Computing & Software for SCT detector at BINP: status

A. Sukharev

Joint Workshop on future charm-tau factory
hosted by University of Science and Technology of China

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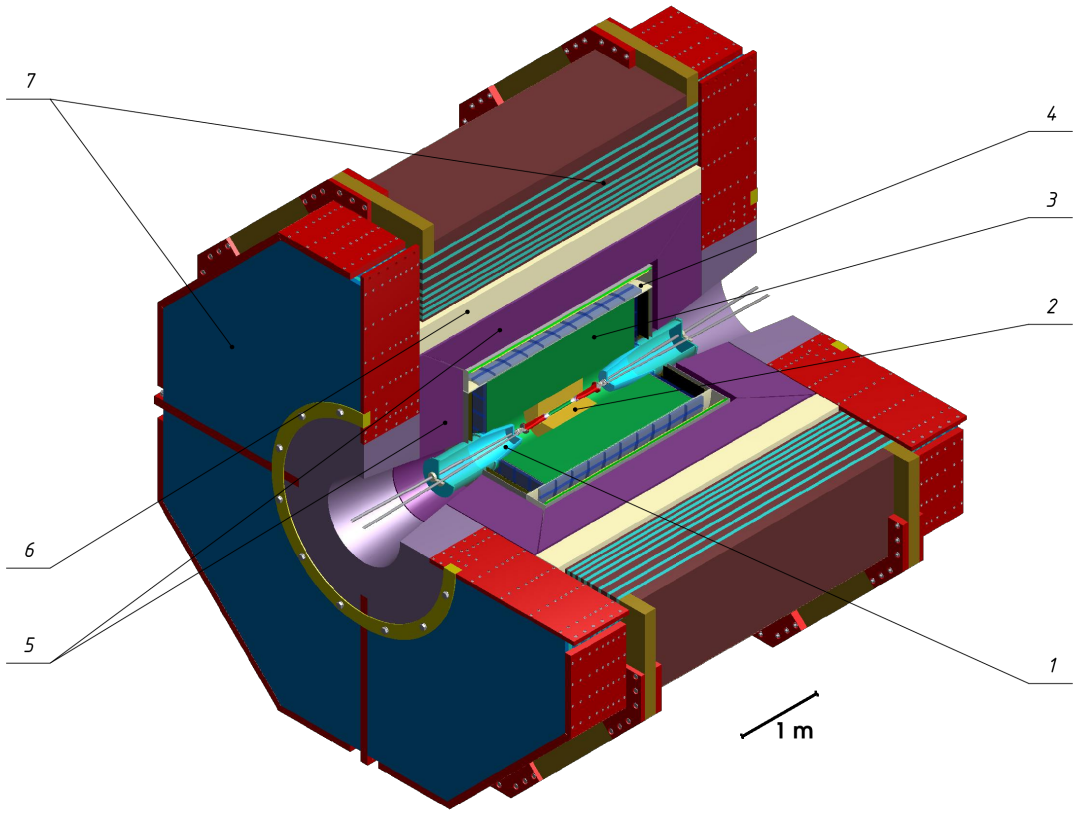
BINP

Novosibirsk State University

Detector overview

Requirements:

- Occupancy 300 kHz
- Good energy and momentum resolution
- High detection efficiency of soft tracks
- Best possible π/K and π/μ separations
- Minimal CP detection asymmetry



	subsystem	options		subsystem	options
1	Beam pipe	beryllium	**2**	Inner tracker	TPC, cGEM, Si-strip
3	Main tracker	drift chamber	**4**	PID system	FARICH, ASHIPH
5	Calorimeter	CsI, LYSO, LXe	**6**	Magnet	thin coil?
7	Muon system	Scintillators, RPC, ...			

