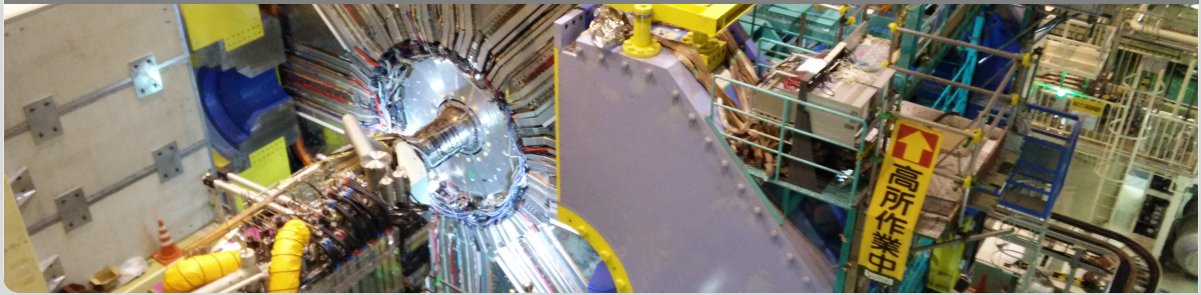
Karlsruher Institut für Technologie

Tracking Algorithms in the Belle II Drift Chamber

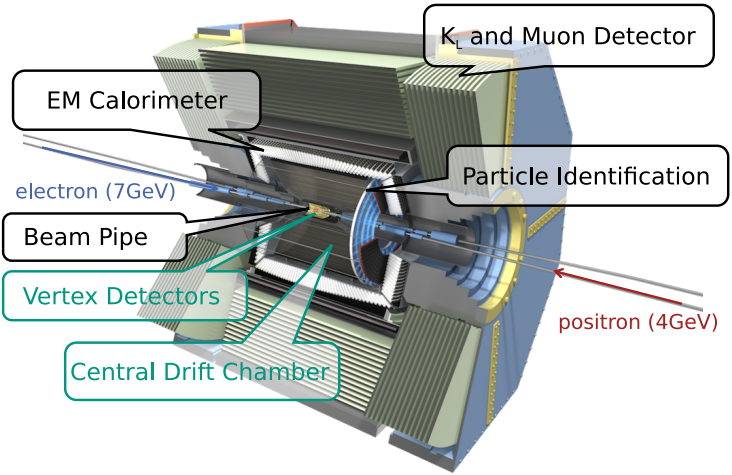
with first pilot run results

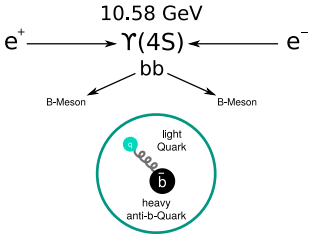
Nils Braun | 21.03.2018

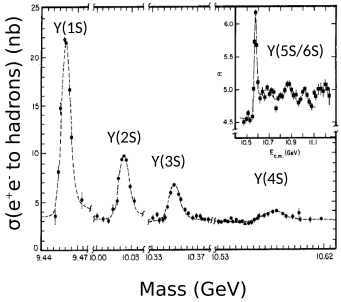
KIT



Introduction to Belle II







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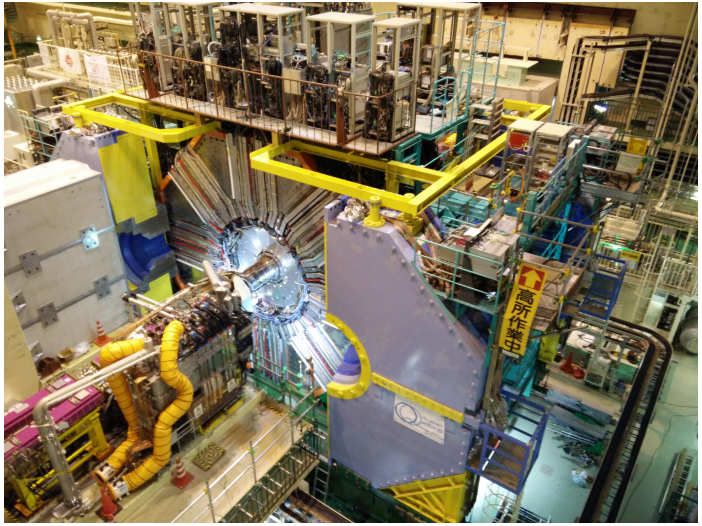
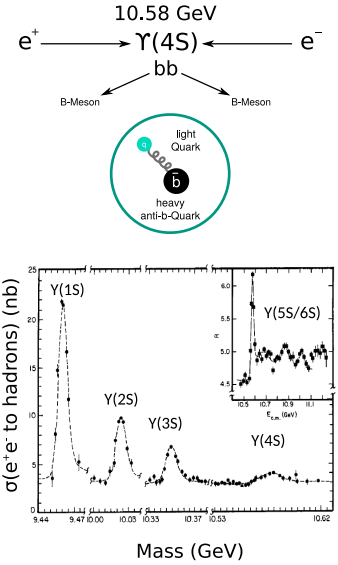
