

# COMPARISON OF TRACKING ALGORITHMS IN PANDAROOT

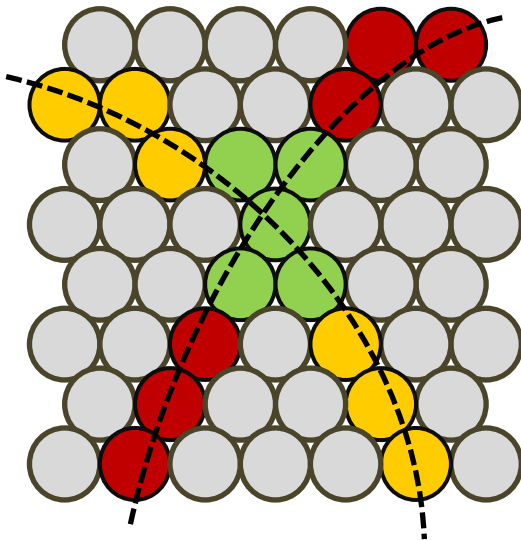
09.03.2021 | PANDA COLLABORATION MEETING | ANNA ALICKE

# AVAILABLE VERSION OF HOUGH TRACK FINDER IN PANDAROOT

- Optimized version of HoughTrackFinder now available in PandaRoot
- Working principle of the Version:

## 1. Preselection:

Stt Hits: Cellular Automaton

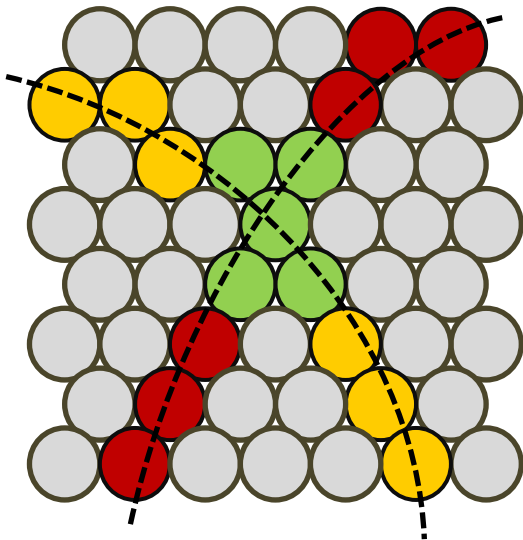


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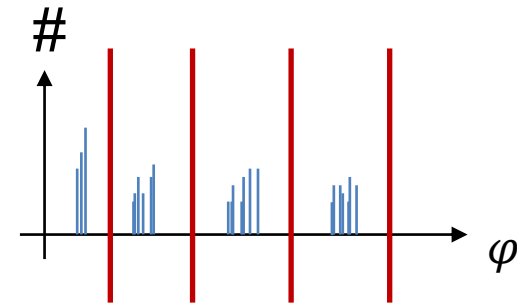
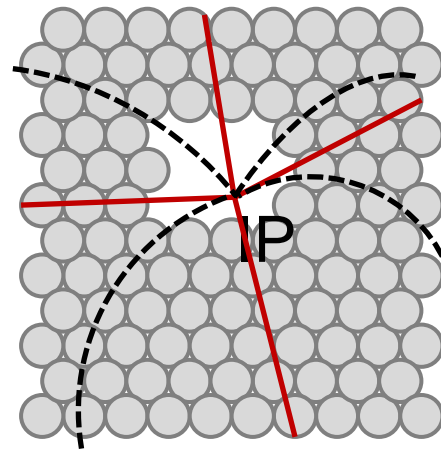
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- Working principle of the Version:

## 1. Preselection:

Stt Hits: Cellular Automaton



MVD/GEM Hits: Segmentation

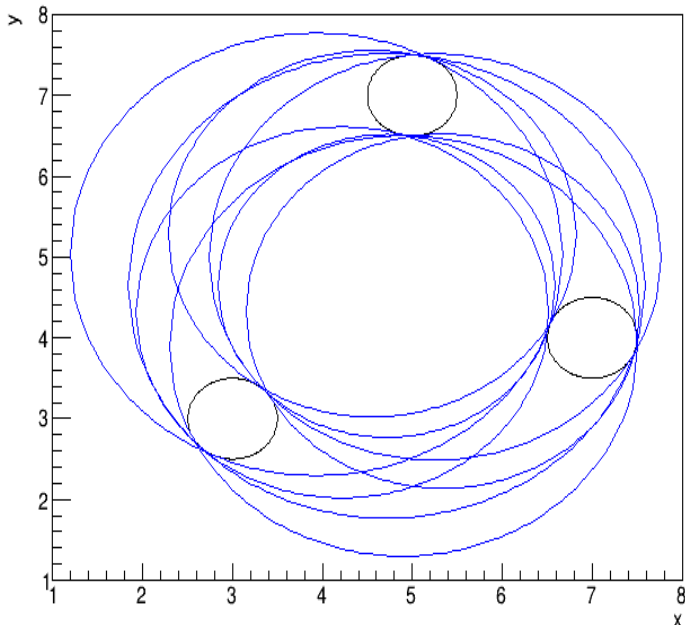


# AVAILABLE VERSION OF HOUGH TRACK FINDER IN PANDAROOT

- Optimized version of HoughTrackFinder now available in PandaRoot
- Working principle of this Version:

## 2. Hough Transformation

Apollonius calculation

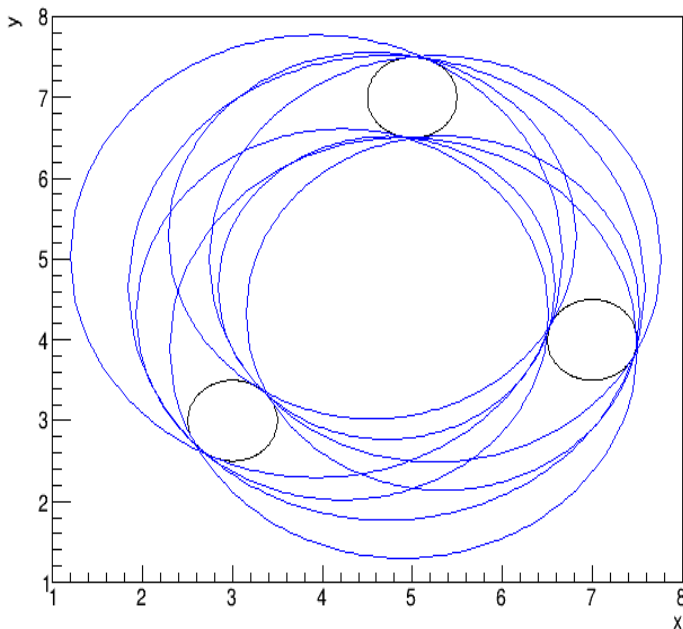


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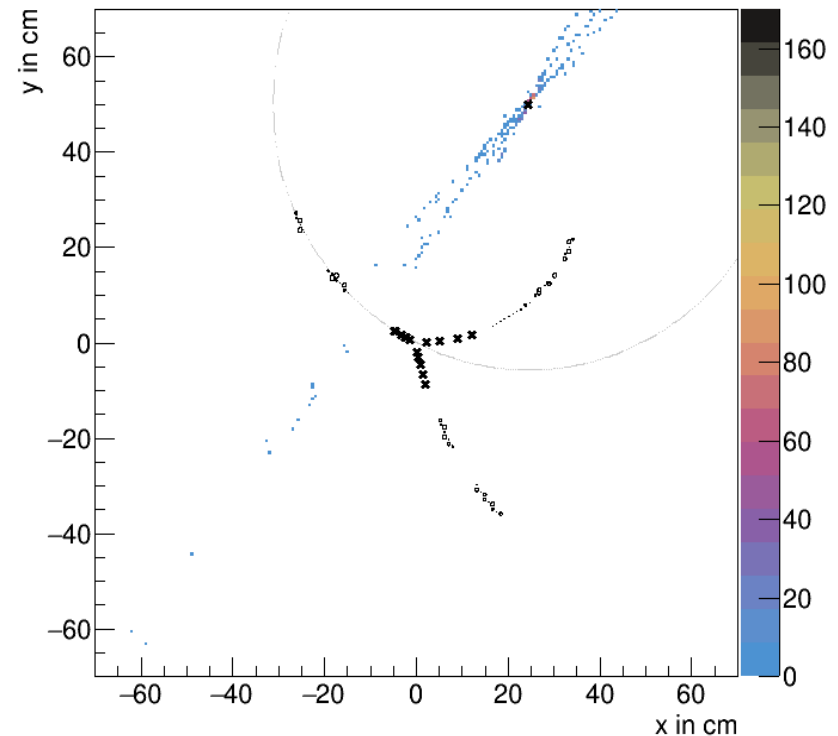
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Apollonius calculation