Computing infrastructure for the project

- Login servers and general services based on BINP/GCF
  - local computing farm
  - storage area
  - git, wiki, web, mail list...
- Computing resources of Novosibirsk Scientific Center
  - NUSC & SSCC supercomputers
  - ICT SB RAS storage
  - ...available via isolated 10GbE network (SCN)
- Dedicated network link to Moscow
  - 2 Gbps presently
  - direct access to LHCone network

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No lack of computing resources for the present stage of the detector project

Offline computing infrastructure development

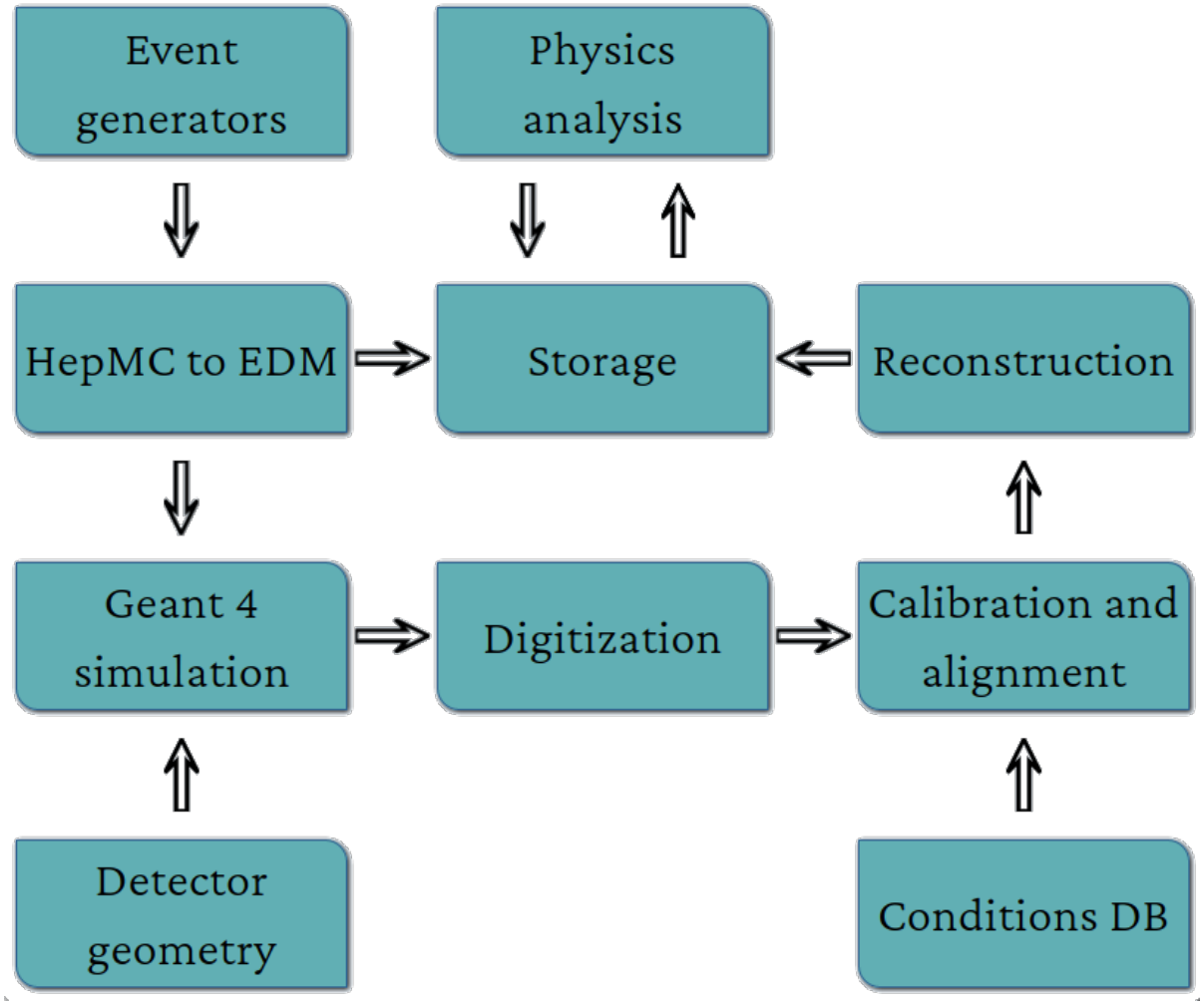
- Development of the simulation model of HPC system for the Super Charm-Tau factory
  - the goal is to estimate parameters and consider various options for computing farms and storage systems for the experiment
  - in cooperation with ICM&MG SB RAS
- Development of the offline data processing and analysis system based on the BioUML platform
  - in cooperation with ICG SB RAS
- Integration of the simulation model and the BioUML-based system