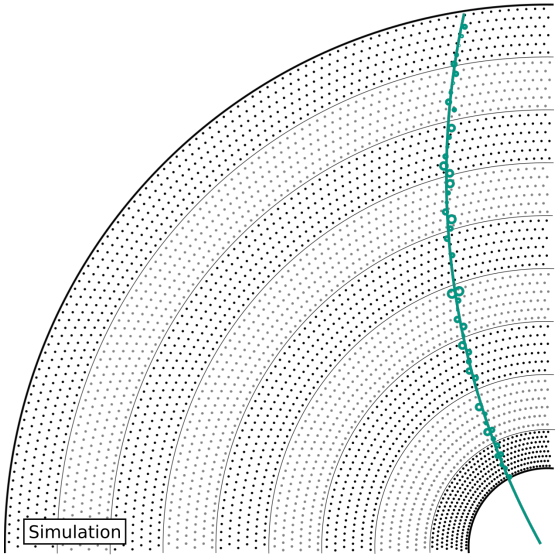




Outline of the following talks

- General Cosmics Run (GCR) using the CDC last summer (this talk)



Outline of the following talks

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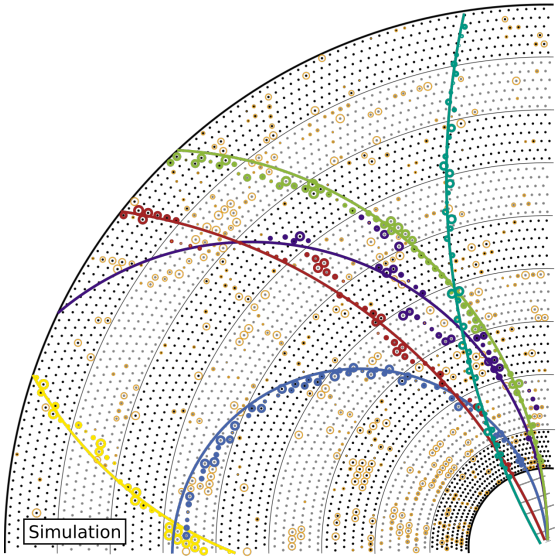
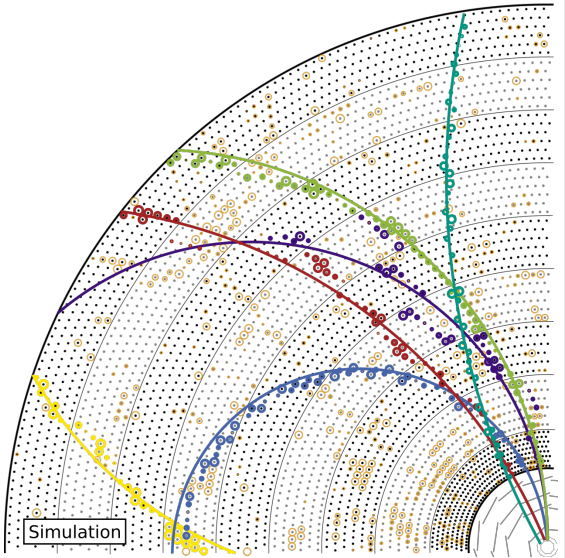
- Phase 2: Beam-induced background condition measurements with a slice of the VXD beginning of this year and collisions in the next weeks.



