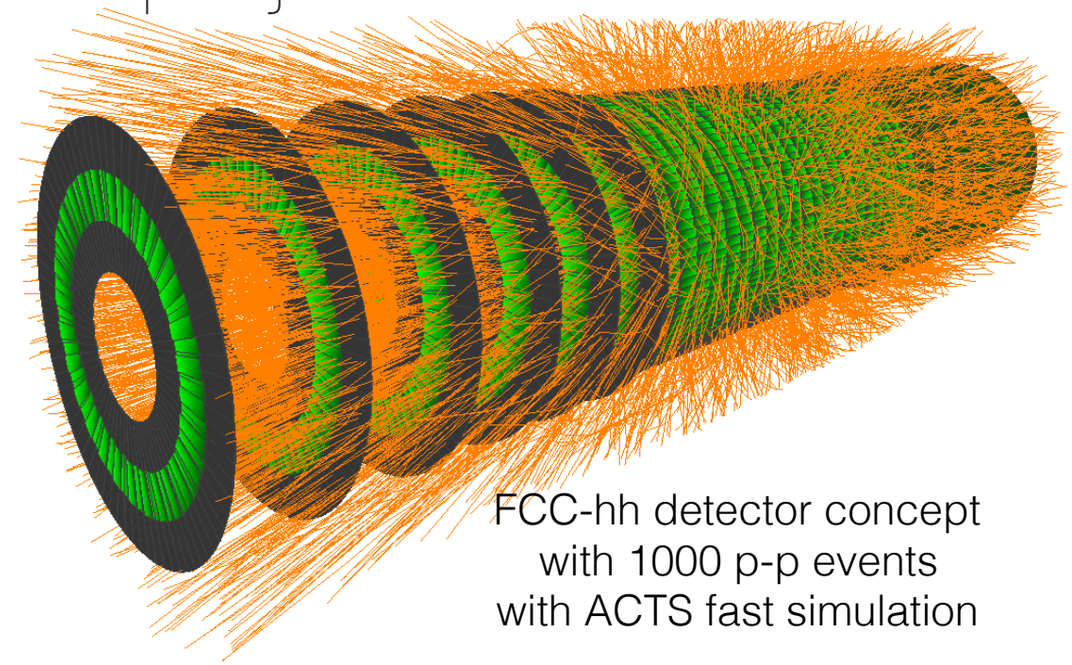
ACTS A Common Tracking Software project



FCC-hh detector concept
with 1000 p-p events
with ACTS fast simulation

Project to preserve and enhance LHC track reconstruction software for future **detectors** and **computing infrastructure**

A flexible, **open source R&D testbed**:

- facilitate collaboration across experiments and external contributors, e.g. machine learning experts
- allow for novel algorithms and detector components (e.g. timing, track lets)

A **high-performant toolbox** for track reconstruction based on LHC experience

- modern code and software concepts to allow for concurrent computing
- support high luminosity and high precision tracking algorithms

Currently developers from ATLAS, LHCb, FCC-hh

- supporting: FCC-hh, Tracking machine learning challenge

http://acts.web.cern.ch/ACTS/

Motivation ATLAS Tracking SW (> 15 years)

Common set of Tools and interfaces

Tracking					
Geometry (TrkDetDescr)	Event Data Model (TrkEvent)	Extrapolation (TrkExtrapolation)	Fitting (TrkFitter)	Calibration, general (TrkTools)	Alignment (TrkAlignment)

Detector specific extension

InnerDetector		
EDM (InDetRecEvent)	Geometry (InDetTrackingGeometry)	Tools (InDetRecTools)

Calorimeter
Geometry (CaloTrackingGeometry)

MuonSpectrometer		
EDM (MuonRecEvent)	Geometry (MuonTrackingGeometry)	Tools (MuonRecTools)

Fast track simulation extension

ISF_Fatras		
EDM (ISF_FatrasEvent)	Geometry (ISF_FatrasDetDescrTools)	Tools (ISF_FatrasRecoTools)

