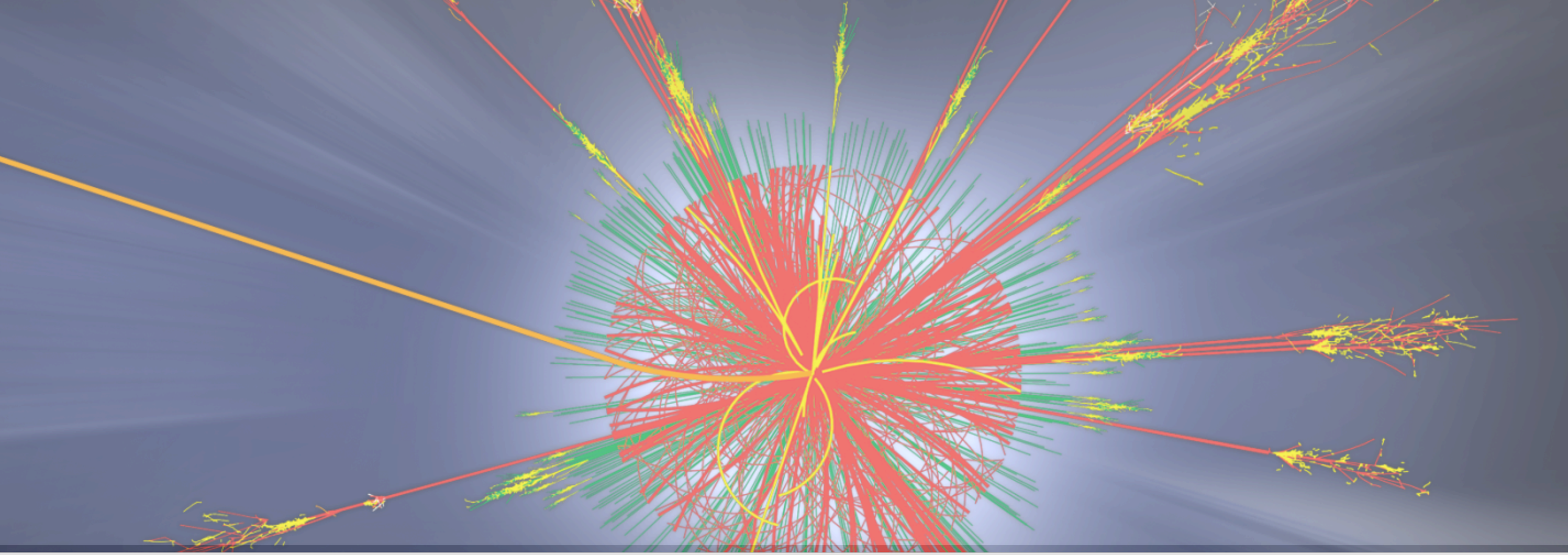


Area D Activities

IDT Collaboration Meeting Spring 2021

Florian Bernlochner

Bundesministerium für Bildung und Forschung

ErUM-Data IDT

UNIVERSITÄT BONN

Area D Activities Overview

GOETHE UNIVERSITÄT FRANKFURT AM MAIN

RWTH AACHEN UNIVERSITY

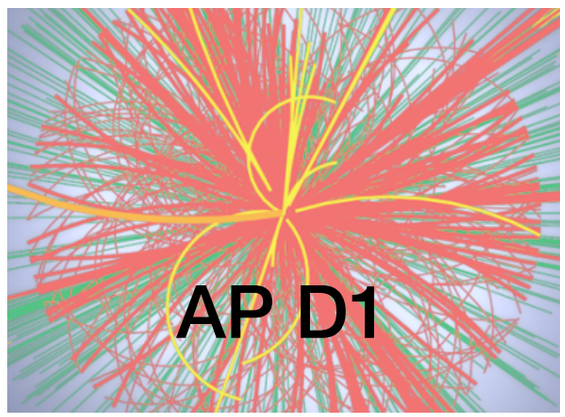
UNIVERSITÄT BONN

AP D1: Novel Track reconstruction algorithms

AP D2: Common tools for tracking → a:ts

