

ACTS Tracking Software Status

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for the ACTS developers

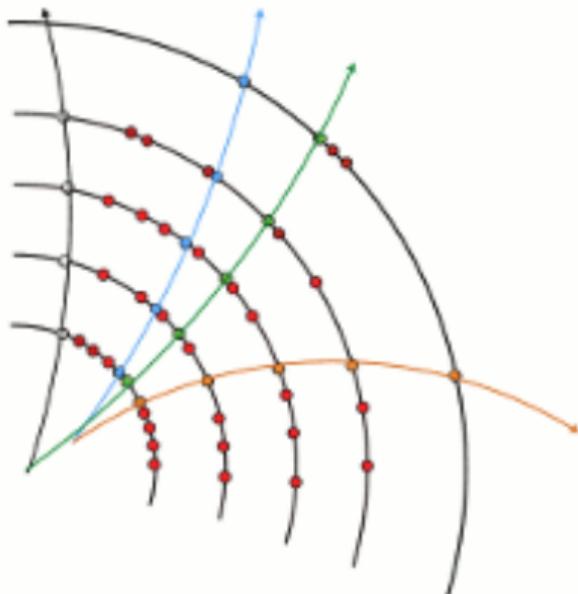
Université de Genève

2016-10-19 FCC-hh detector meeting



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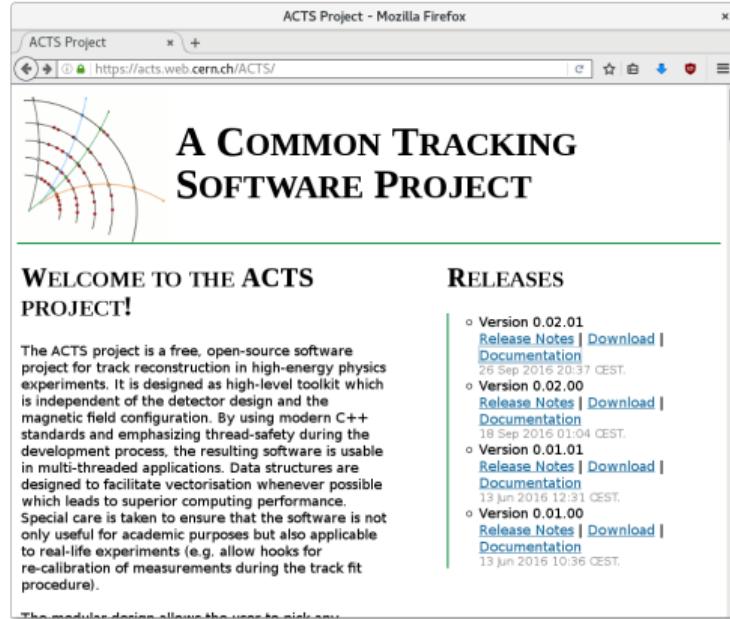
ACTS — A Common Tracking Software



- Experiment independent tracking tools
- Derived from current ATLAS reconstruction
- Standalone
- Minimal dependencies



ACTS — Framework



The screenshot shows the homepage of the ACTS Project website. At the top, there is a navigation bar with tabs for "ACTS Project" and "Documentation". Below the navigation bar, the URL "https://acts.web.cern.ch/ACTS/" is displayed. The main content area features a graphic of particle tracks and a title "A COMMON TRACKING SOFTWARE PROJECT". On the left, a section titled "WELCOME TO THE ACTS PROJECT!" contains a detailed description of the project's purpose and design. On the right, a "RELEASES" section lists five versions of the software, each with links to "Release Notes", "Download", and "Documentation".

The ACTS project is a free, open-source software project for track reconstruction in high-energy physics experiments. It is designed as high-level toolkit which is independent of the detector design and the magnetic field configuration. By using modern C++ standards and emphasizing thread-safety during the development process, the resulting software is usable in multi-threaded applications. Data structures are designed to facilitate vectorisation whenever possible which leads to superior computing performance. Special care is taken to ensure that the software is not only useful for academic purposes but also applicable to real-life experiments (e.g. allow hooks for re-calibration of measurements during the track fit procedure).