Status Shift to ACTS modules

ATLAS Tracking modules

Tracking					
Geometry (TrkDetDescr)	Event Data Model (TrkEvent)	Extrapolation (TrkExtrapolation)	Fitting (TrkFitter)	Calibration, general (TrkTools)	Alignment (TrkAlignment)

- Detector
- Volumes
- Layers
- Surfaces
- Material

- EventData

- Extrapolation
- Propagator

- Fitter

- MagneticField
- Tools
- Utilities

ACTS Mission statement

Detector description

Magnetic field

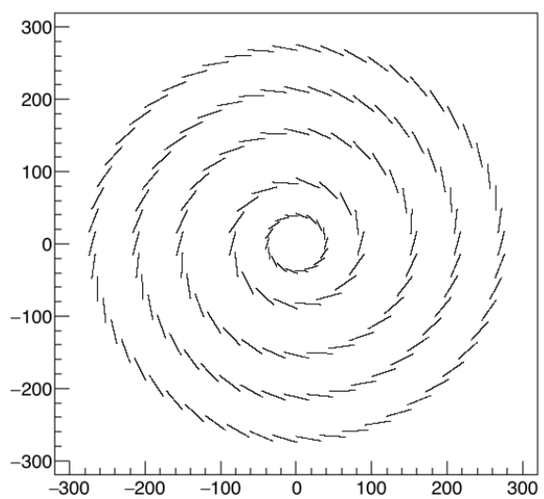
ACTS plugin
(from Geant4, ROOT, etc.)

ACTS plugin
(from ROOT, txt file)

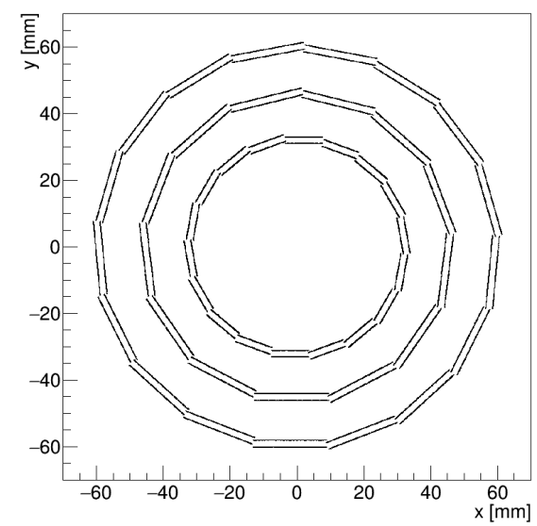
Track reconstruction tools, fast simulation

Examples:

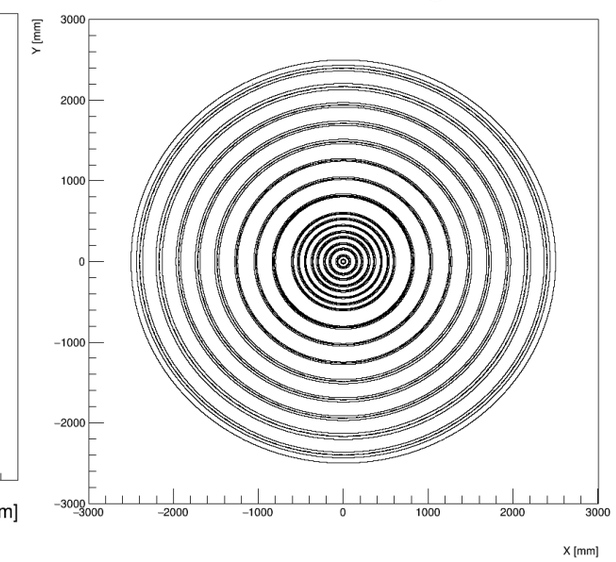
ATLAS ITk Pixel version



CLIC Inner



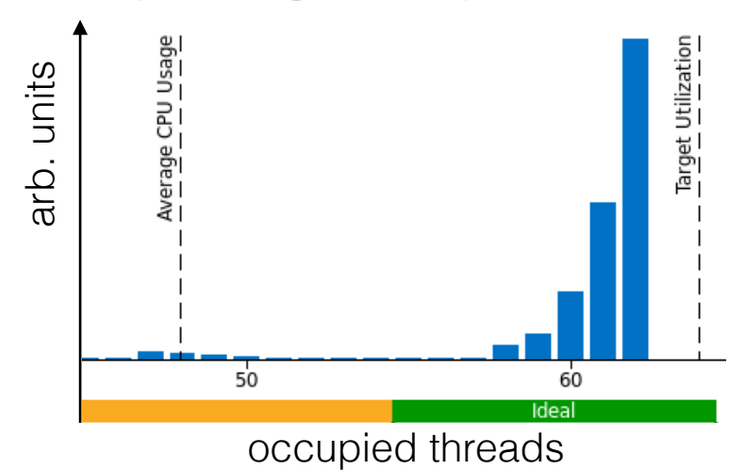
FCC-hh design



Tools implemented to be executed in concurrent computing setup

- flexibility needed to react to future computing hardware architectures (many cores, GPUs, …)

Example: ACTS fast simulation on a 64 thread machine, occupying ~60 threads most of the time



ACTS Toolkit for parallel execution

const-correctness

- [ ] **Remove every use of "mutable" in ACTS**
  !265 · opened 3 days ago by Hadrien Grasland

1 1 9
updated 3 days ago

statelessness

- cache visitor pattern for calls that need to run concurrently

```
namespace Acts {
  /// doxygen documentation
  class WorkHorse {
    /// @struct Config for To
    struct Cache {
       float accumlatedPath; ///< configure the coat colour
    };
    /// method to make the horse run
    /// @param hCache - cache tracker for this horse
    /// @param coords - place where the horse should run to
    /// @return a result, horse may drop dead if max path is reached
    const RunResult run(Cache& hCache, const Vector3D& coords) const;

 };
}
```