Area D Activities Overview

Goal: Exploratory studies on including ACTS in CMS track finding

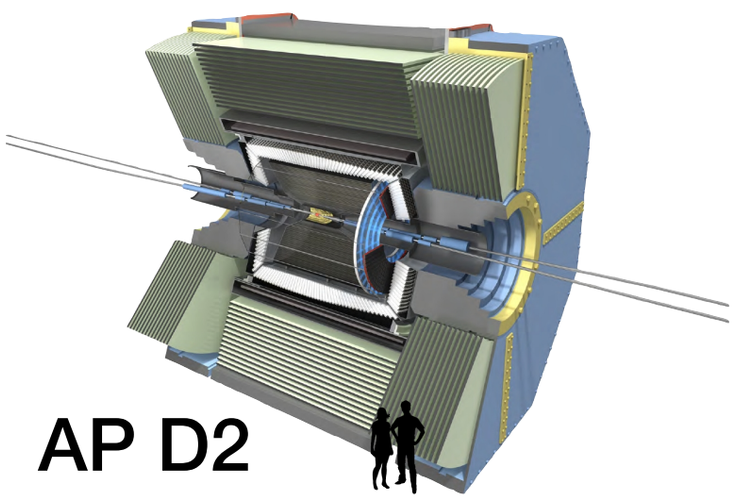


Goal: Implement novel track finding algorithms in ACTS

Cellular Automaton for track finding

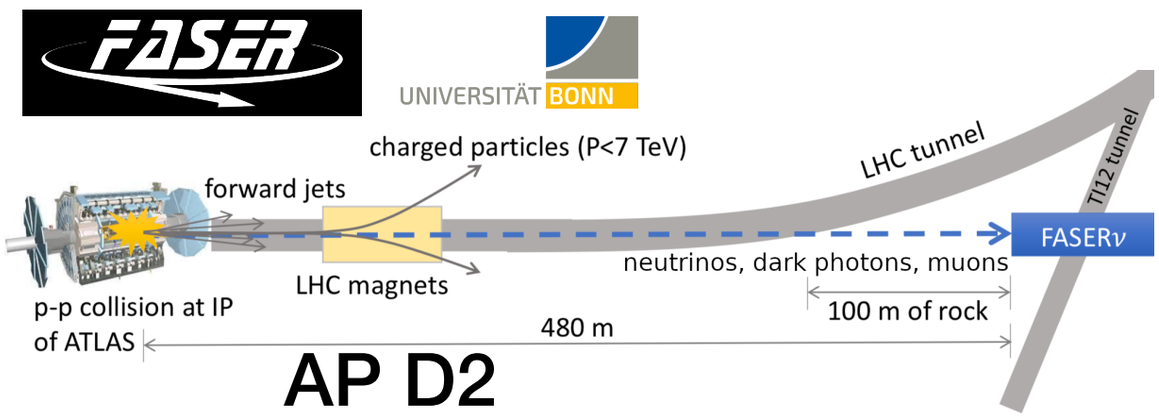
AP D1

Goal: Exploratory studies on including ACTS in Belle II track finding



AP D2

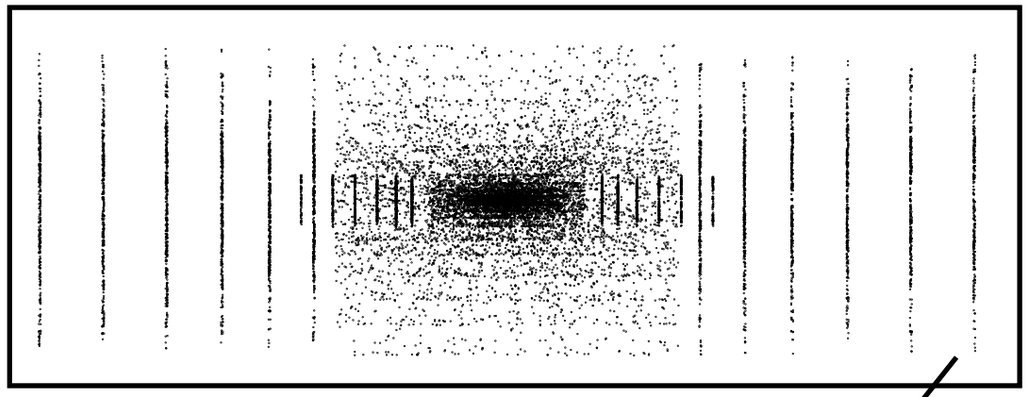
Goal: Implement full ACTS-based track finding