ACTS Project - Mozilla Firefox

ACTS Project https://acts.web.cern.ch/ACTS/

A COMMON TRACKING SOFTWARE PROJECT

WELCOME TO THE ACTS PROJECT!

The ACTS project is a free, open-source software project for track reconstruction in high-energy physics experiments. It is designed as high-level toolkit which is independent of the detector design and the magnetic field configuration. By using modern C++ standards and emphasizing thread-safety during the development process, the resulting software is usable in multi-threaded applications. Data structures are designed to facilitate vectorisation whenever possible which leads to superior computing performance. Special care is taken to ensure that the software is not only useful for academic purposes but also applicable to real-life experiments (e.g. allow hooks for re-calibration of measurements during the track fit procedure).

RELEASES

- o Version 0.02.01
[Release Notes](#) | [Download](#) | [Documentation](#)
26 Sep 2016 20:37 CEST.
- o Version 0.02.00
[Release Notes](#) | [Download](#) | [Documentation](#)
18 Sep 2016 01:04 CEST.
- o Version 0.01.01
[Release Notes](#) | [Download](#) | [Documentation](#)
13 Jun 2016 12:31 CEST.
- o Version 0.01.00
[Release Notes](#) | [Download](#) | [Documentation](#)
13 Jun 2016 10:36 CEST.

<https://acts.web.cern.ch/>

<https://gitlab.cern.ch/acts/a-common-tracking-sw>

What's new?

- Website
- Issue Tracker
- Continous Integration
- Unit tests
- Mailinglists
acts-developers, acts-users



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ACTS — Releases

ACTS: 0.02.00 - CERN Central Jira - Mozilla Firefox

https://its.cern.ch/jira/projects/ACTS/versions/24736

Version 0.02.00 RELEASED

Start date not set Released 18/Sep/16 Release Notes
beta release: fast simulation & fast digitisation available, DD4Hep & TGeo Plugins

38 Issues in version 38 done 0 Issues in progress 0 Issues to do

P	T	Key	Summary	Assignee	Status
BUG	INF	ACTS-37	TGeo Plugin	Jula Hrdinka	CLOSED
BUG	INF	ACTS-85	wire contribution guide	Christian Gumpert	CLOSED
BUG	INF	ACTS-124	Extrapolation to layers not working	Jula Hrdinka	CLOSED
INF	INF	ACTS-18	Establish full extrapolation chain	Andreas Salzburger	CLOSED
INF	INF	ACTS-55	Integrate Fitter MaterialEffects updator as Service	Noemi Calace	CLOSED
INF	INF	ACTS-56	Create a generic equidistant SurfaceArray	Andreas Salzburger	CLOSED
INF	INF	ACTS-77	MSG_X() does not work within Tools package	Andreas Salzburger	CLOSED
INF	INF	ACTS-95	Memory Management of Extrapolation	Andreas Salzburger	CLOSED
INF	INF	ACTS-112	Enable multi-ring detector building	Unassigned	CLOSED
INF	INF	ACTS-138	Robust bin ordering with Range	Andreas Salzburger	CLOSED
INF	INF	ACTS-42	Provide method to get index of some parameter in vector	Christian Gumpert	CLOSED

