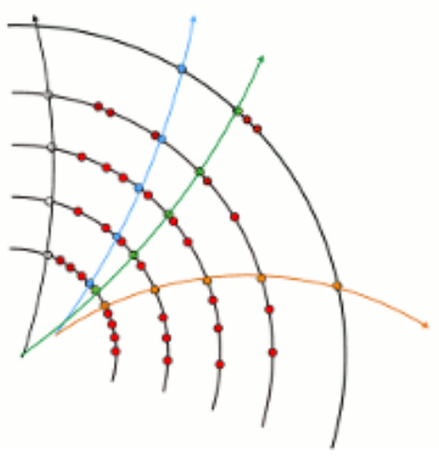

ACTS: learn by examples

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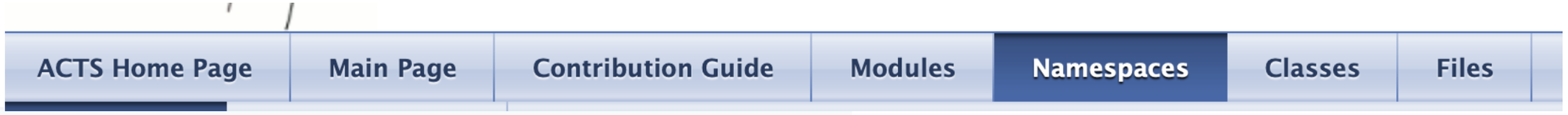
Get familiar with ACTS

- Documentation:
  - http://acts.web.cern.ch/ACTS/
  - http://acts.web.cern.ch/ACTS/latest/doc/index.html
  - https://indico.cern.ch/category/7968/ (meetings)
- **Best way to learn it by example(s)**
  - https://gitlab.cern.ch/jinz/acts-framework-cepc/-/tree/master/
  - **https://gitlab.cern.ch/acts/acts-core**



Modules

Here is a list of all modules:

▼ **Design and concept descriptions**	Description of general concepts used in ACTS
Debug output options	Description of debug output options
▼ **Core classes**	ACTS core classes
Tracking geometry	Description of the tracking geometry
Event data model	Event data model
Track extrapolation	Algorithms for extrapolation of track parameters
Track fitters	Algorithms for track fitting
Layers	Description of detector layers
Magnetic field	Description of magnetic field configurations
Material	Description of material properties
Geometric surfaces	Description of geometric surfaces
Tools	Geometry building tools
Helper classes	Helper utilities
Volumes	Description of geometric volumes
Examples	ACTS Examples
▼ **Plugins**	ACTS extensions
DD4hepPlugins	Build ACTS tracking geometry from *DD4hep* input
MaterialPlugins	Map material onto the ACTS geometry
Contribution guide	

STEP 1: INSTALLATION

```
_ export workdir="/cefs/higgs/lig/ACTS-related/acts_nb"
  cd $workdir
  source $workdir/acts-fw/external/acts-core/CI/setup_lcg95.sh

  mkdir -p build && rm -fr build/*
  cd build
  cmake -DACTS_BUILD_DD4HEP_PLUGIN=ON -DACTS_BUILD_EXAMPLES=ON \
     -DACTS_BUILD_TGEO_PLUGIN=ON -DCMAKE_INSTALL_PREFIX=$workdir\
     -DUSE_DD4HEP=ON -DUSE_GEANT4=ON -DUSE_PYTHIA8=ON -DUSE_TGEO=ON \
     -Ddfelibs_BUILD_EXAMPLES=ON -Ddfelibs_BUILD_UNITTESTS=ON \
     -Ddfelibs_ENABLE_INSTALL=ON $workdir/acts-fw
   make install -j16

   source $workdir/bin/this_acts.sh
~
```