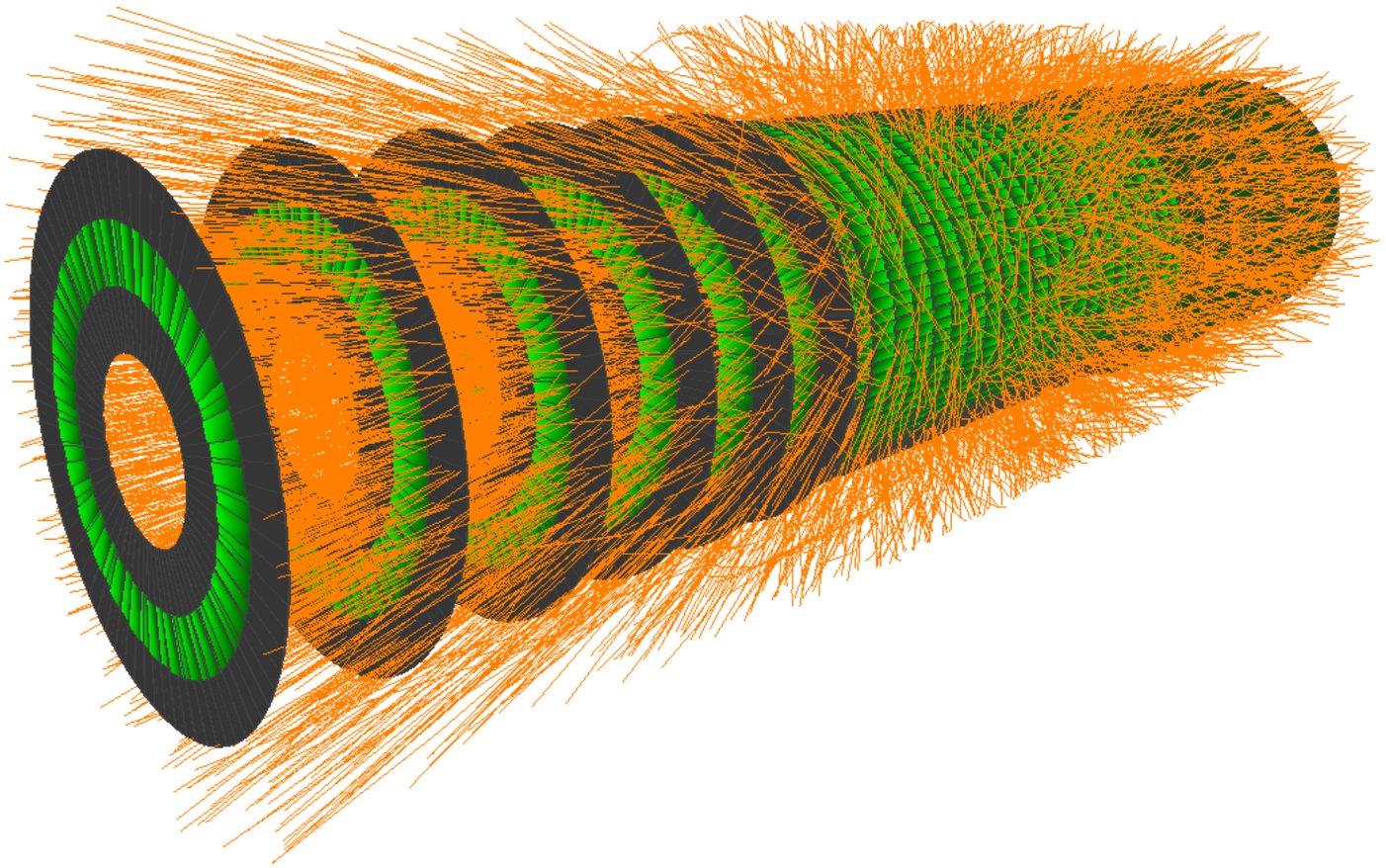
Team ACTS group members/**developers**

Members with access to **acts** 30

- **ACTS Jenkins** @atsjenkins
  Joined 5 months ago
- **Andreas Salzburger** @asalzbur It's you
  Joined a year ago
- **Benedikt Hegner** @hegner
  Joined 5 months ago
- **Christian Gumpert** @cgumpert
  Joined a year ago
- **David Chamont** @chamont
  Joined 3 months ago
- **David Rousseau** @droussea
  Joined 5 months ago
- **Dmitry Emeliyanov** @demelian
  Joined 5 months ago
- **Edward Moyse** @emoyse
  Joined 5 months ago
- **Felice Pantaleo** @fpantale
  Joined a month ago
- **Frank-Dieter Gaede** @fgaede
  Joined 5 months ago
- **Hadrien Grasland** @hgraslan
  Joined 7 months ago
- **Joschka Lingemann** @jlingema
  Joined 5 months ago
- **Julia Hrdinka** @jhrdinka
  Joined a year ago
- **Karolos Potamianos** @karolos
  Joined 5 months ago
- **Marco Rovere** @rovere
  Joined a week ago
- **Markus Elsing** @elsing
  Joined 5 months ago
- **Moritz Kiehn** @msmk
  Joined a year ago
- **Nicholas Styles** @nstyles
  Joined 5 months ago
- **Nicolas Paul Loizeau** @nloizeau
  Joined 2 months ago
- **Noemi Calace** @ncalace
  Joined a year ago
- **Paolo Calafiura** @calaf
  Joined 5 months ago
- **Paul Gessinger** @pagessin
  Joined 2 weeks ago
- **Robert Johannes Langenberg** @rlangenb
  Joined a year ago
- **Sarka Todorova** @nova
  Joined 5 months ago
- **Shaun Roe** @sroe
  Joined 5 months ago
- **Stewart Martin-Haugh** @smh
  Joined 5 months ago
- **Tobias Golling** @golling
  Joined 3 months ago
- **Valentin Volkl** @vavolkl
  Joined a year ago
- **Vincenzo Innocente** @innocent
  Joined 5 months ago
- **Wolfgang Liebig** @liebig
  Joined 5 months ago