Latest release 0.02.01

- Updated DD4Hep, TGeo Plugins
- Updated extrapolation
- Bugfixes

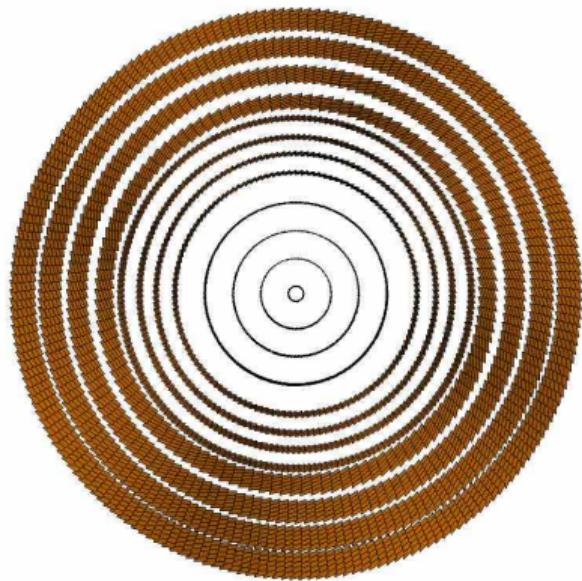
Upcoming 0.03.00

- Generic example detector
- Digitization
- Seeding
- Propagator

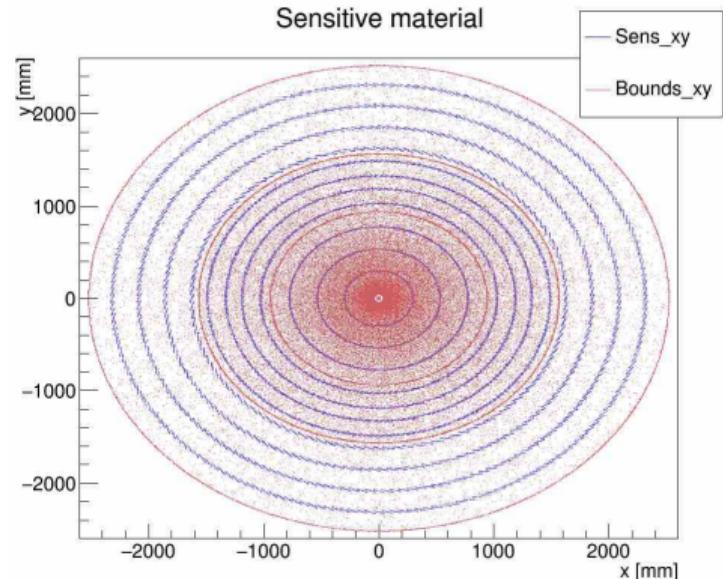


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DD4Hep Geometry

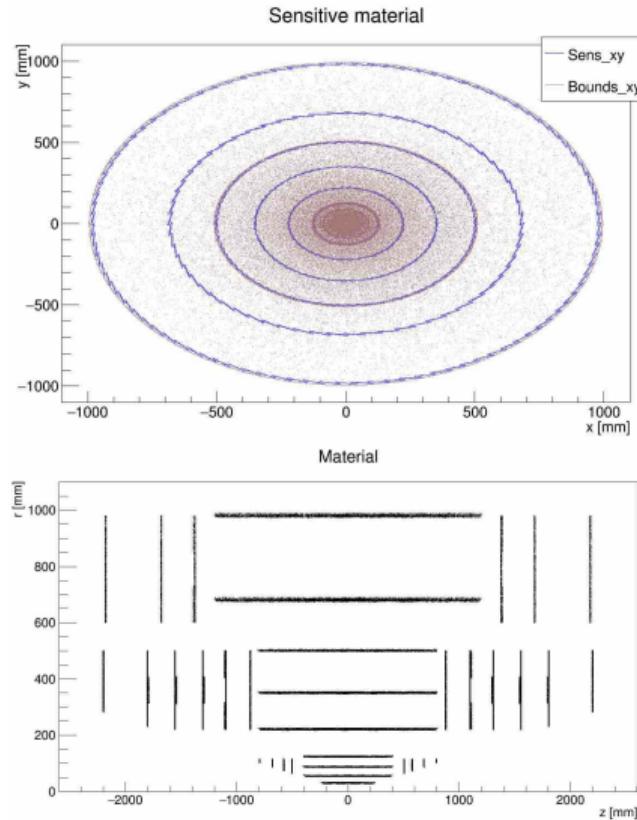


DD4Hep detector model



Fast navigation & extrapolation

Generic Detector Example



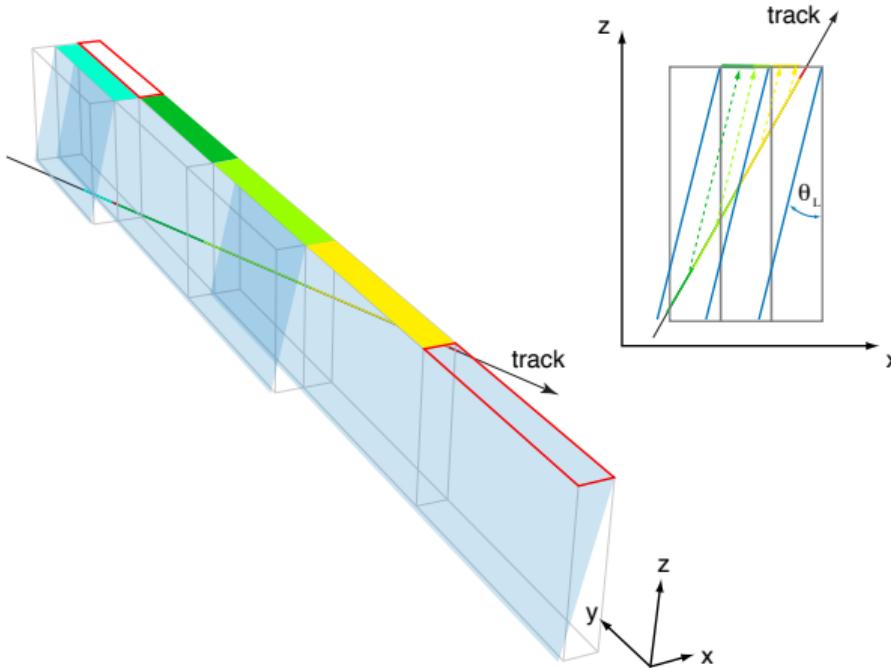
Geometric Components