- Once code modified: “make install” in build

STEP 2: SETUP ENV.

```
export workdir="/cefs/higgs/lig/ACTS-related/acts_nb"
source $workdir/acts-fw/external/acts-core/CI/setup_lcg95.sh
source $workdir/bin/this_acts.sh
```

```
[11:20 AM]: /cefs/higgs/lig/ACTS-related/acts_nb$ tree -L 1
.
|-- acts-fw
|-- bin
|-- build
|-- env.sh
|-- include
|-- install.sh
|-- jobs
|-- lib64
`-- share
```

Once code modified: “make install” in build

STEP 3: TRY EXAMPLES

```
[11:17 AM]: /cefs/higgs/lig/ACTS-related/acts_nb$ ls bin/
ACTFWAlignedGeometryExample*              ACTFWPayloadPropagationExample*
ACTFWAlignedPropagationExample*           ACTFWTGeoGeometryExample*
ACTFWBFieldAccessExample*                 ACTFWTGeoPropagationExample*
ACTFWBFieldExample*                       ACTFWVertexFinderExample*
ACTFWDD4hepGeometryExample*               ACTFWVertexFitterExample*
ACTFWDD4hepMaterialMappingExample*        ACTFWVertexReaderExample*
ACTFWDD4hepMaterialValidationExample*     ACTFWVertexWriterExample*
ACTFWDD4hepPropagationExample*            ActsGenParticleGun*
ACTFWEmptyGeometryExample*                ActsGenPythia8*
ACTFWEmptyPropagationExample*             ActsRecTruthTracks*
ACTFWGeantinoRecordingExample*            ActsSimFatrasAligned*
ACTFWGenericGeometryExample*              ActsSimFatrasDD4hep*
ACTFWGenericMaterialMappingExample*       ActsSimFatrasGeneric*
ACTFWGenericMaterialValidationExample*    ActsSimFatrasPayload*
ACTFWGenericPropagationExample*           ActsSimFatrasTGeo*
ACTFWGenericReadCsvExample*               ActsTabulateEnergyLoss*
ACTFWHelloWorldExample*                   this_acts.sh
ACTFWPayloadGeometryExample*
```

Get help: ACTFWDD4hepGeometryExample -h

ACTS version and Geometry

- Latest ACTS: Core, Fatras, and framework
- **branch** make-rec-run-with-DD4hep from Jin Zhang
- Some minor changes for compilation and install
- TPC doesn't work in the latest version of ACTS, others seem OK
- Jin will fixed this in new version of ACTS