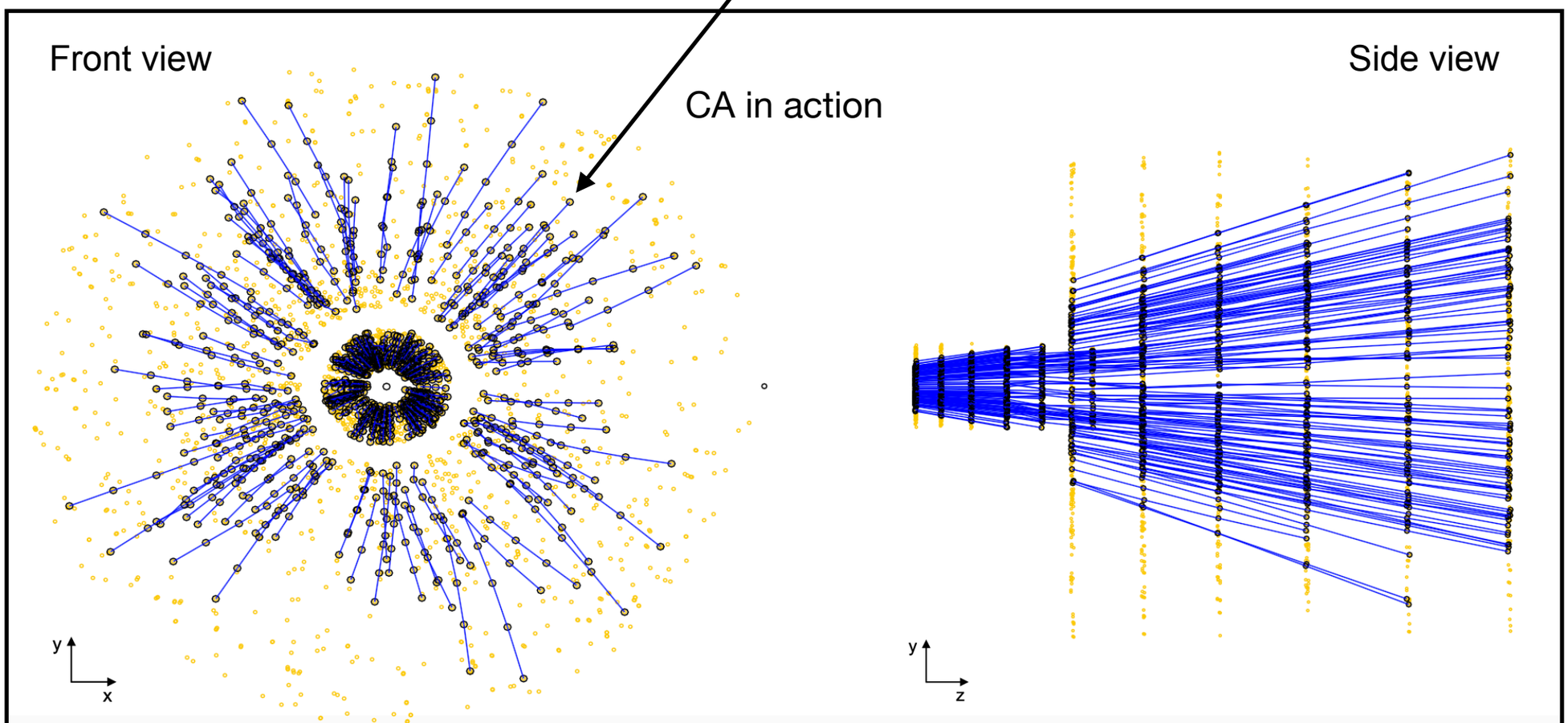
AP D2

AP D1

From Ivan Kisel's Group



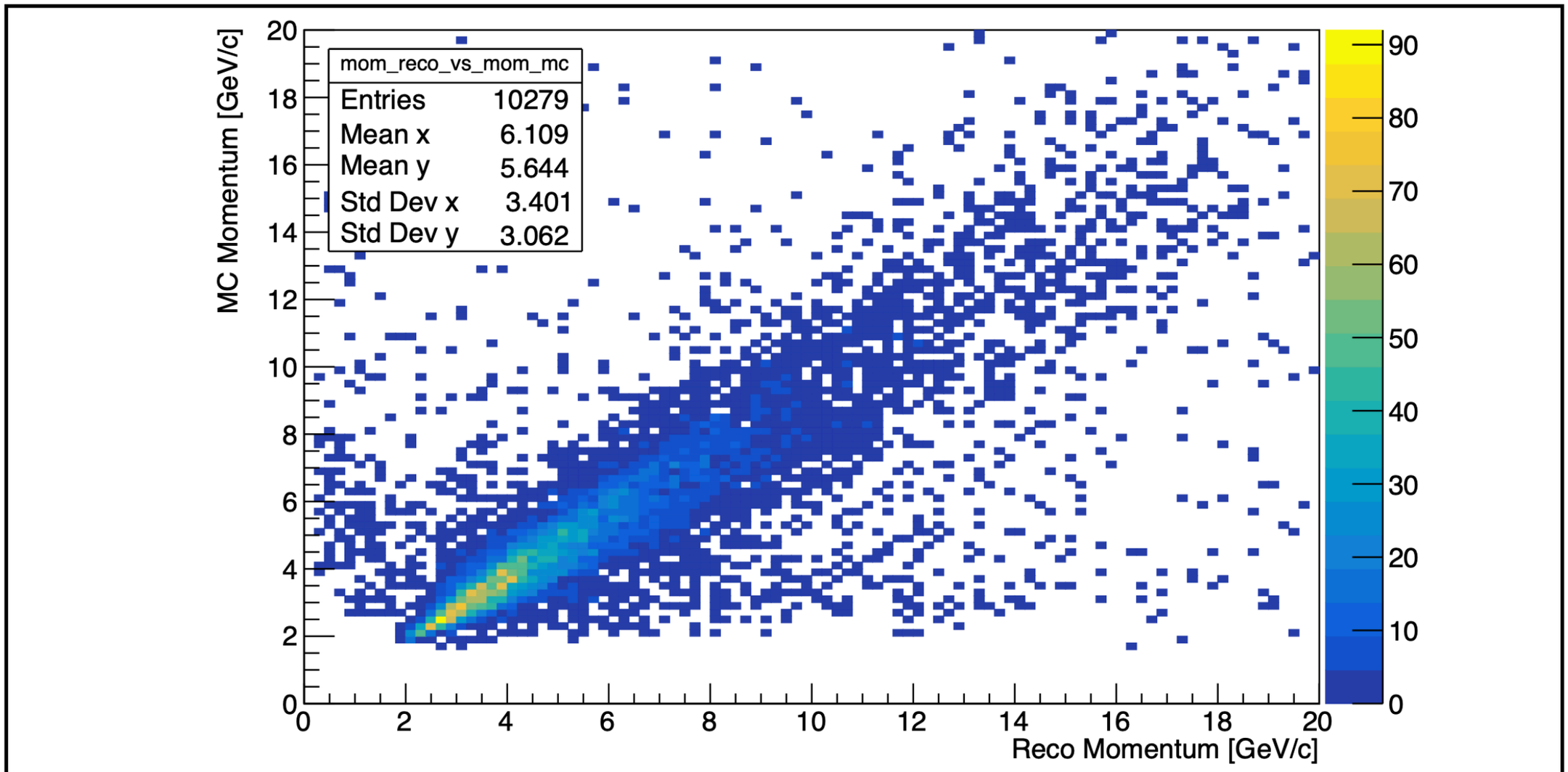
Simulated hits
with *TrackML* detector



- Integration of the Cellular Automaton track finder into the ACTS framework
- Track reconstruction in the end-cap detector system (only the right part is shown)
- Small overlap of inner and outer sub-detectors acceptances
- Requires precise KF fit of segments within the track finder or additional merging stage