- Pixels
 - Short/long strips
 - Barrels
 - Discs
-
- Debugged extrapolation
 - Validation



Fast Digitization

7



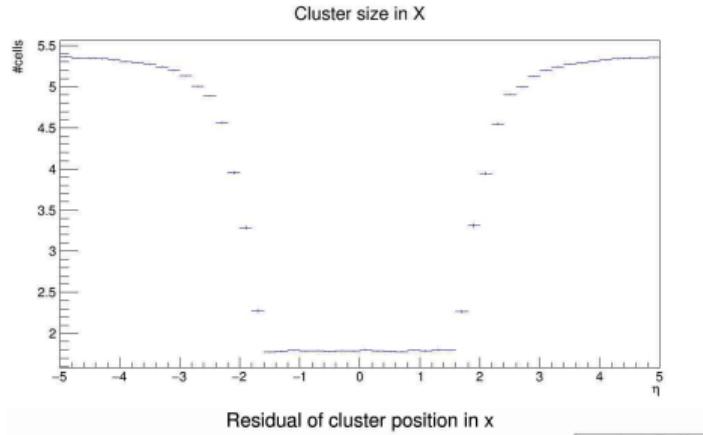
Features

- Purely geometric
- Variable segmentation
- Includes Lorentz-angle



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Fast Digitization



Preliminary results
Clustering in ϕ -direction

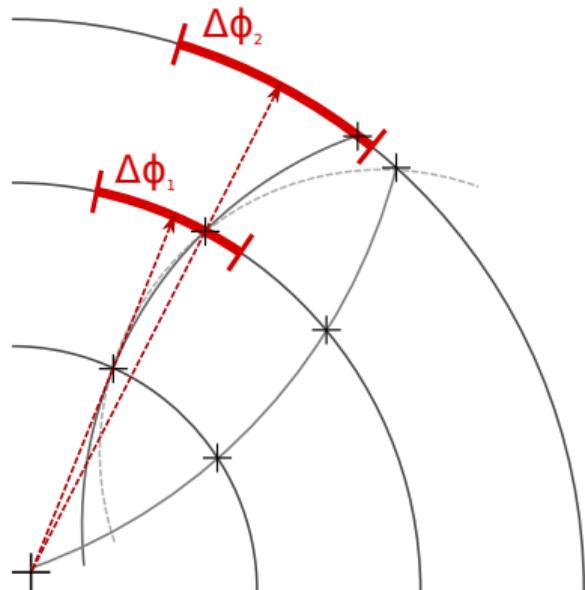
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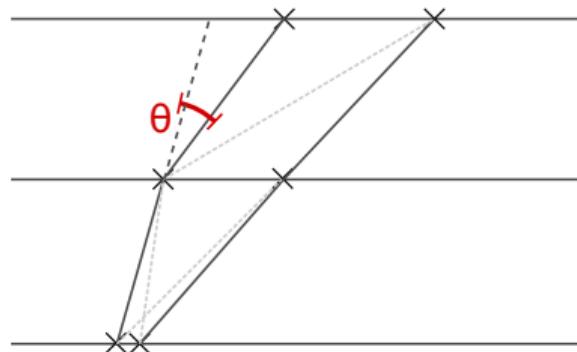
Seeding — Status