Outline of the following talks

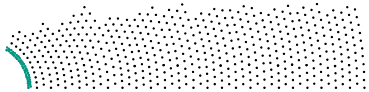
- General Cosmics Run (GCR) using the CDC last summer (this talk)
- Phase 2: Beam-induced background condition measurements with a slice of the VXD beginning of this year and collisions in the next weeks.
- Phase 3: Physics data taking with full VXD next year (next talk)



Introduction to the CDC

magnetic field	1.5 T
gas mixture	helium, ethane
radius	160 mm – 1130 mm
acceptance	17° – 150°
layers	56
stereo and axial wires	14336
radiation length	680 m

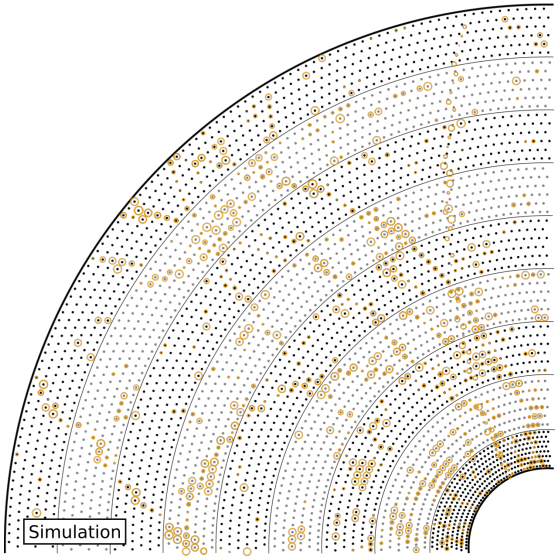
Belle



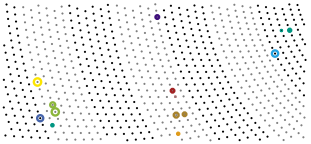
Belle II

Simulation

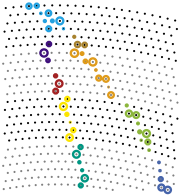
Let's find tracks!



Background Filter

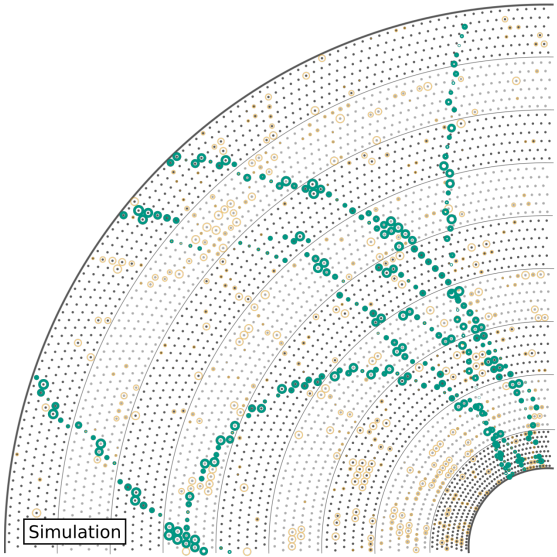


Background



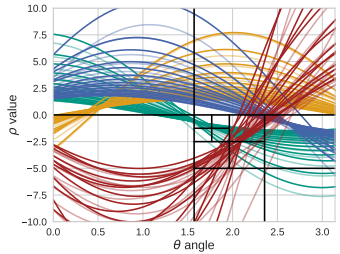
Signal

- using a MVA (FastBDT)
- based on variables from clustered hits
- will be tuned with background-only data from random trigger