AP D1

From Ivan Kisel's Group



- Investigation of the ACTS Kalman Filter track fit for use within CA track finder
- Strong correlation of the simulated and reconstructed momenta of the tracks is shown
- Adaptation of the ACTS Kalman Filter track fit for use within the CA track finder in progress

AP D2

From FB's Group

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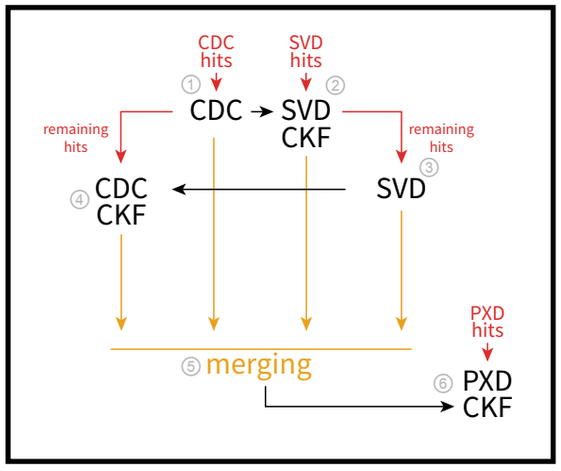
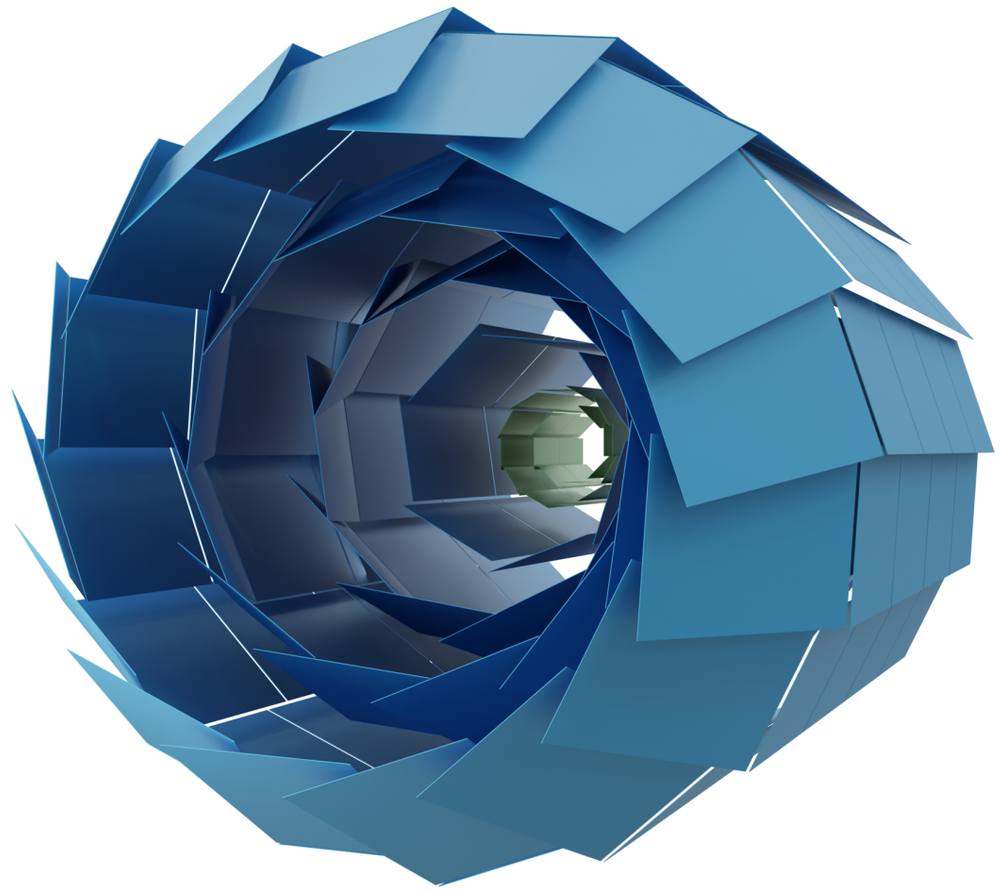
Goal of activities:

Identify and help develop missing features
that prevent use of ACTS at Belle II or similar experiments

Produce a "dummy" track reconstruction chain in ACTS
that replicates the full Belle II track reconstruction algorithm





Belle II VXD Geometry
Render by Paul Gessinger-Befurt

Activities:

- Helped in the development, debugging and validation of **CKF**
(in collaboration with Prof. Heather Gray, Dr. Xiaocong Ai

Current blockers:

- CDC implementation complicated
- Digitization of VXD hits

AP D2

Current Focus:

- Development of global χ^2 track fitter

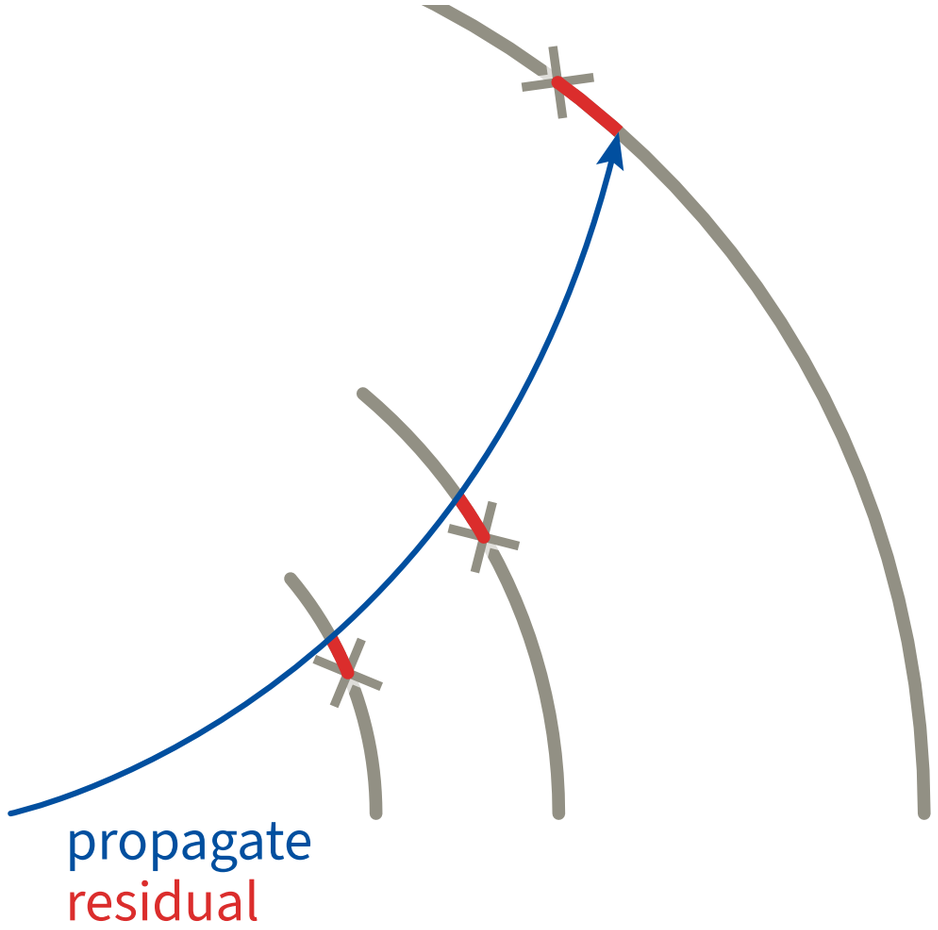
- starting track parameters $\vec{x}_0$ (6-dim)
- propagation with transport matrix H
- residuals $r = m - H\vec{x}_0$

$$\chi^2 = r^T \,\mathrm{cov}^{-1}\, r$$

- update

$$\frac{\mathrm{d}\chi^2}{\mathrm{d}x} = -2H^T \,\mathrm{cov}^{-1}\, r \qquad \frac{\mathrm{d}^2\chi^2}{\mathrm{d}x^2} = 2H^T \,\mathrm{cov}^{-1}\, H$$

$$\vec{x}_1 = \vec{x}_0 - \left(\frac{\mathrm{d}^2\chi^2}{\mathrm{d}x^2}\right)^{-1} \frac{\mathrm{d}\chi^2}{\mathrm{d}x}$$