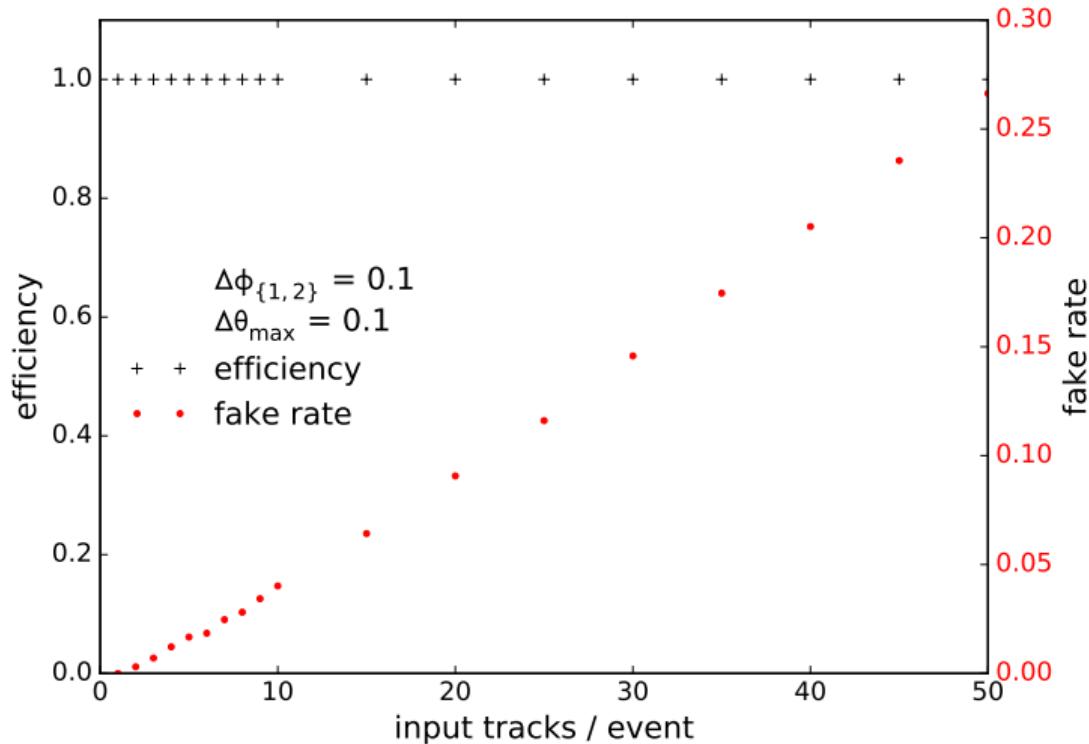
+

Helix Seed Finder

- Circle + line
- Combinatorial seed finder:
Search window $\Delta\phi_{\{1,2\}}$
Cut $\Delta\theta_{\max}$



Seeding — Validation



Input:

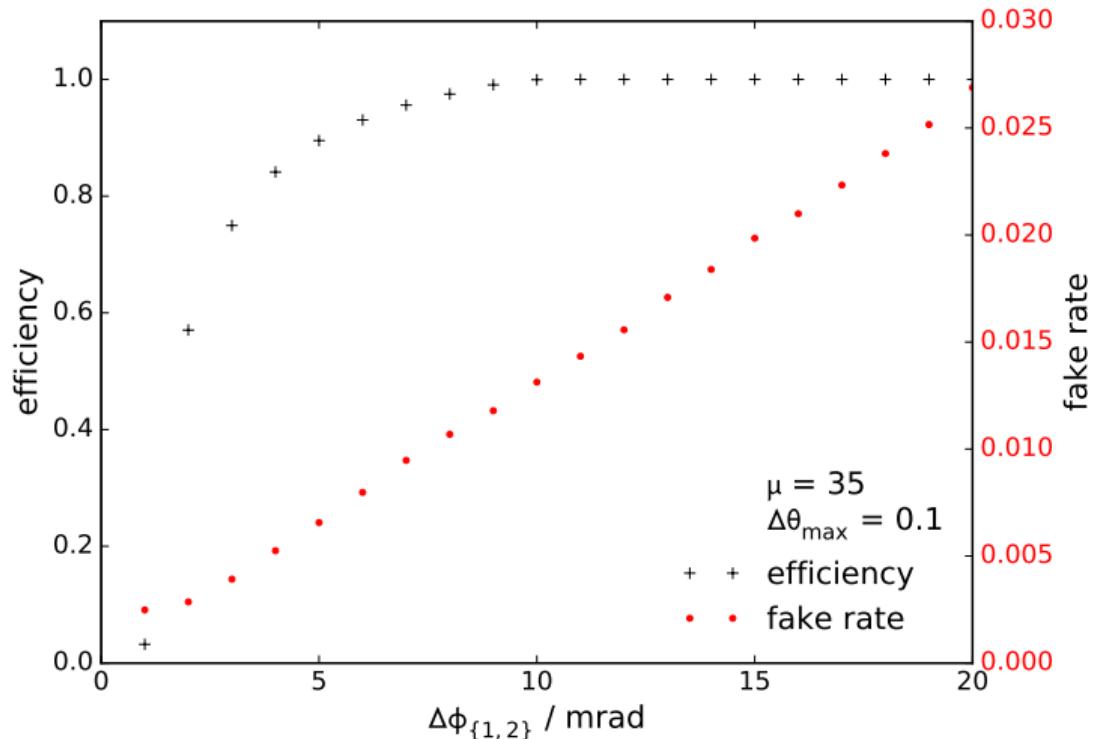
- Flat track parameters
- $p_T = 1\text{--}100 \text{ GeV}$
- Truth hits from ACTS extrapolation

Efficiency vs number of tracks



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Seeding — Validation



Input:

- Flat track parameters
- $p_T = 1\text{--}100 \text{ GeV}$
- Truth hits from ACTS extrapolation

Efficiency vs ϕ window

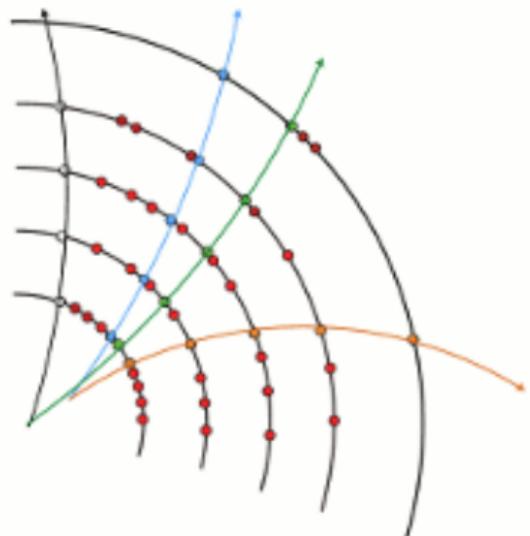


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Setup

- 4-cores/8-threads Xeon CPU
- ExtrapolationTest with generic detector (test framework)
- Using OpenMP
- Without I/O

threads	time / ns	speedup
1	47	
2	24	2.0
4	12	3.9
8	9	5.2



Status

- Geometry, e.g. from DD4Hep
- Propagation
- Basic seeding
- Parallel-ready codebase