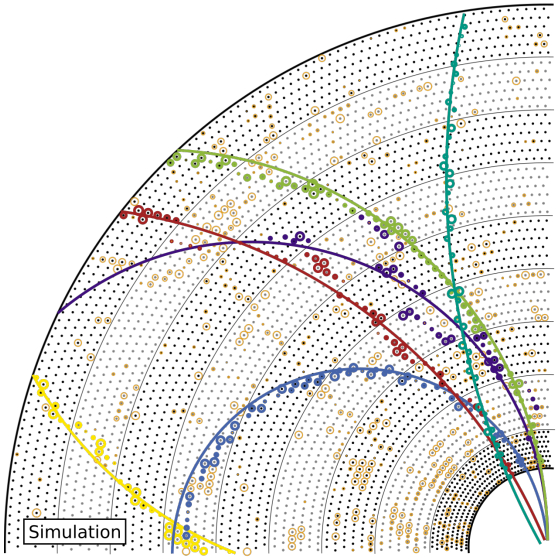


Global Legendre Algorithm

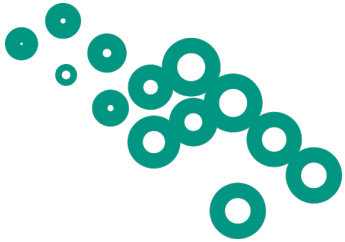
$$\rho_{\pm}(\theta) = x' \cos(\theta) + y' \sin(\theta) \pm d$$



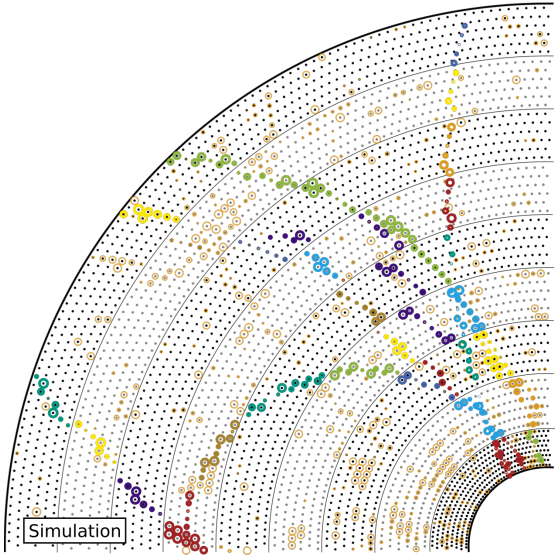
- shifting binary search with re-centering
- ρ dependent maximal level
- multiple passes
- post-processing for curler merging based on fast Riemann fit



Global Cellular Automaton



- clusters
- MVA filters or hand crafted features
- hit-bridging
- extension to track finder possible



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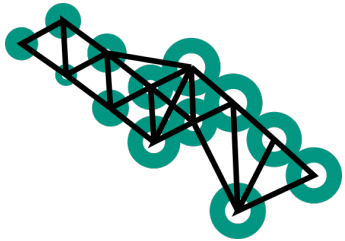
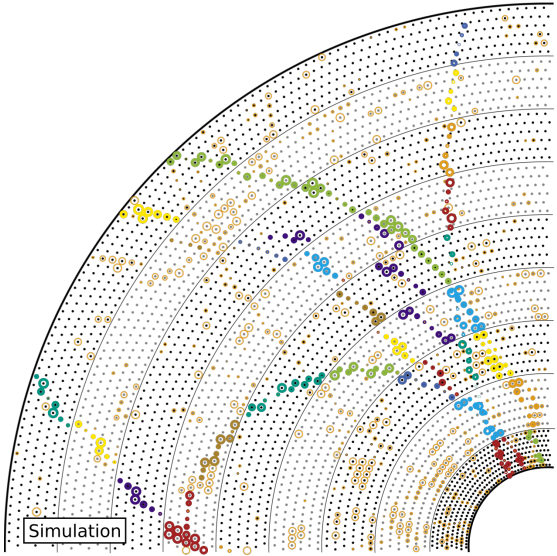


- clusters, triplets
- MVA filters or hand crafted features
- hit-bridging
- extension to track finder possible