More about the status in Ralf Farkas' Talk Tomorrow

AP D2

From FB's Group

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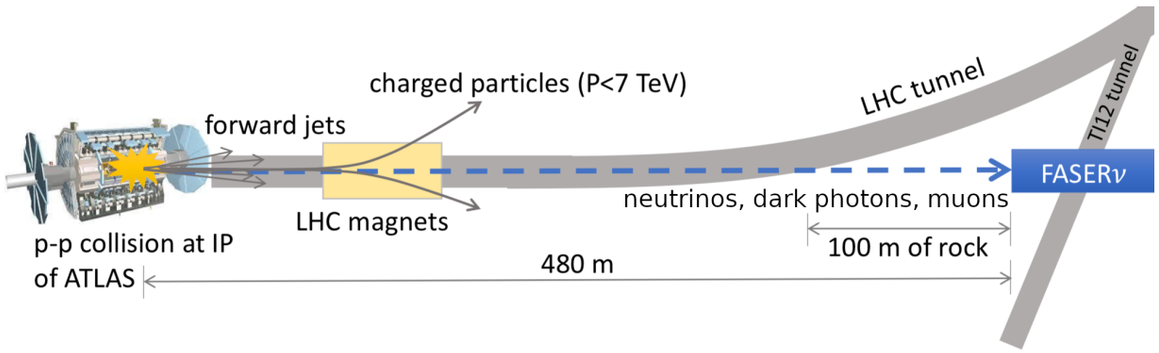
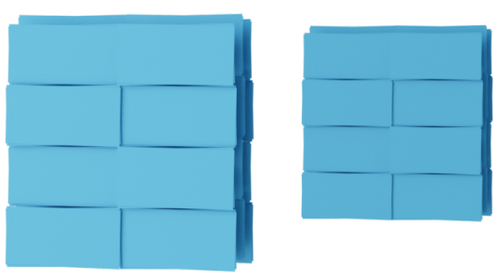
Very challenging to replace existing tracking Framework in a running experiment

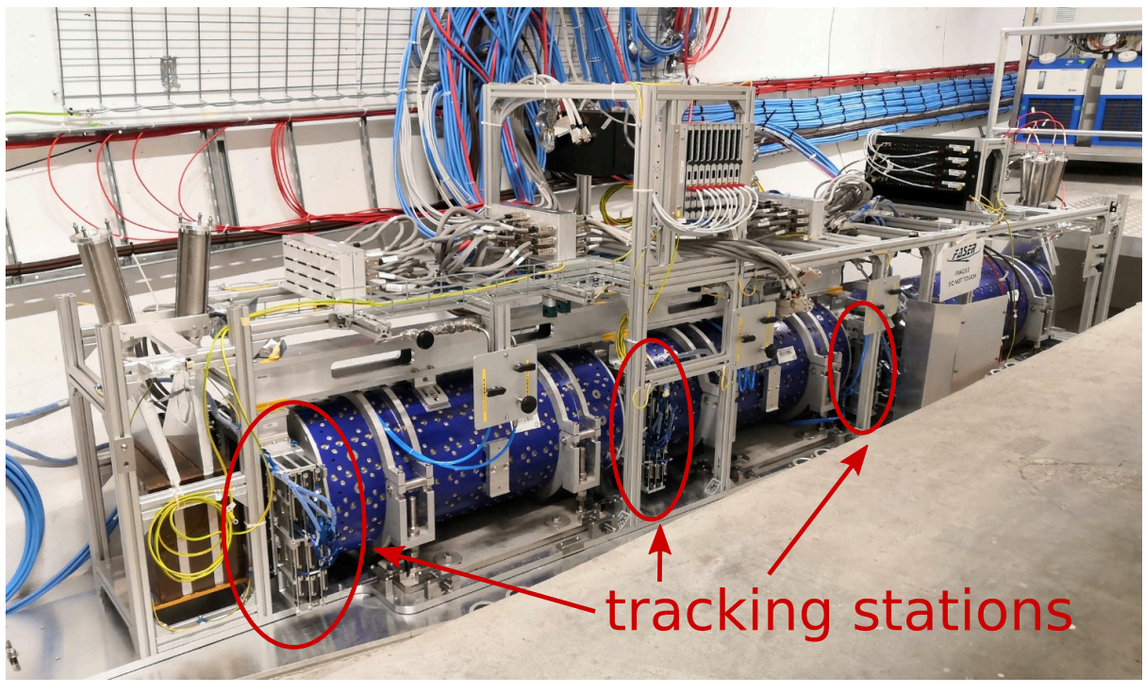
- Many (wo)manyears were used to develop them; cannot be replaced by the work of a single PhD student
- Never change a running system (running experiments often have other worries than replacing something that does its job)
- Technical challenges

