Compressed Baryonic Matter experiment at FAIR

**Time-based particle reconstruction and event selection in the CBM experiment**

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Novel Data-processing Concept of CBM

- CBM is the future fixed-target heavy-ion experiment at FAIR.
- Observables include extremely rare probes (e.g. one D⁺ per 10⁹ collisions).
- Unprecedented rates of 10¹⁵ collisions per second with up to 1000 charged particles are required for sufficient statistics in measurements.
- Observables have complex signatures, no simple hardware triggers.

**4D Cellular Automaton Track Fit**

CBM STS detector hits

reconstructed tracks

**4D Kalman Filter Track Fit**

Event Finder

State vector: \( (x, y, \ell, \ell, \ell, \ell) \)

Linear scalability on different systems

- unbiased track parameters with high resolution;
- correctly estimated errors;
- strong scalability on various computer systems;
- tracks are split into collision-corresponding groups based on the reconstructed time;
- adding all sub-detectors information is in progress;

Parallel and SIMD-ised algorithm allows for timeslice-based reconstruction

Strange Particle Reconstruction in Time-slices

**KF Particle Finder**

- short-lived particles are of particular physics interest;
- particles are reconstructed via decay products;
- events from event finder serve as input for KF Particle Finder;
- time-based reconstruction performance is comparable to the event-based procedure;
- Monte-Carlo particle identification is currently used;
- work in progress: multi-vertex analysis and all detector sub-systems.

**Conclusions**

- The FLES package is efficient, fast and is highly parallelized both on the data and task levels.
- The reconstruction chain of CBM is being developed capable of the free-streaming data processing.
- It allows to reconstruct individual events out of continuous time-stamped data.
- Reconstructed individual collisions serve as an input for the high-level physics analysis.
- The performance of time-based chain is comparable with event-based analysis.

4D reconstruction performance shows that results of event-based feasibility studies are valid.