Hough Transformation

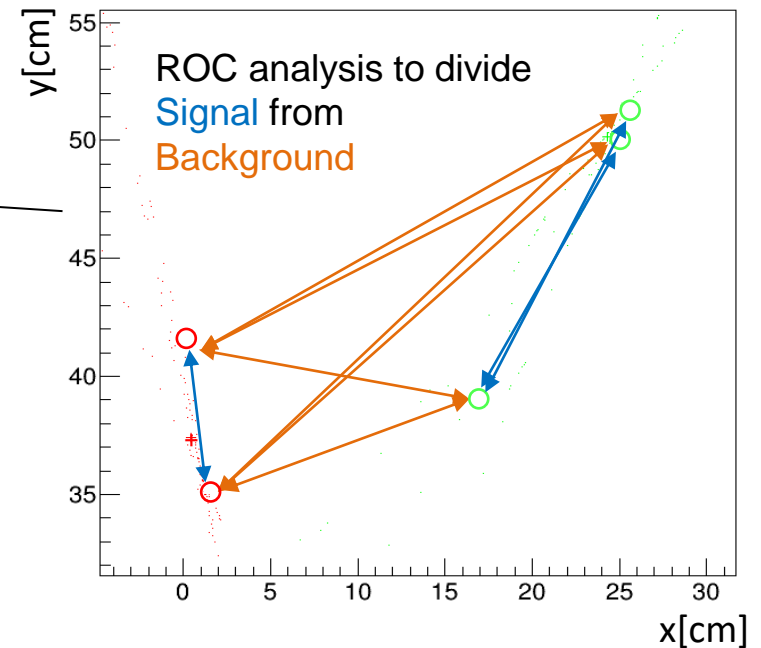
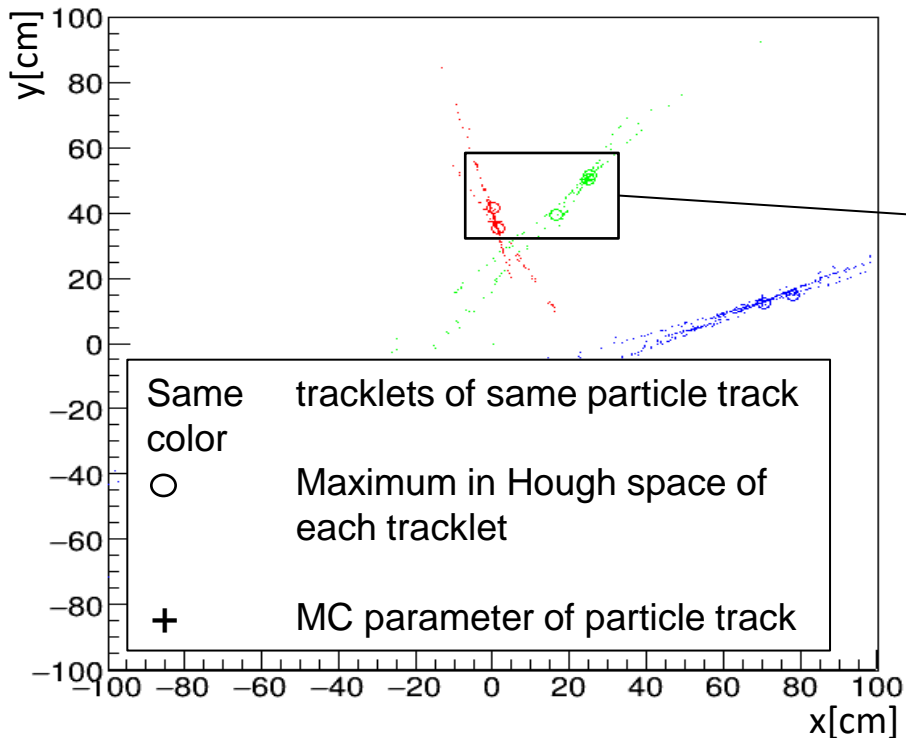


# AVAILABLE VERSION OF HOUGH TRACK FINDER IN PANDAROOT

- Optimized version of HoughTrackFinder now available in PandaRoot
- Working principle of this Version:

### 3. Merging of tracklets:

Tracklets of one particle track are closer as the one of different tracks  
→ distance of maxima in Hough space as merging criterion



