LUXE DESY meeting, 20th February 2024

QC tracking status

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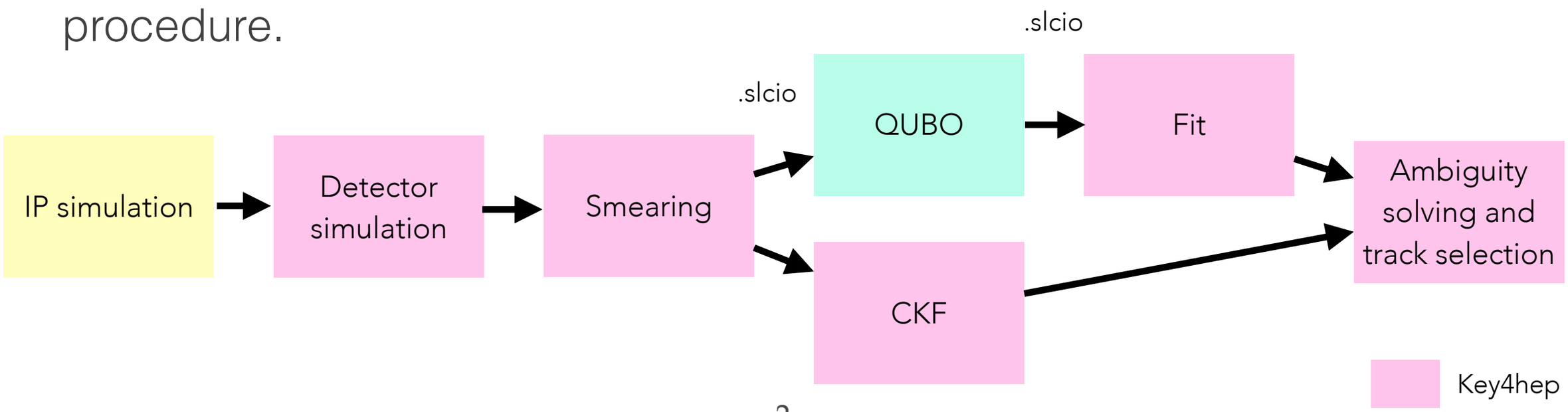
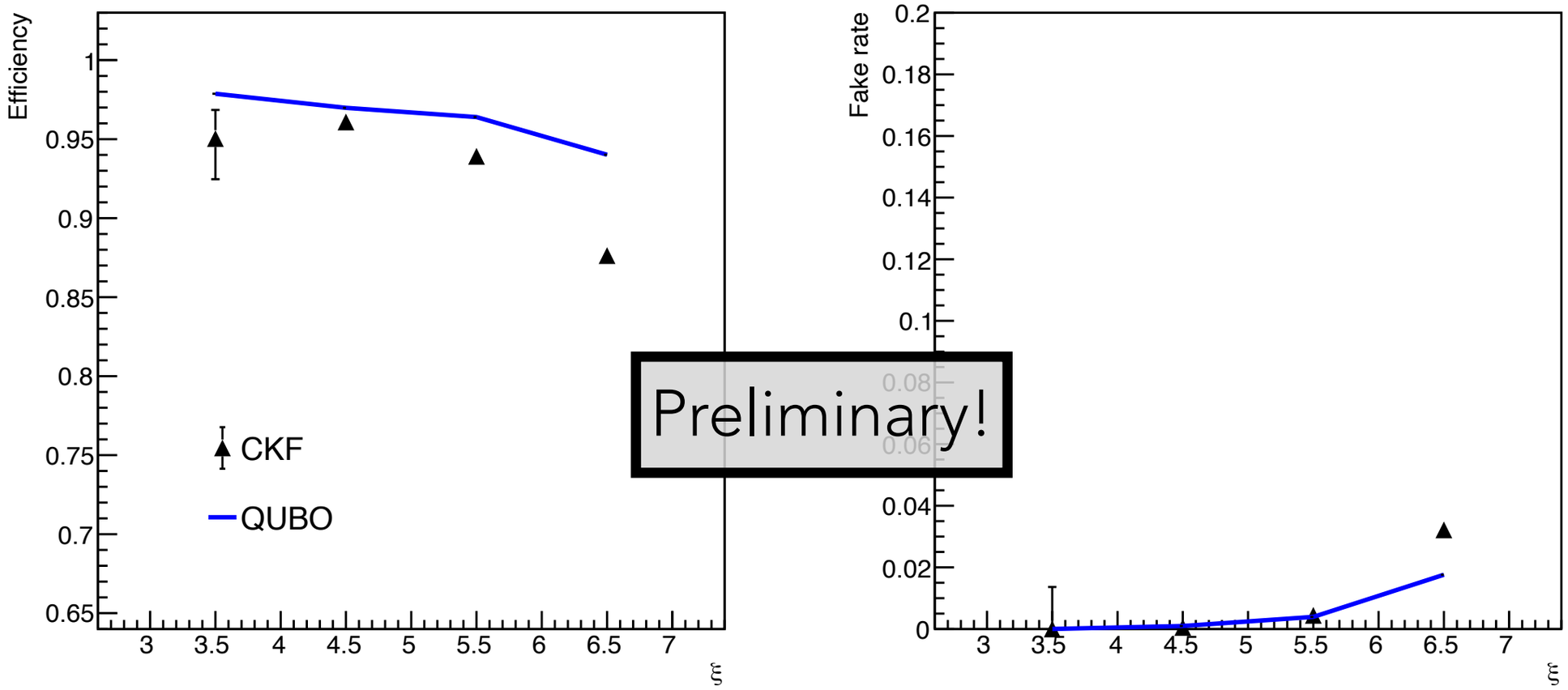
Key4hep-QC integration