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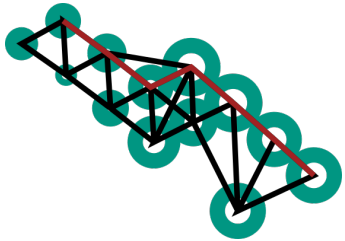
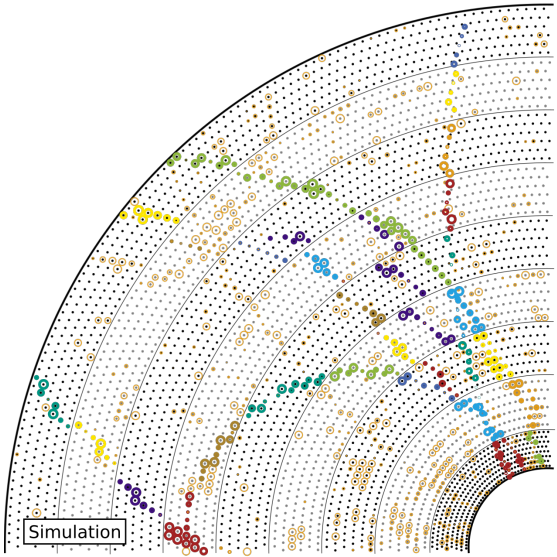
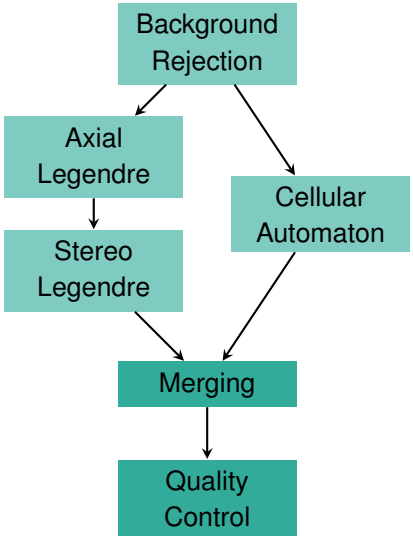
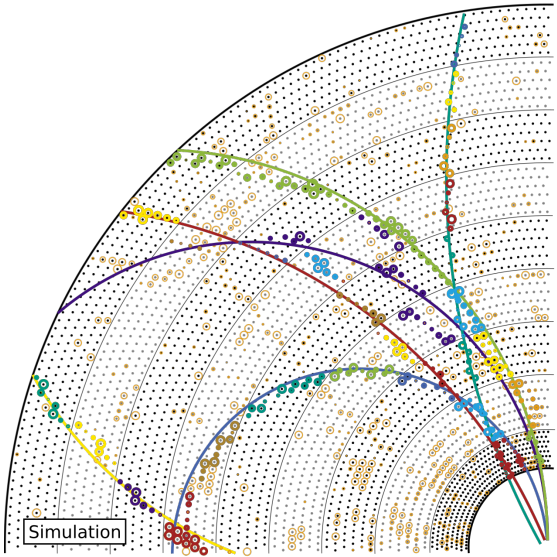


- clusters, triplets, segments
- MVA filters or hand crafted features
- hit-bridging
- extension to track finder possible