# TRACKING IN PANDAROOT



- Compared different track finders in PandaRoot
- Used data sample: 1000 events, 7 GeV/c beam momentum, DPM

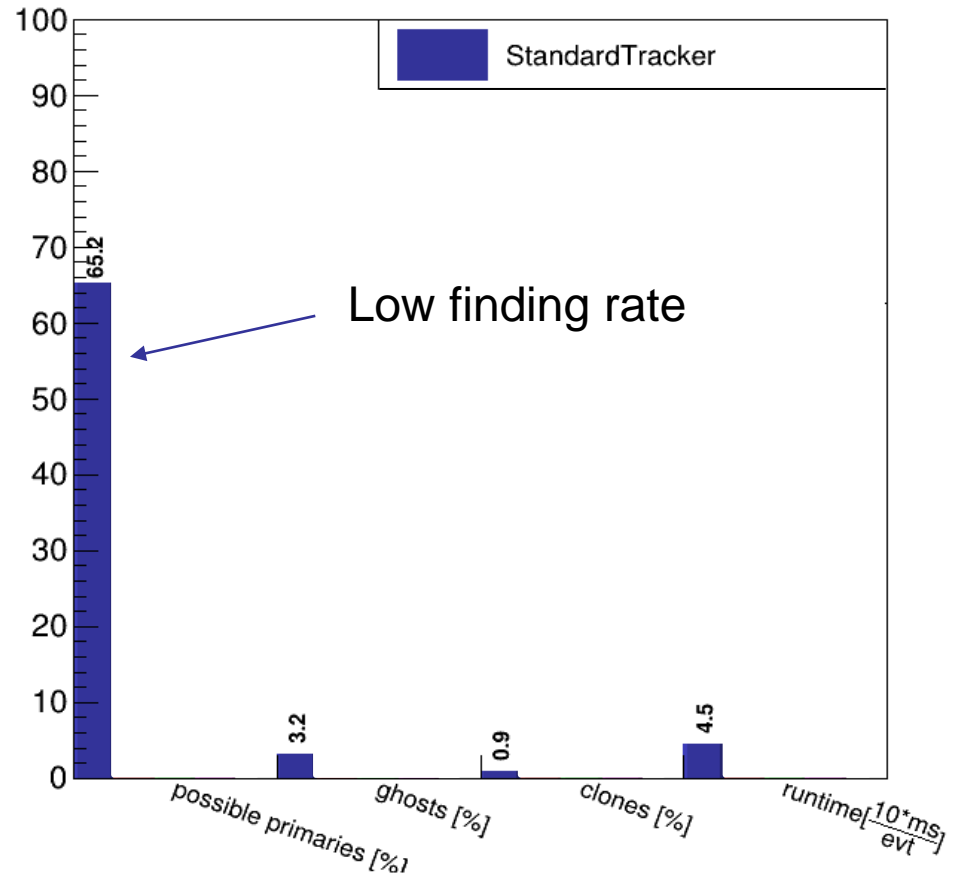
# TRACKING IN PANDAROOT



- Compared different track finders in PandaRoot
- Used data sample: 1000 events, 7 GeV/c beam momentum, DPM

- Default: **StandardTracker**

- Starting with seed hits at boundary of STT
- Conformal mapping + Hough transform for initial parameters
- Add MVD, GEM hits close to the trajectory
- $\chi^2$ - fit for more precise track parameters
- Clean up procedure to discard fake tracks
- Only primaries