Outlook

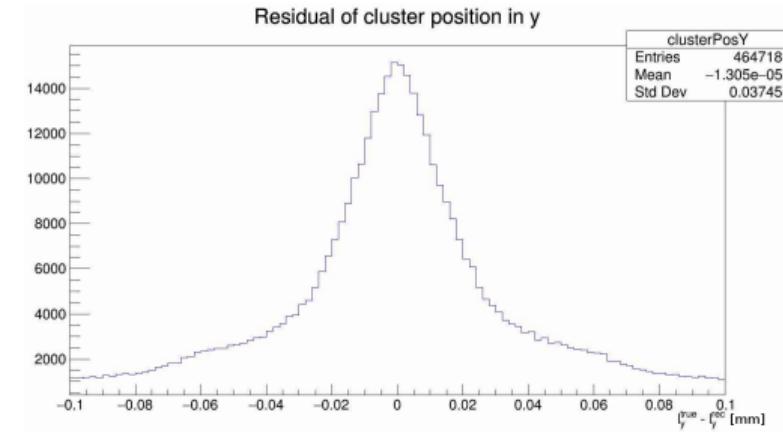
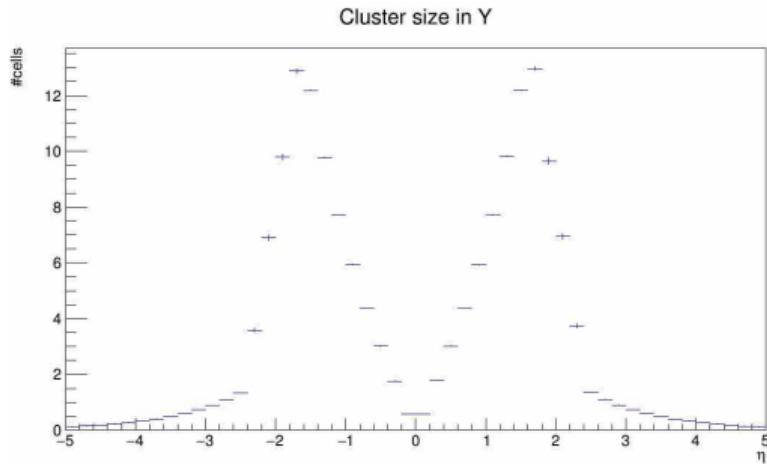
- Full pipeline: from fast simulation to reconstructed tracks
- FCC demonstrator