The prototype using container technologies is deployed at SSCC

The activity is supported by three-year RSF grant 19-72-20114

Software for the project

HEP software framework



Status of the software

The Aurora framework

- using Gaudi
- build & configuration system inspired by ATLAS Athena
- `lcgcmake` system to build external packages
- nightly builds
- standard computing environment is Scientific Linux 7 x86_64, GCC8 + Python2&3
- Conventional and recently emerged HEP software tools:
  - ROOT, Geant4
  - FCCSW
  - DD4Hep

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Standalone studies

- Parametric simulation tool for quick estimations of the detector response
- Background simulations with Fluka
- Gas mixture studies and electric field simulations with Garfield for TPC and DC
- CERN team develops TCP variant & adopts track finding algorithms from iLCSoft

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  $\rightarrow$ **now incorporating into the framework**
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- CERN team develops TCP variant
  & adopts track finding algorithms from iLCSoft
  $\rightarrow$ **have a prototype, now incorporating into the framework**

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Geometry in Aurora

- Subsystems implemented to the moment:
  - Beam pipe & final focus magnets
  - Inner tracker (three options)
  - Advanced DC with StereoLayers
  - Particle ID (two options)
  - Crystal calorimeter
  - Simplified s/c coil
  - Muon system & yoke
- Geometry testing tools for CI

  (overlaps, material scans. . .)

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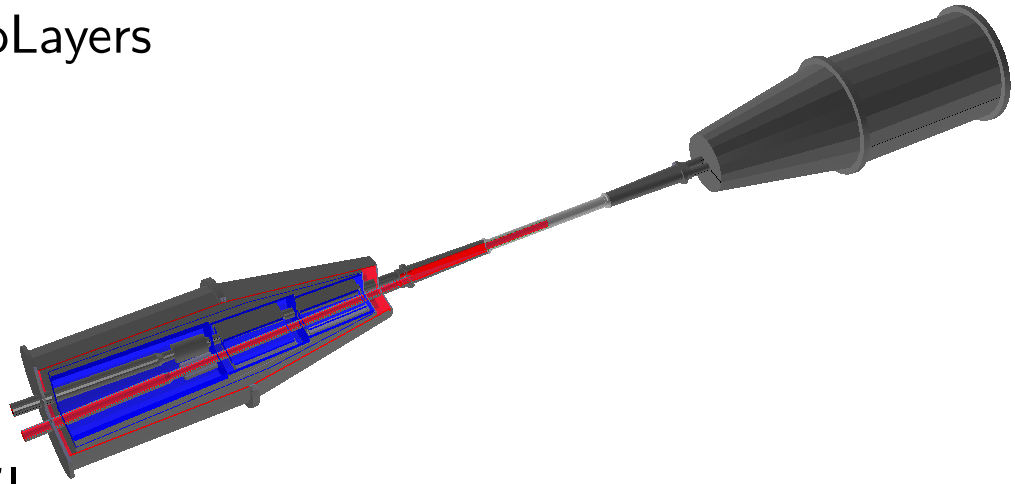

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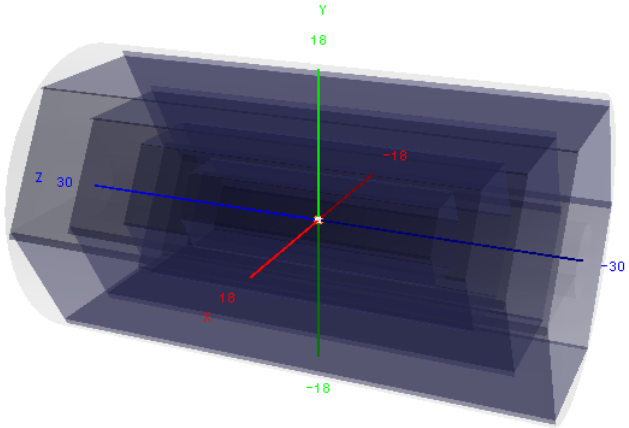