# TRACKING IN PANDAROOT

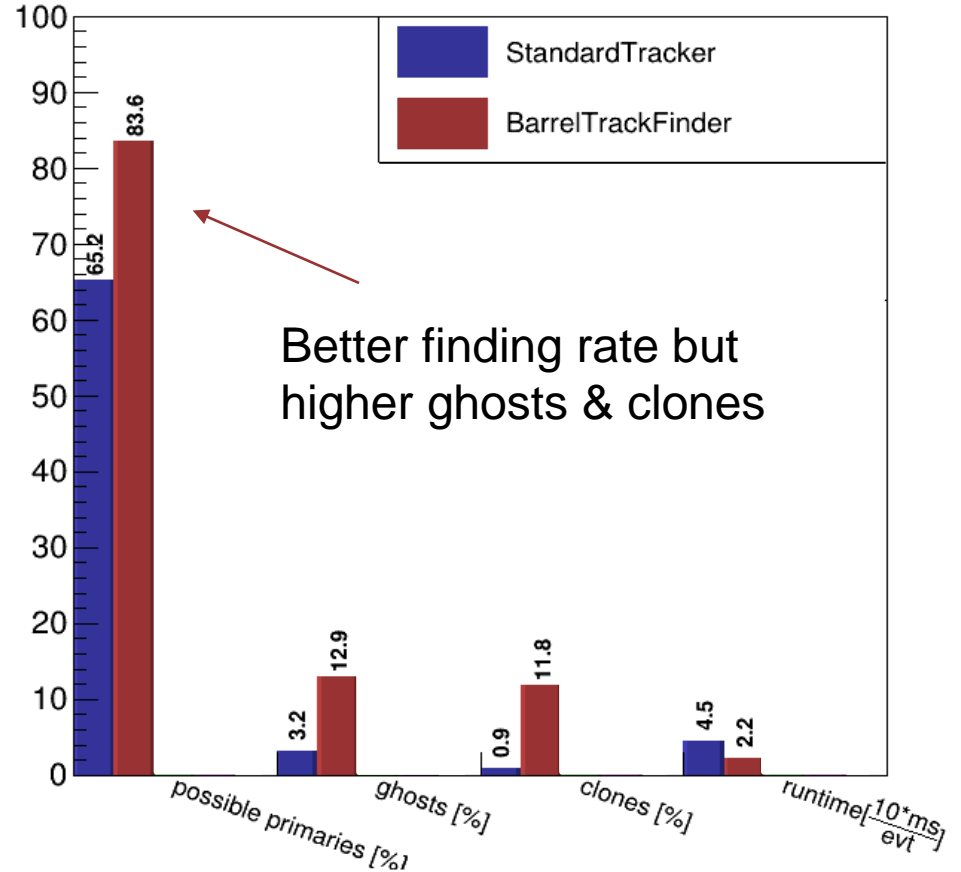


- Compared different track finders in PandaRoot
- Used data sample: 1000 events, 7 GeV/c beam momentum, DPM

- Default: StandardTracker

- Exchanged in new Release by **BarrelTrackFinder**

- No detector prioritization
- randomly take one hit after another
- Hit is matched to track if certain criteria are satisfied
- Only primaries