ActsSimFatrasDD4hep

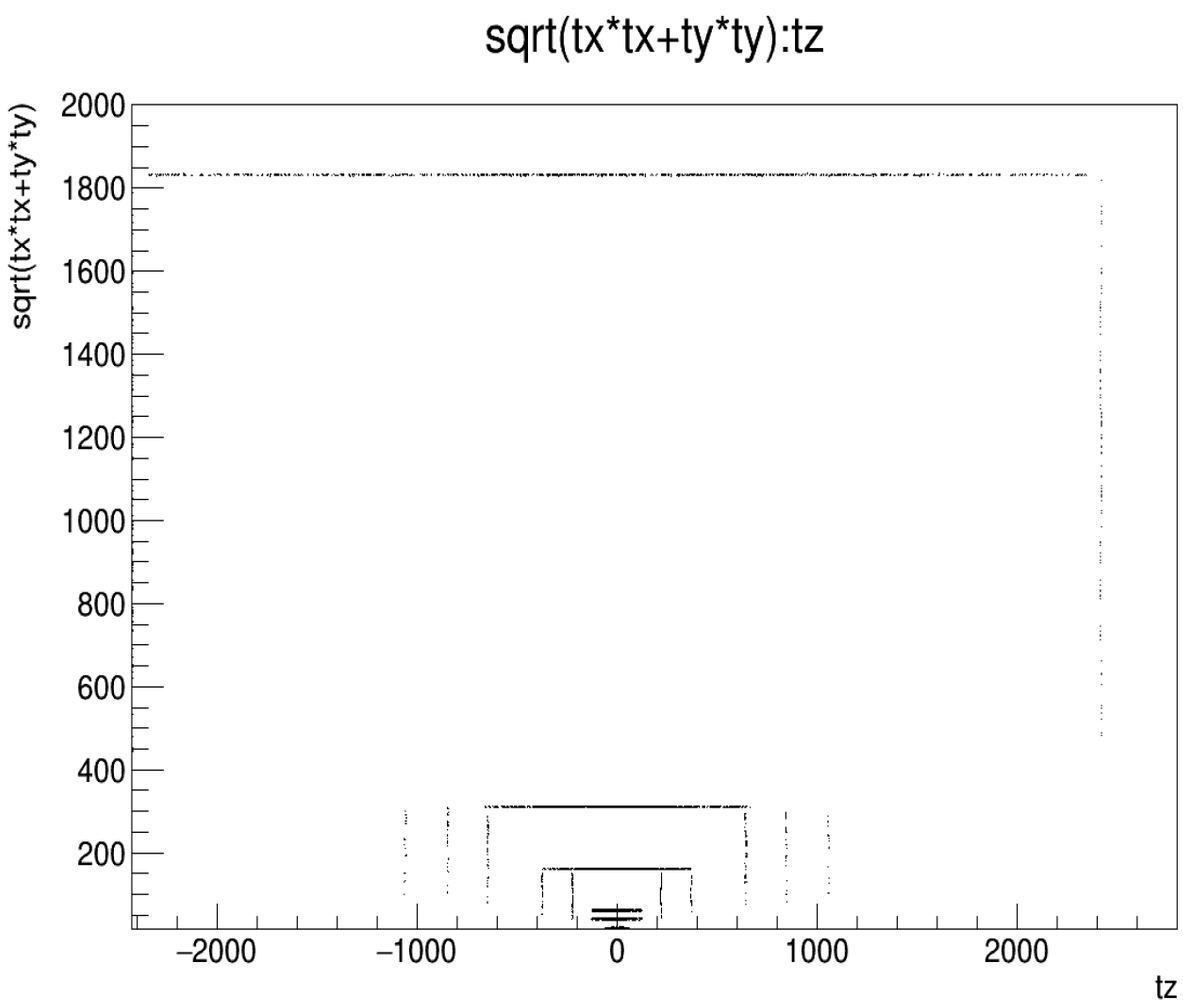
- Including event generation (particle gun and pythia8), simulation, simple digitization, and track reconstruction. (8 algorithms, 7 writers and 1 writer)
- ActsSimFatrasDD4hep --fatras-pmin-gev 0.1 --dd4hep-input ../acts-fw/Detectors/DD4hepDetector/compact/CEPC/cepc_v04_master.xml --bf-values 0 0 3 --evg-input-type gun --output-root 1 -n 10000