Backup

Fast Digitization — Along Z

A1



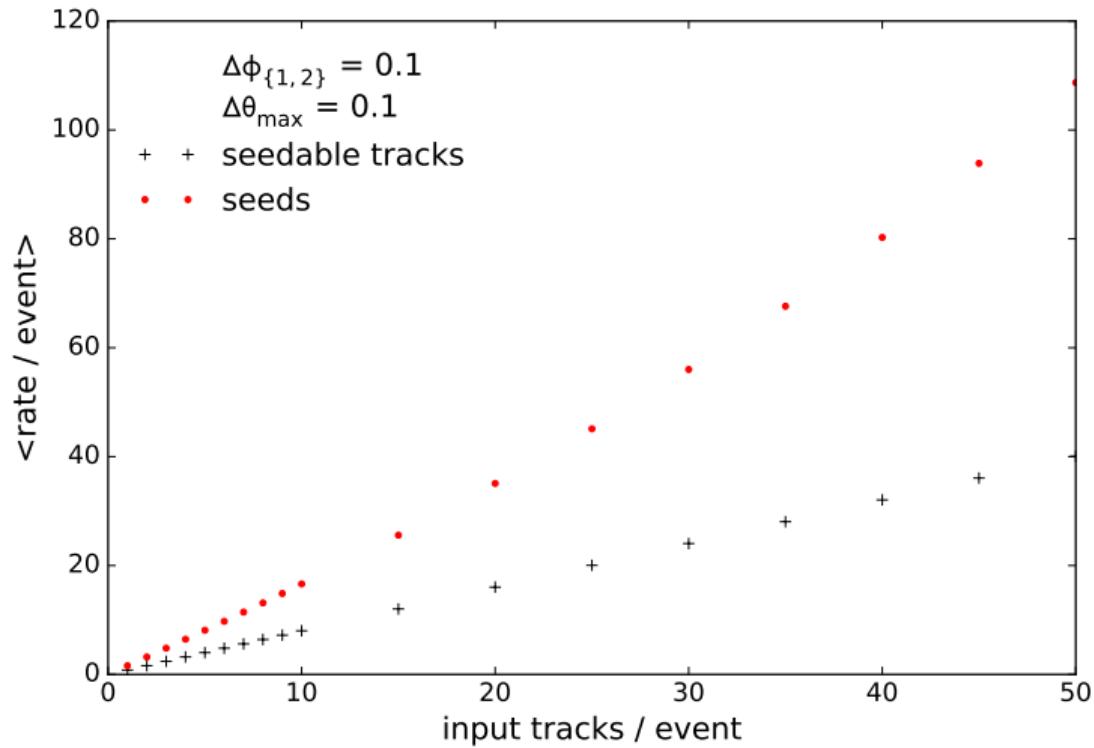
Preliminary Results



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Helix Seeding — Rates

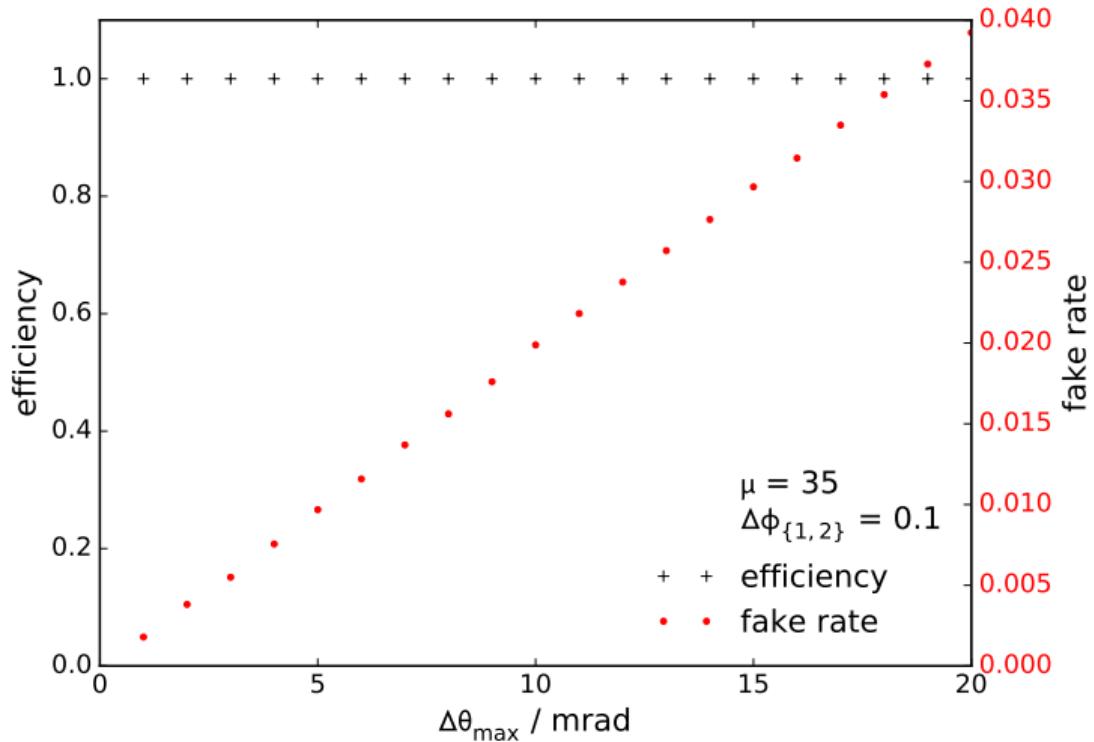
A2



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Helix Seeding — Efficiency vs θ Window

A3



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