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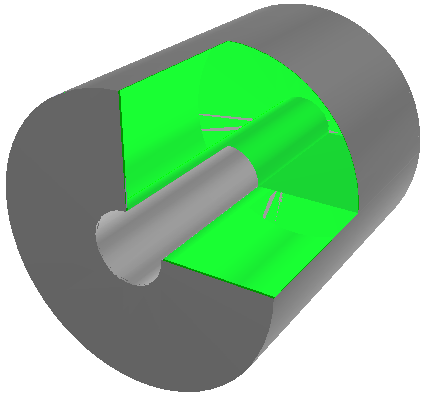

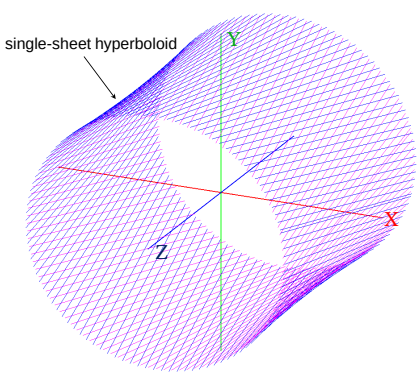

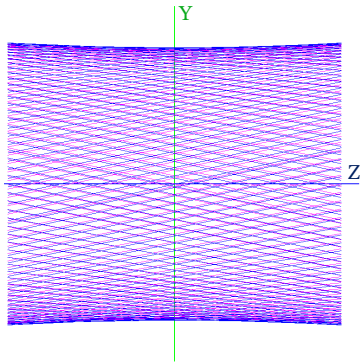

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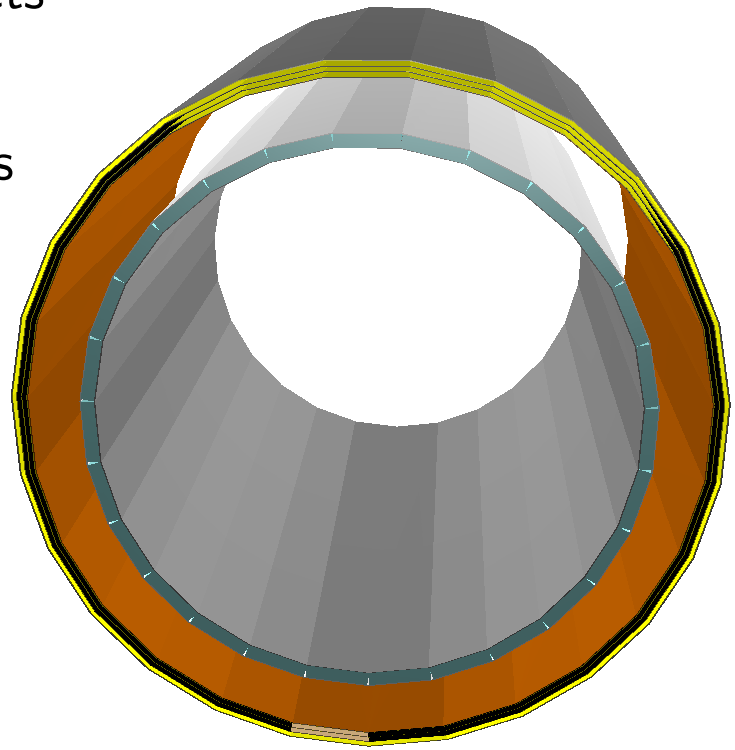