ATLAS
LHCb
FCCSW

Backup slides …

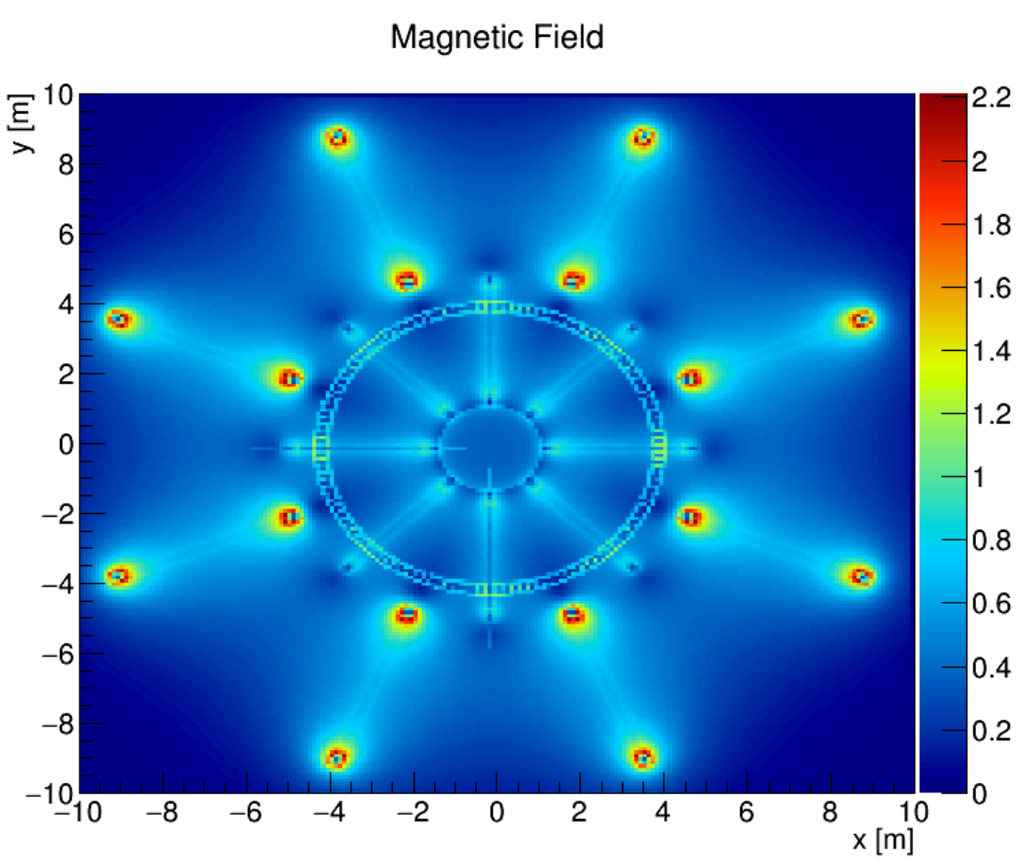


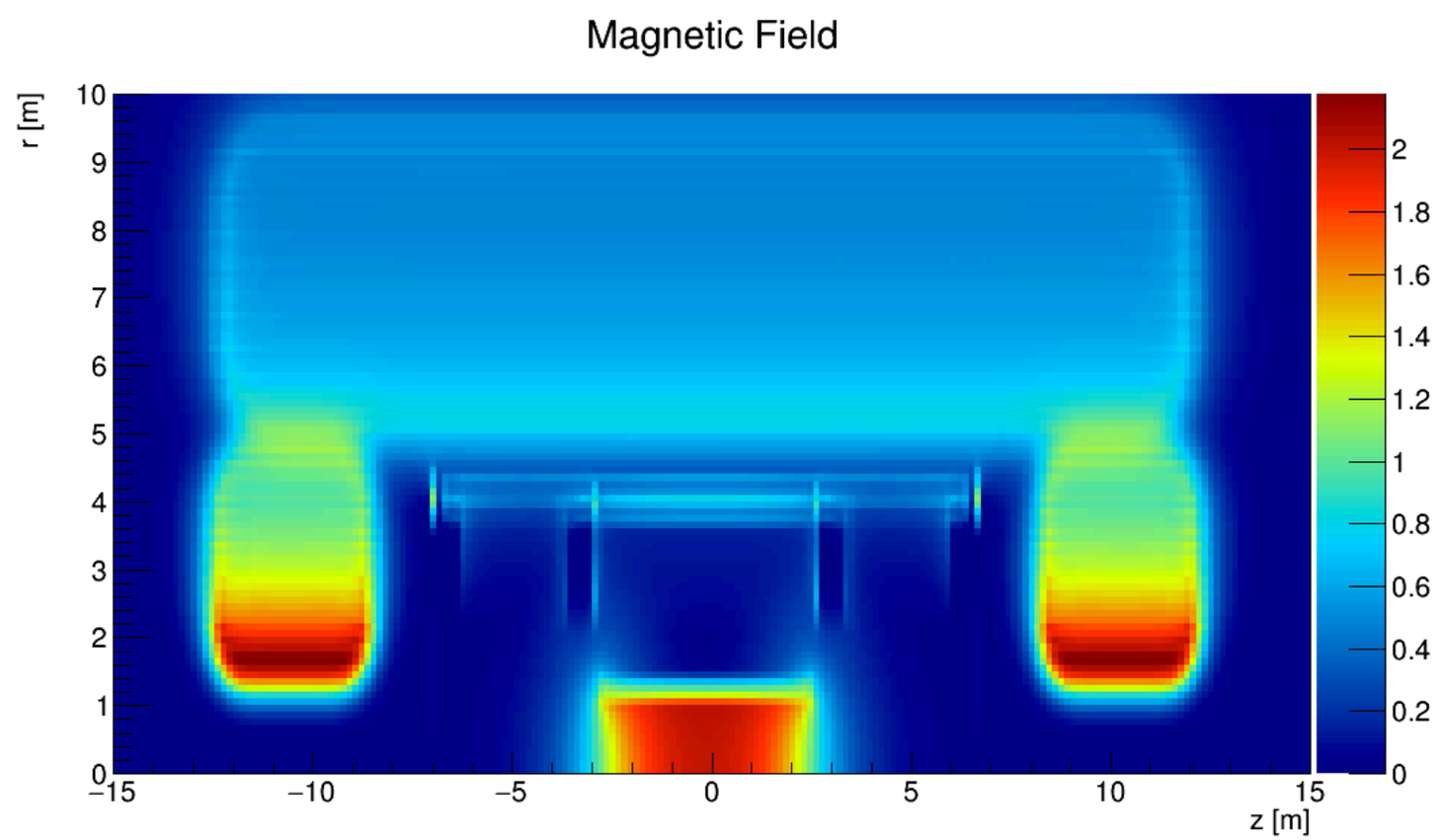
Tracking detector in ACTS with 1000 pileup events and ACTS fast simulation

Status Current magnetic field map support

Tests using different magnetic field inputs within ACTS

- ATLAS map (currently converted from ATLAS root file),
  direct use of ATLAS MagneticFieldSvc possible (template parameter)
- FCC-hh field map





ATLAS magnetic field map in ACTS

Status Binding ACTS with a detector (SW) backend

Geometry binding via DetectorElementBase

```
namespace Acts {
  /// doxygen documentation
  class DetectorElementBase {
    /// the according represented surface
    virtual const Surface& associatedSurface() const = 0;
  };
}
```

```
class MyDetectorElement {
   /// @copydoc DetectorElementBase::asscociatedSurface
   const PlaneSurface& associatedSurface() const;
 };
```