Introduce ACTS into a new Experiment: Meet FASER





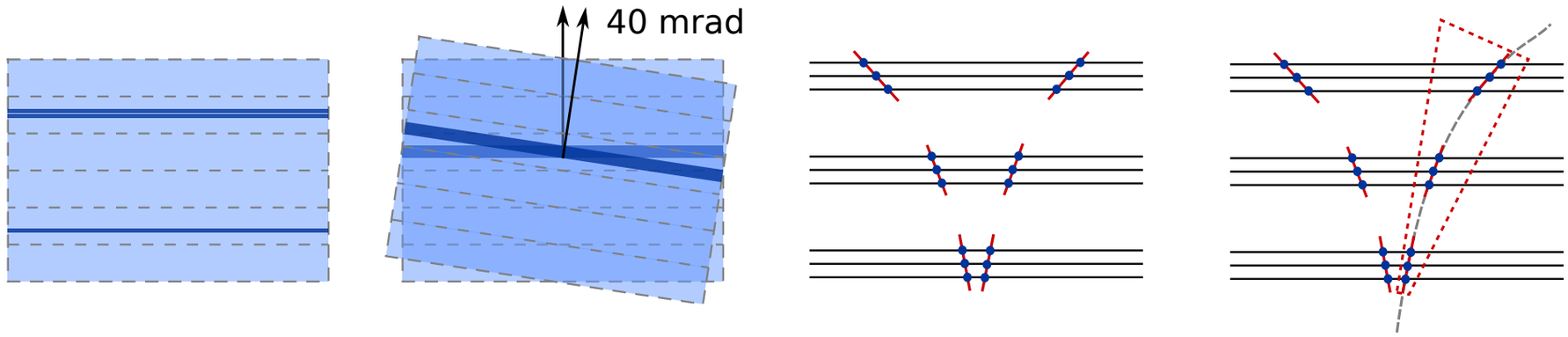
Built from ATLAS SCT Modules



Track Reconstruction

- use ATLAS Offline Software Framework "Athena"
  and ACTS: A Common Tracking Software
  for track reconstruction

Cluster ⟶ Space points ⟶ Track Seeds ⟶ Tracks



create clusters from semiconductor strips

combine clusters from front and back to a space point

create track seeds from linear χ^2 fit

use combinatorial Kalman filter for track finding and fitting

Implemented full tracking chain in offline software; carried out first MC tests

Reconstruction of first cosmic data with ACTS imminent —> Nice milestone to actually reconstruct data in a first experiment!

More about the status in Tobias Boeckh's Talk Tomorrow

ACTS Paper in Preparation

Computing and Software for Big Science manuscript No.
(will be inserted by the editor)

A Common Tracking Software Project

Xiaocong Ai · Corentin Allaire · Noemi Calace · Angela Czirkos · Irene Ene · Ralf Farkas · Louis-Guillaume Gagnon · Rocky Garg · Paul Gessinger · Hadrien Grasland · Heather Gray · Christian Gumpert ·

To be submitted to
Computing and Software for Big Science