- QC pattern recognition algorithm as a standalone python package (see here).
- Choose either: analytical solution, ideal/noisy simulation or IBM hardware.
- All done within key4hep environment with LCIO event format.
- More realistic tracker layout with staggered staves, gaps and overlaps.
- Unified digitisation, fitting, ambiguity resolution and track selection procedure.



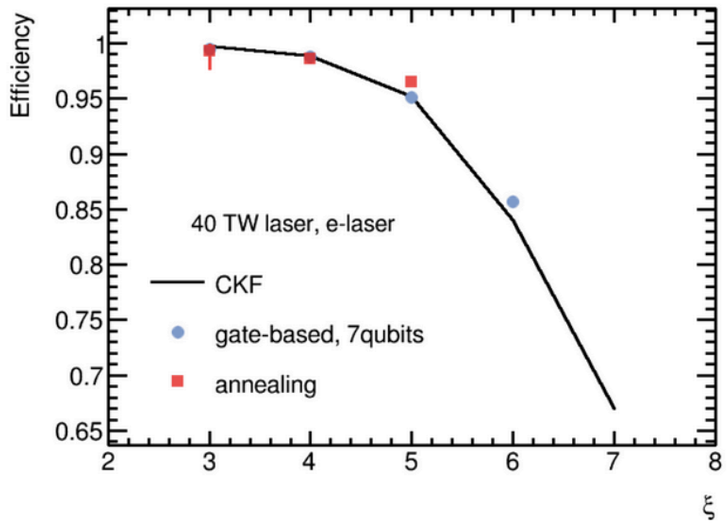
Key4hep-QC integration

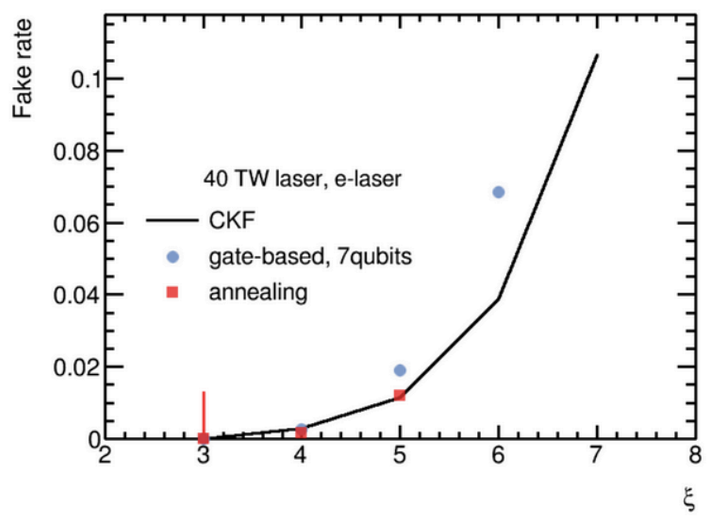
- Other improvements in tracking (splitting of QUBO done differently, refined ambiguity resolution).
- CKF still needs to be optimised.