# TRACKING IN PANDAROOT

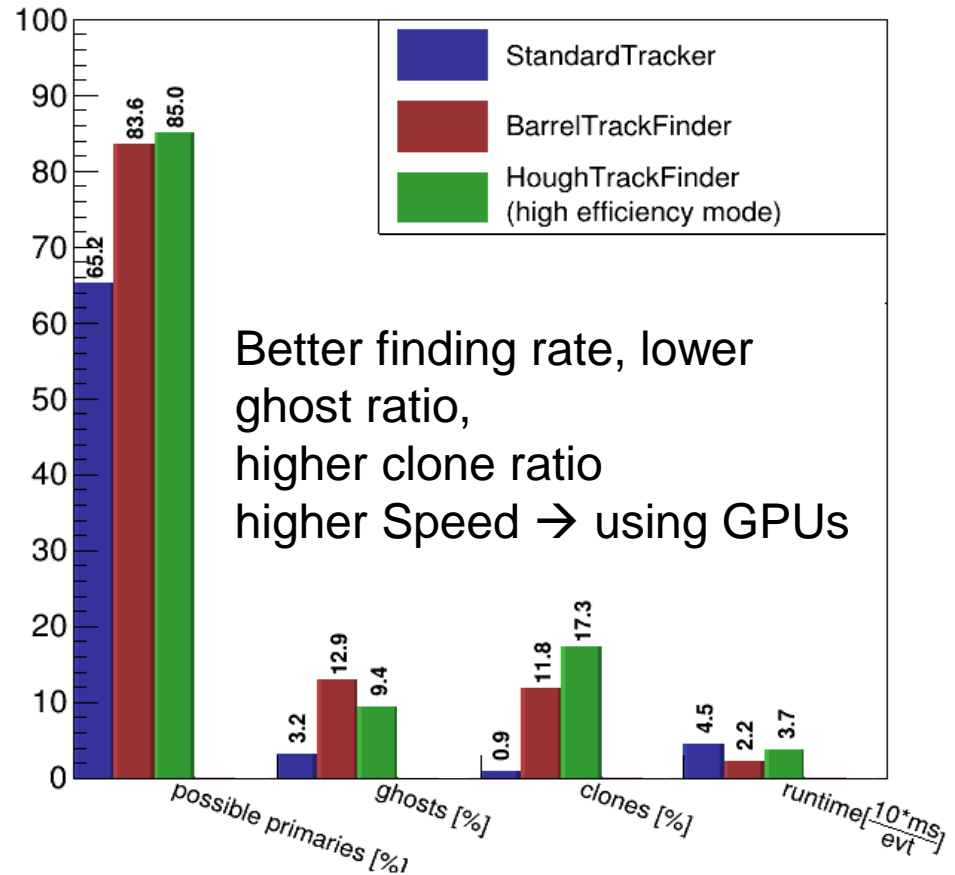


- Compared different track finders in PandaRoot
- Used data sample: 1000 events, 7 GeV/c beam momentum, DPM

- Default: StandardTracker
- Exchanged in new Release by BarrelTrackFinder

- Want to exchange BarrelTrackFinder by **HoughTrackFinder**

- Already as good as (or better than) BarrelTrackFinder
- Speed better than StandardTracker but worse than BarrelTrackFinder
- Further development: Speed + Secondaries