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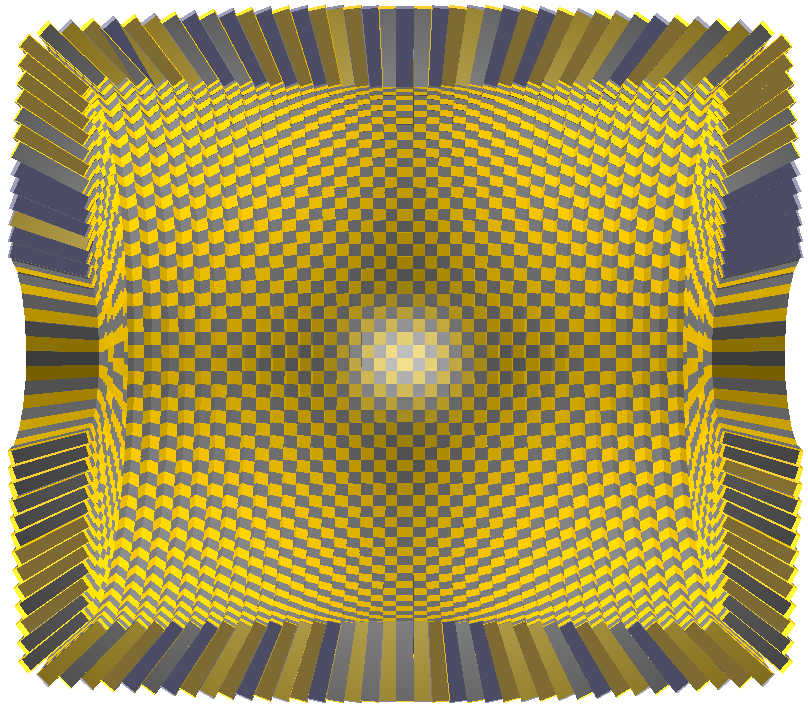

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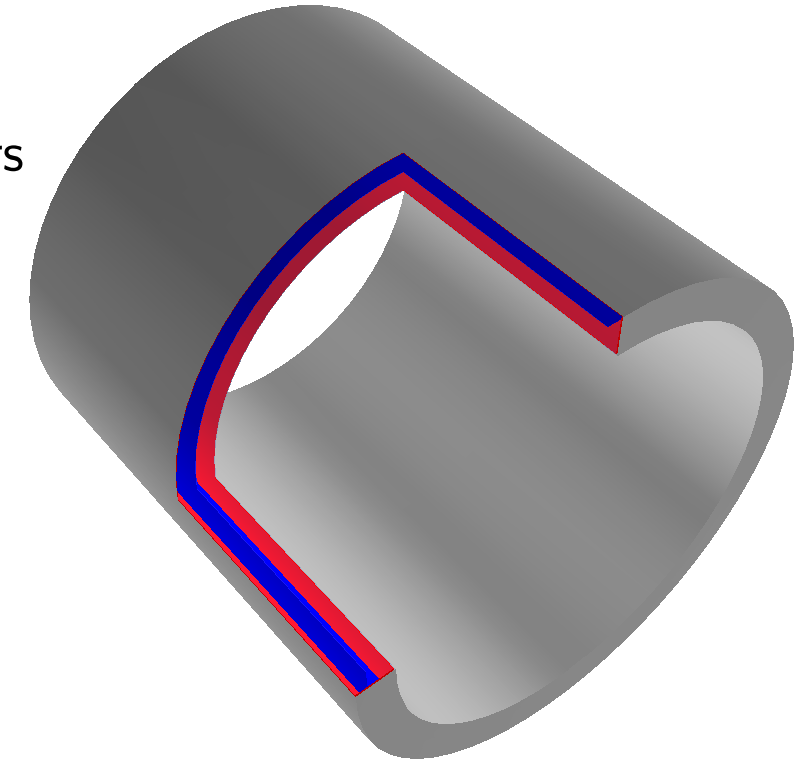