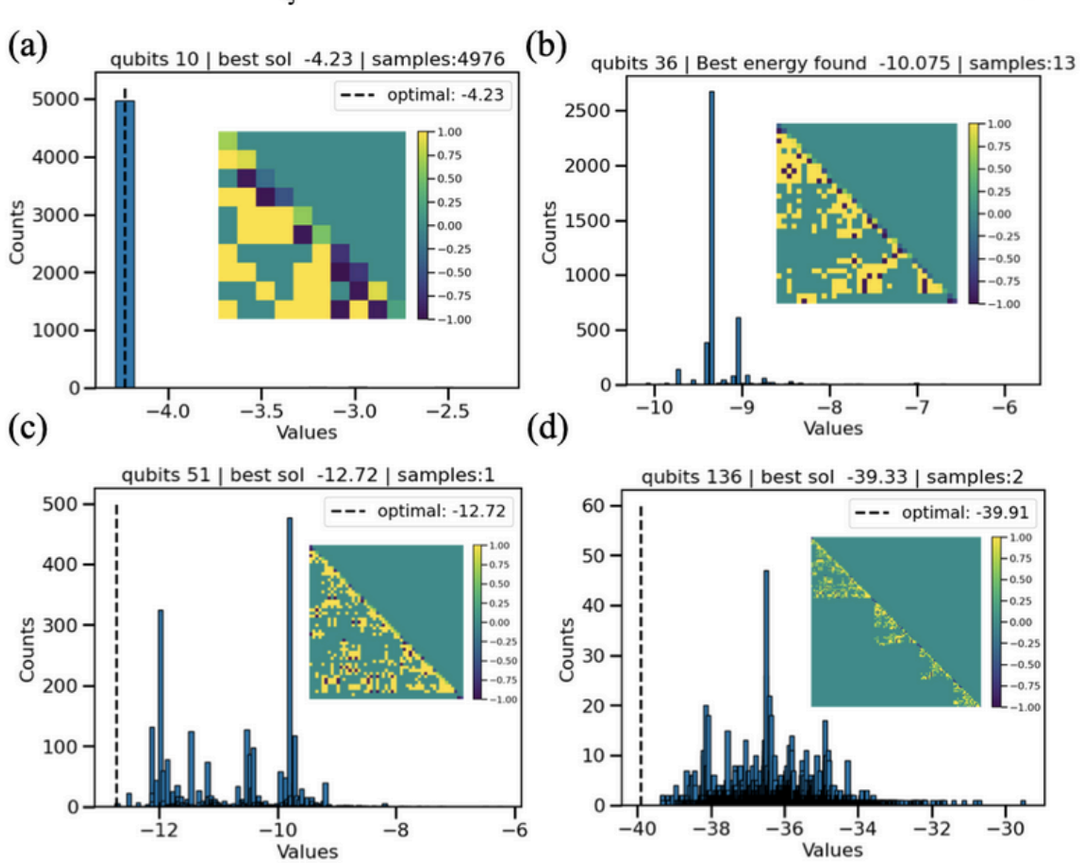


Quantum annealers

- Simulated annealing
- Real annealers at Jülich
  - Run a few QUBO examples with size 10-136.
  - Ground state found for smaller QUBO sizes.

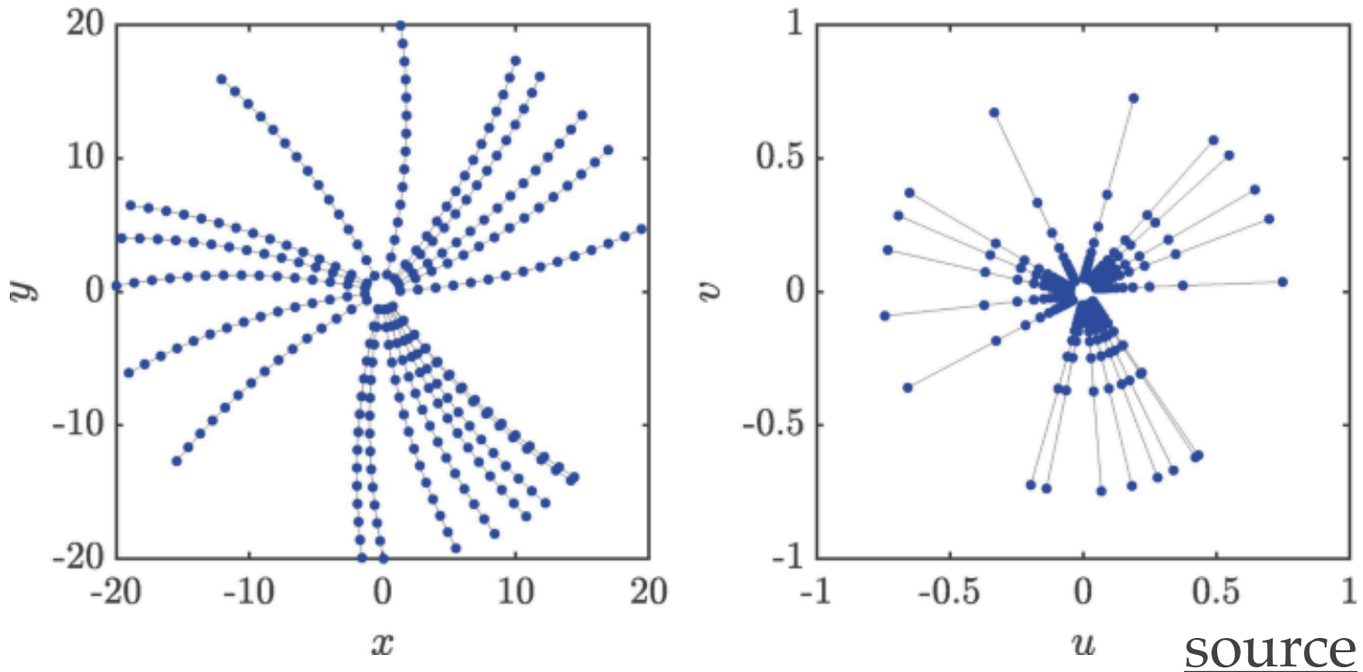






Outlook

- Use ML to learn a better QUBO encoding.
- Application on future colliders.
- Conformal transformation implemented in QUBO framework.
- Leads to straight tracks in the conformal space for charged particles in magnetic field.



source

Combined approach

- Use QUBO approach in the seeding part and continue track finding with combinatorial Kalman Filter.
- More relevant for muon collider (or in general tracking in more than 4 detector layers) than LUXE.
- Reduce number of seeds.
- Kalman filter is used anyway for fitting.