# TRACKING IN PANDAROOT

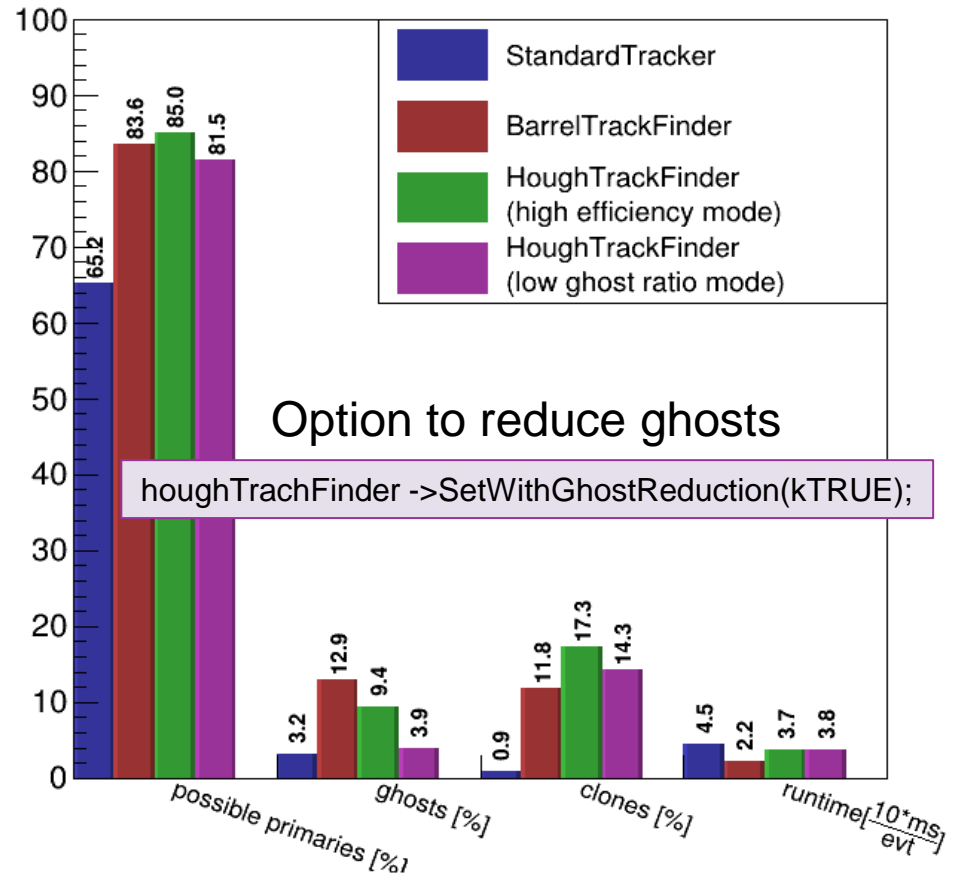


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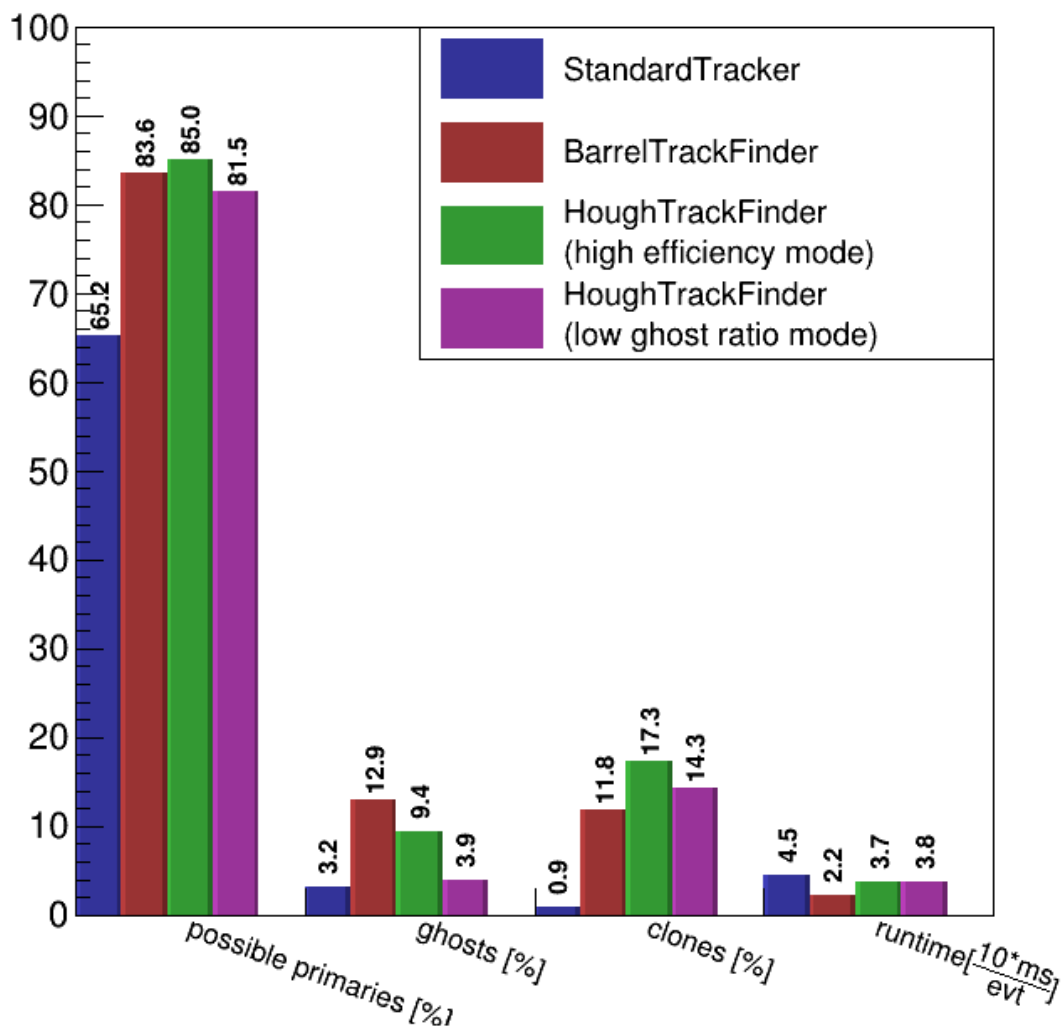
- Default: StandardTracker
- Exchanged in new Release by BarrelTrackFinder

- Want to exchange BarrelTrackFinder by **HoughTrackFinder**

- Already as good as (or better than) BarrelTrackFinder
- Further development: Speed + Secondaries
- Two modes exist: high efficiency/ low ghost ratio



