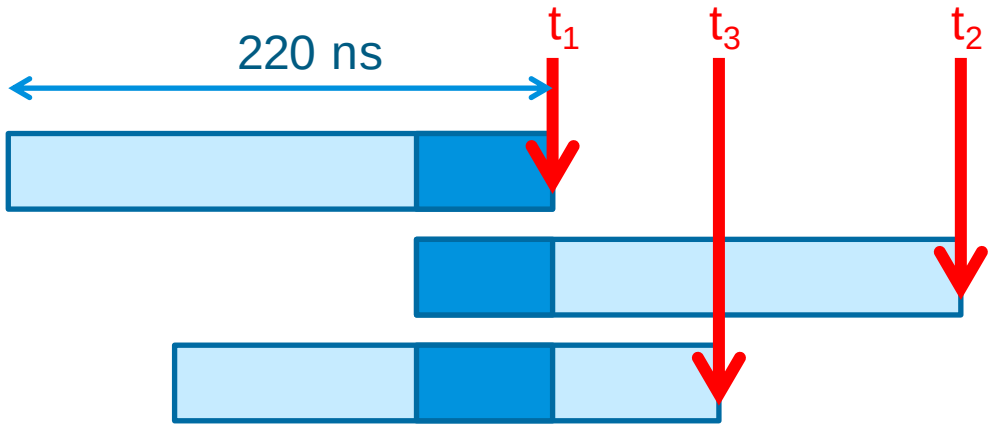
Black circles: Early isochrone
Blue circles: Early skewed isochrone
Green circles: Close isochrone
Red circles: Late isochrone
Black dots: MVD hits
Green dots: MVD hits r/z > 0.3
Black+Red dots: Triplets/Skewlets
Yellow tracks: Vetoed
Blue tracks: Accepted

DPM Benchmark:
> 50% of primary tracks in the STT reconstructed by basic triplet finder

Triplet Finder Status



- t_0 constraining concept for Triplets and tracks:



Future Investigations: Fit/Finder Quality

- Association of hits to tracks → Design questions
  - *Ideal storage for these associations?*
  - *Desired parameters to store?*
  - *Override old values? Store list?*

- Parameters for assigned hits/tracks:
  - *Unassigned*
  - *Bad Hit – Clutter, Noise, etc.*
  - *Low Quality – veto value close to threshold*
  - *Mid Quality*
  - *High Quality – additional quality criterion passed*
  - *Multi Algorithm Confirmed Quality*

More (Online) Tracking Algorithms

Algorithm	Comments
Hough Transform, Yutie Liang	FPGA implementation
Hough Transform, Mohammad Al-Turany/Andreas Herten	GPU implementation
Non-Origin Trackfinder, Lia Lavezzi	Focused on offline, online application(?)
Triplet Finder, MCM	No isochrone info required
Track Segment Finder + Linker, Sean Dobbs	Template based
Fast Combinatorial Finder / Fitter, Sean Dobbs	Based on CLEO's SOLO
Forward Hough, Martin Galuska	Focused on offline, applicable for online
Riemann Tracker, Tobias Stockmanns	Focused on offline, online application(?)
Global Tracking in PandaRoot, Gianluigi Boca	Focused on offline
Neural networks pattern reco, Pablo Genova	Focused on offline, applicable for online
Rieman Tracker, Andreas Herten	GPU implementation

Other developments?

Summary/Outlook

- Online Manager: Implementation of canonical ROOT interface
- Quantitative Triplet Finder benchmark (DPM):
  > 50% reconstructed tracks

Thank you for your attention

  - *Characteristics need to be investigated*
  - *Triplet Finder adaptions*
  - *Additional algorithms for reconstruction*
- Triplet finder resolution:
  - *Enough for certain selections?*
  - *Other algorithms with higher resolution at momenta > 450 Mev/c?*