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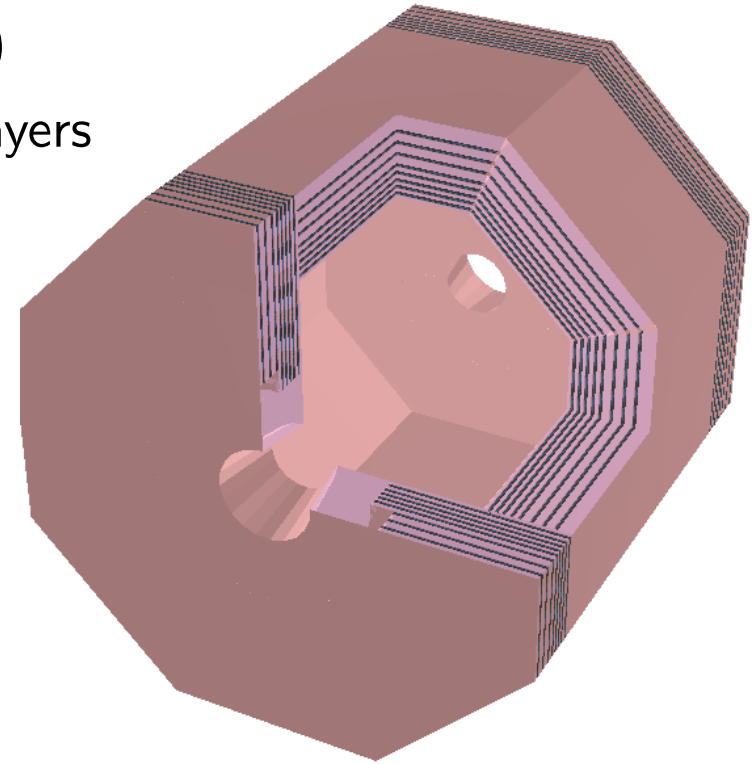

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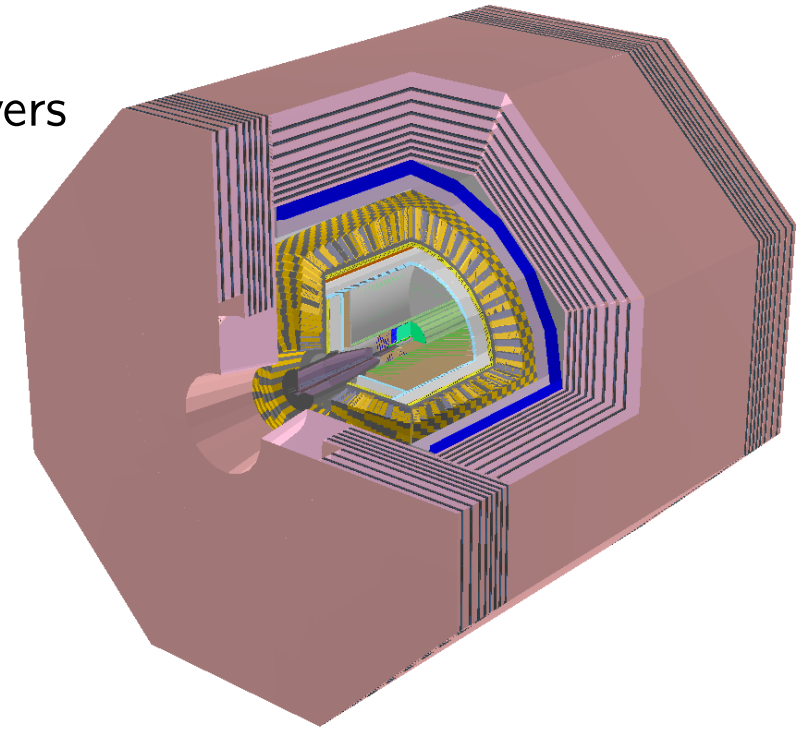