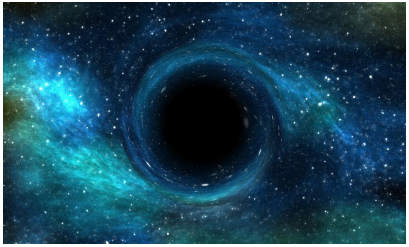


Overview of CDC tracking





Heat map on first recorded Cosmics data



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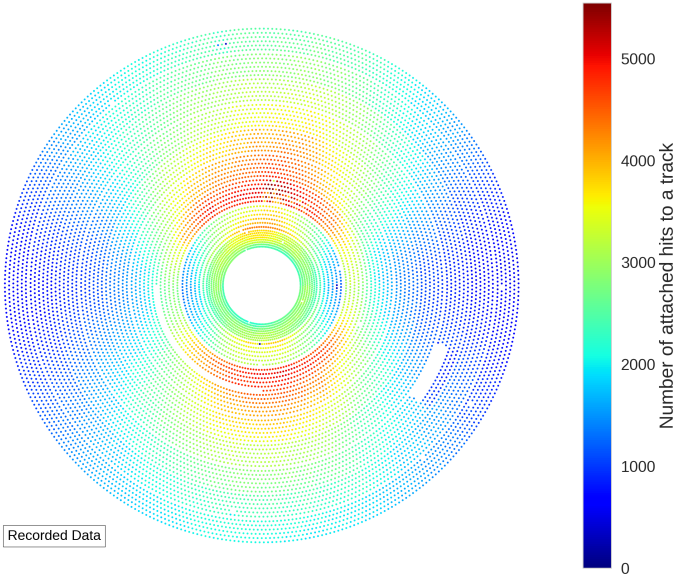
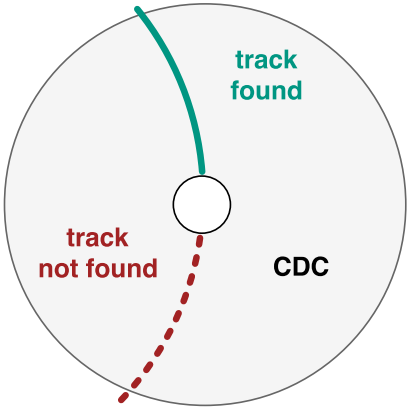
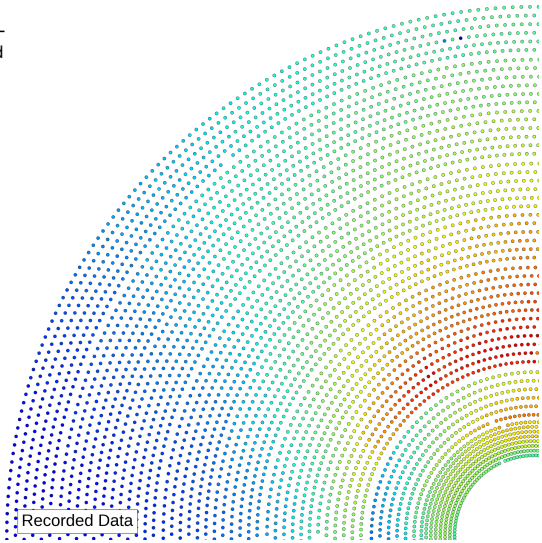


Finding Efficiency on recorded Cosmics data

$$\text{finding efficiency} \approx 1 - \frac{N_{\text{one track found}}}{N_{\text{two tracks expected}}}$$





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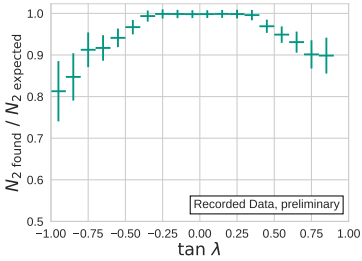
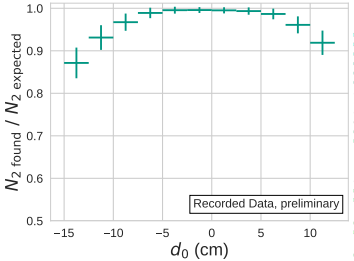
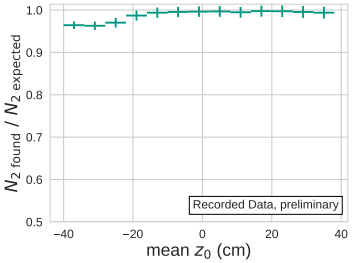
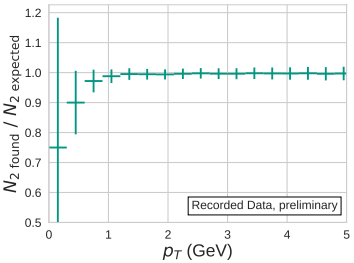
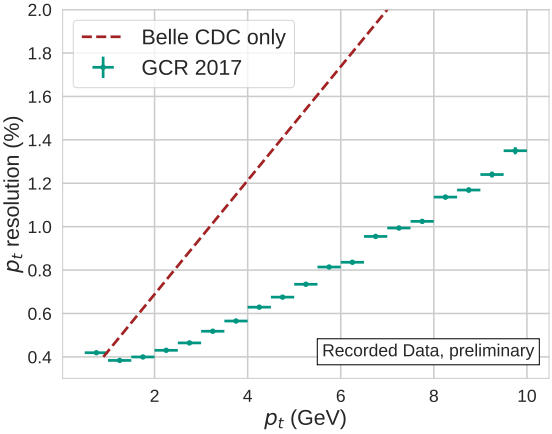