# WHAT'S NEXT?



## Further improvements

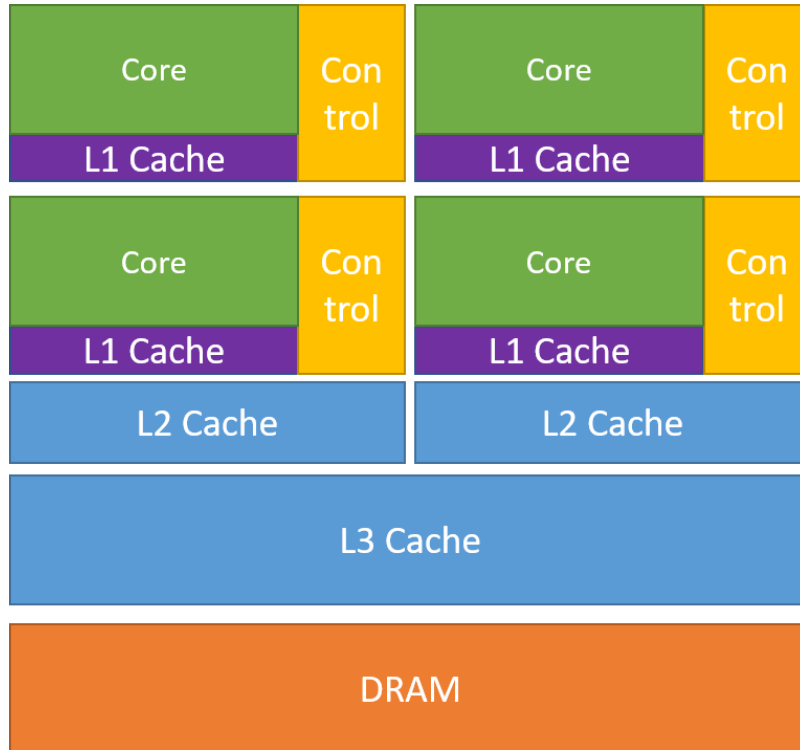
- Runtime improvement
  - Speed up for reaching online capability
  - Using GPUs

# WHY USING GPUS?



## CPU

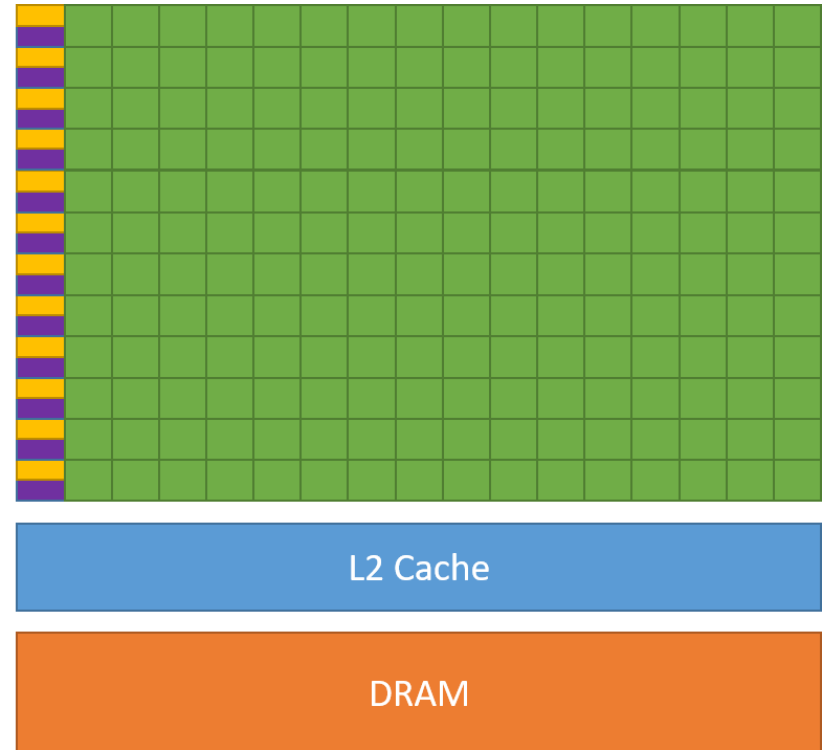
- Large cache and controlling  
→ fast handling of complex sequential calculations



CPU

## GPU

- Small cache and controlling  
→ many small calculations in parallel with less memory accesses



GPU

# WHY USING GPUS?



First preliminary results for GPU calculations

		Speed up (60000 events)
Preselection	Cellular Automaton: shown in previous work	100
	Segmentation	To do
Tracking (Hough transformation)	Creating combinations (MultipletCreator)	47
	MultipletCreator + Apollonius calculations	270
	Maximum finding in Hough space	work in progress
Merging	distances between all Hough space maxima	To do

➔ Aim is to port total calculation on GPU to avoid time consuming data copies between CPU and GPU

# SUMMARY & OUTLOOK



## Summary

- Optimized version of HoughTrackFinder available in PandaRoot
  - higher efficiency and lower ghost ratio than BarrelTrackFinder (number of clones is higher, runtime is a bit worse)
  - Included two modes:
    - “high efficiency”
    - “low ghost ratio”
- First implementation of GPU calculations

## Outlook

- Porting algorithm to GPU for online capability

Thank you for  
your attention!