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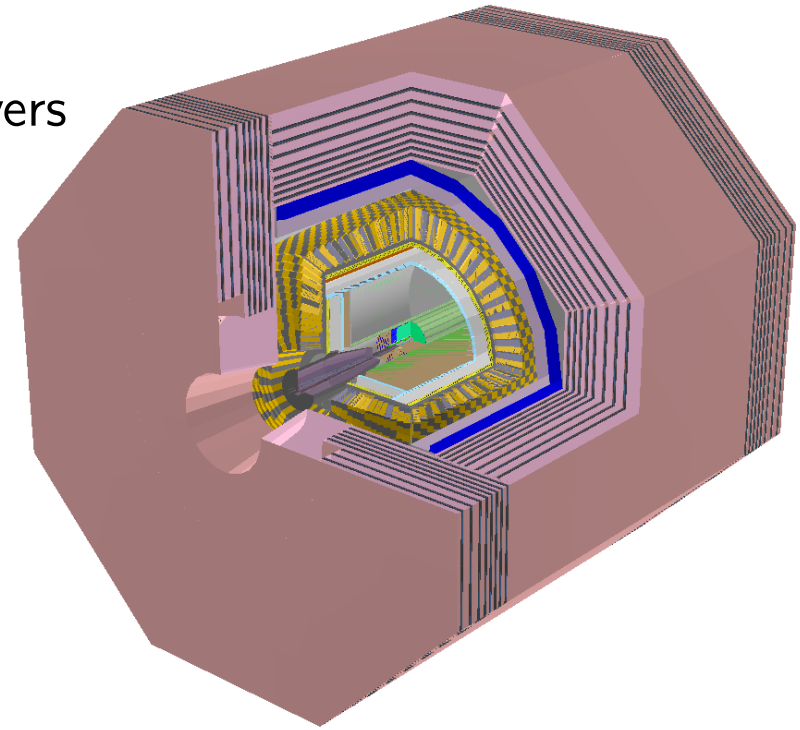

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- Major To Do: production-ready magnetic field description

Status of the software

Reconstruction

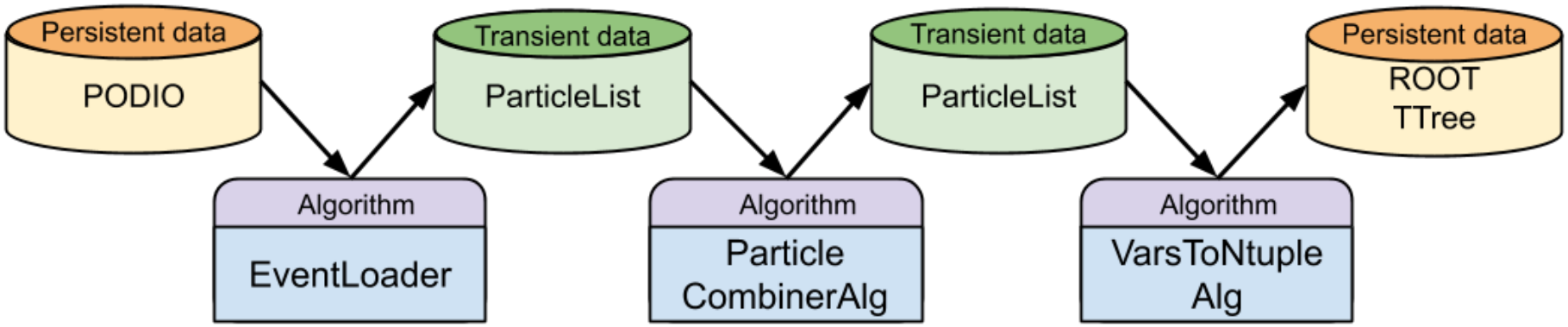
- 1st stage: individual subsystem level
  - in preparation by subsystem groups
  - Calorimeter and DC most advanced at the moment
  - testing various options and packages (GenFit, ACTS...)
- 2st stage: combining subsystems, PID...

  $\rightarrow$ scheduled for next year
- no separate Digitization stage yet
  - integrated into reconstruction
  - based on standalone studies
- the Event Data Model is to be finalized $\rightarrow$ EDM4hep

Status of the software

Event Generation & Data Analysis

- Base set of generators available, with common EvtGen interface
- Adopting Belle II recipes and solutions for analysis
- Base set of analysis algorithms ready:



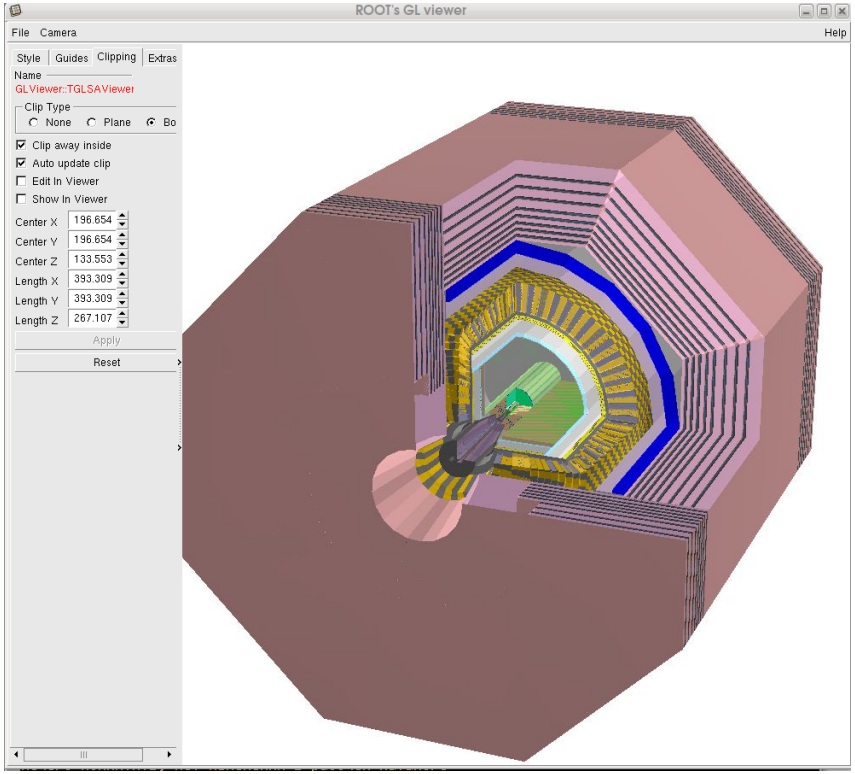
- final particles processing
- kinematic cuts

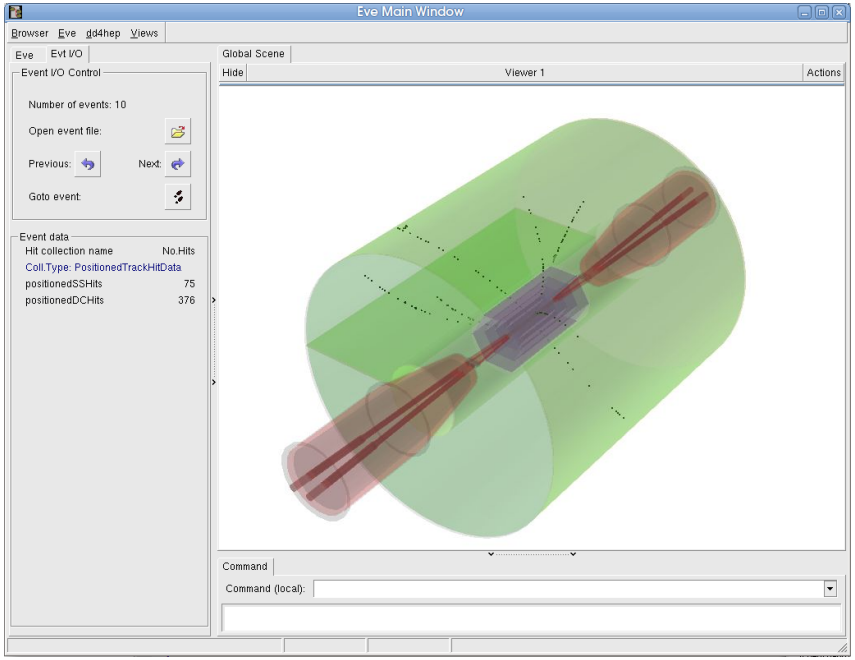
- reconstructuion of decayed particle
- kinematic cuts

- kinematic parameters calculation
- particle selection

Status of the software

Detector/Event Display





- Geometry display tool is ready
- Event display (DDEve-based) available, lots of things to improve
  - show events at subsystem segmentation level
  - draw tracks from G4 hits
  - ...

Conclusions

- Software & computing for the SCTF project at BINP improves continuously,
- despite of external difficulties, good progress achieved:
  - the software framework evolves
  - standalone things merge to the framework
  - new systems introduced
  - geometry generally ready, the primary goal is reconstruction now
- Lots of activities are going to be completed till the end of year
- **The first official release is scheduled for the spring.**

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