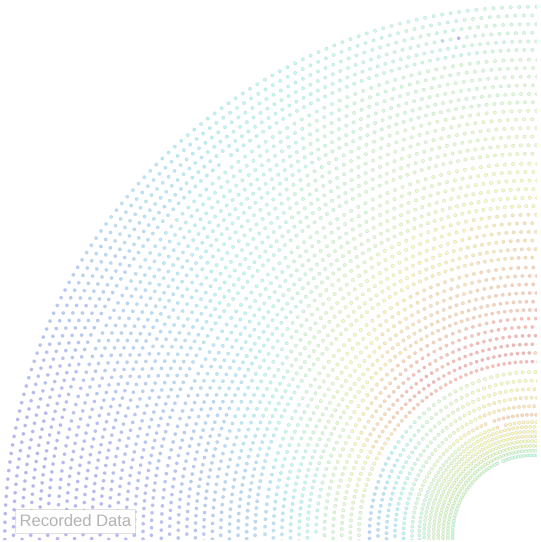






Preliminary Resolution studies on recorded Cosmics data

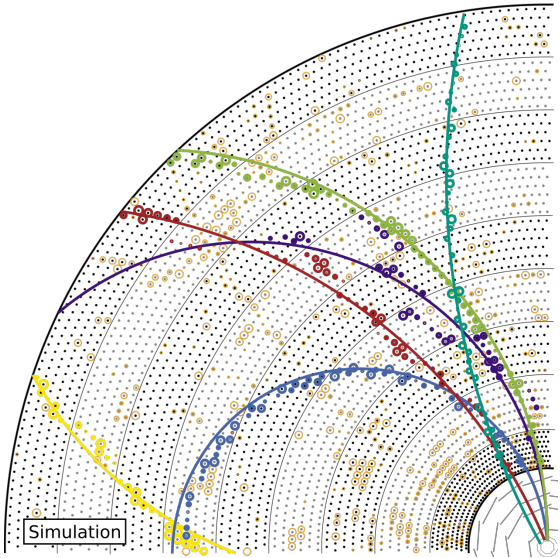




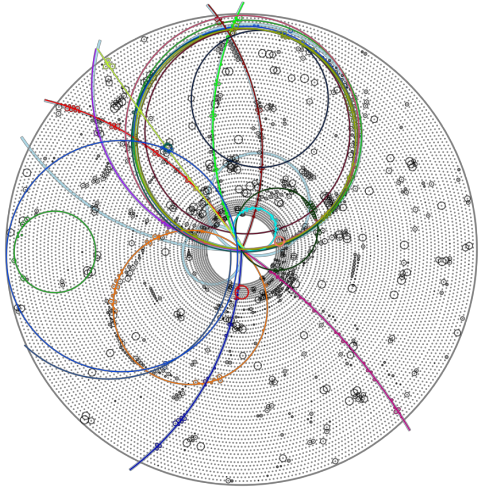
Outlook

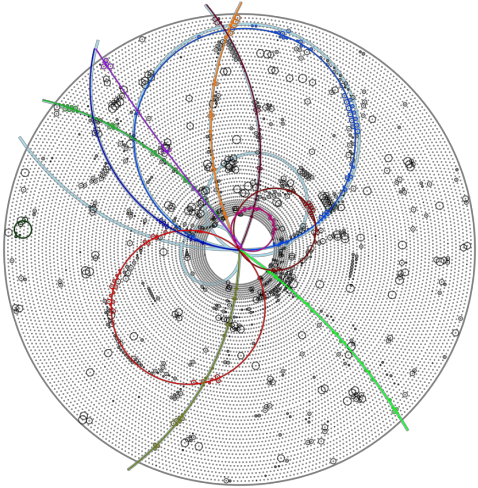
- Belle II's CDC track finding is based on a global Legendre and a local cellular automaton employing MVA methods.
- It is working well with first Cosmics data as well as with beam-induced background on collision data (will be shown by Felix).
- Not shown: Requirements on processing time and memory consumption for HLT are fulfilled.
- Next step: use first collision data this year!

See the full algorithm in the next talk!



Merging in Legendre Finder





Other Enhancements in Legendre Finder