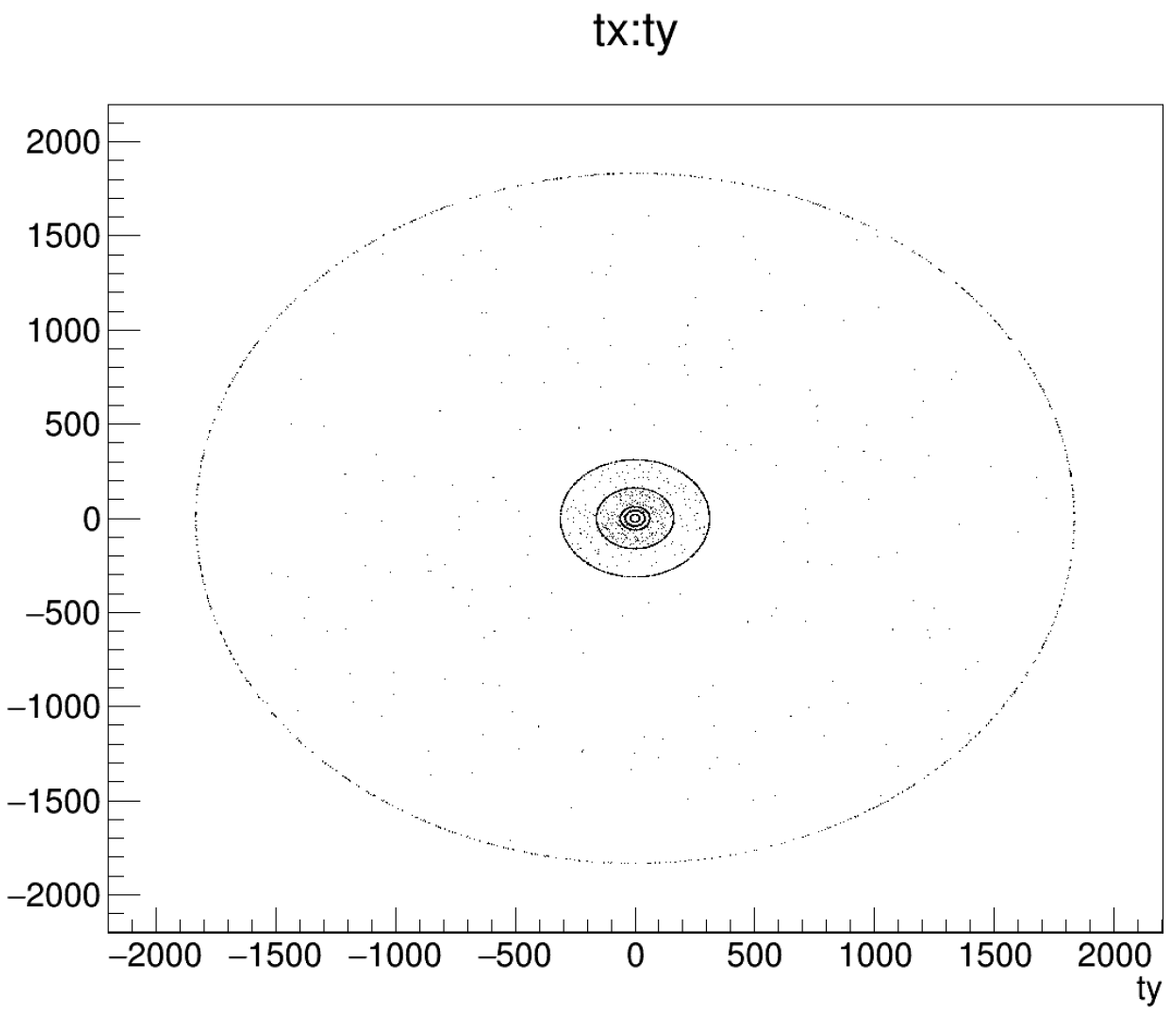
- Successfully got 7 root outputs:
  - performance_track_finder.root
  - performance_track_fitter.root
  - tracks.root
  - hits.root
  - particles_initial.root
  - particles_final.root
  - particles.root

```
// Gaussian sigmas to smear particle parameters
particleSmearingCfg.sigmaD0    = 20_um;
particleSmearingCfg.sigmaD0PtA = 30_um;
particleSmearingCfg.sigmaD0PtB = 0.3 / 1_GeV;
particleSmearingCfg.sigmaZ0    = 20_um;
particleSmearingCfg.sigmaZ0PtA = 30_um;
particleSmearingCfg.sigmaZ0PtB = 0.3 / 1_GeV;
particleSmearingCfg.sigmaPhi   = 1_degree;
particleSmearingCfg.sigmaTheta = 1_degree;
particleSmearingCfg.sigmaPRel  = 0.01;
particleSmearingCfg.sigmaT0    = 1_ns;
```

hits.root

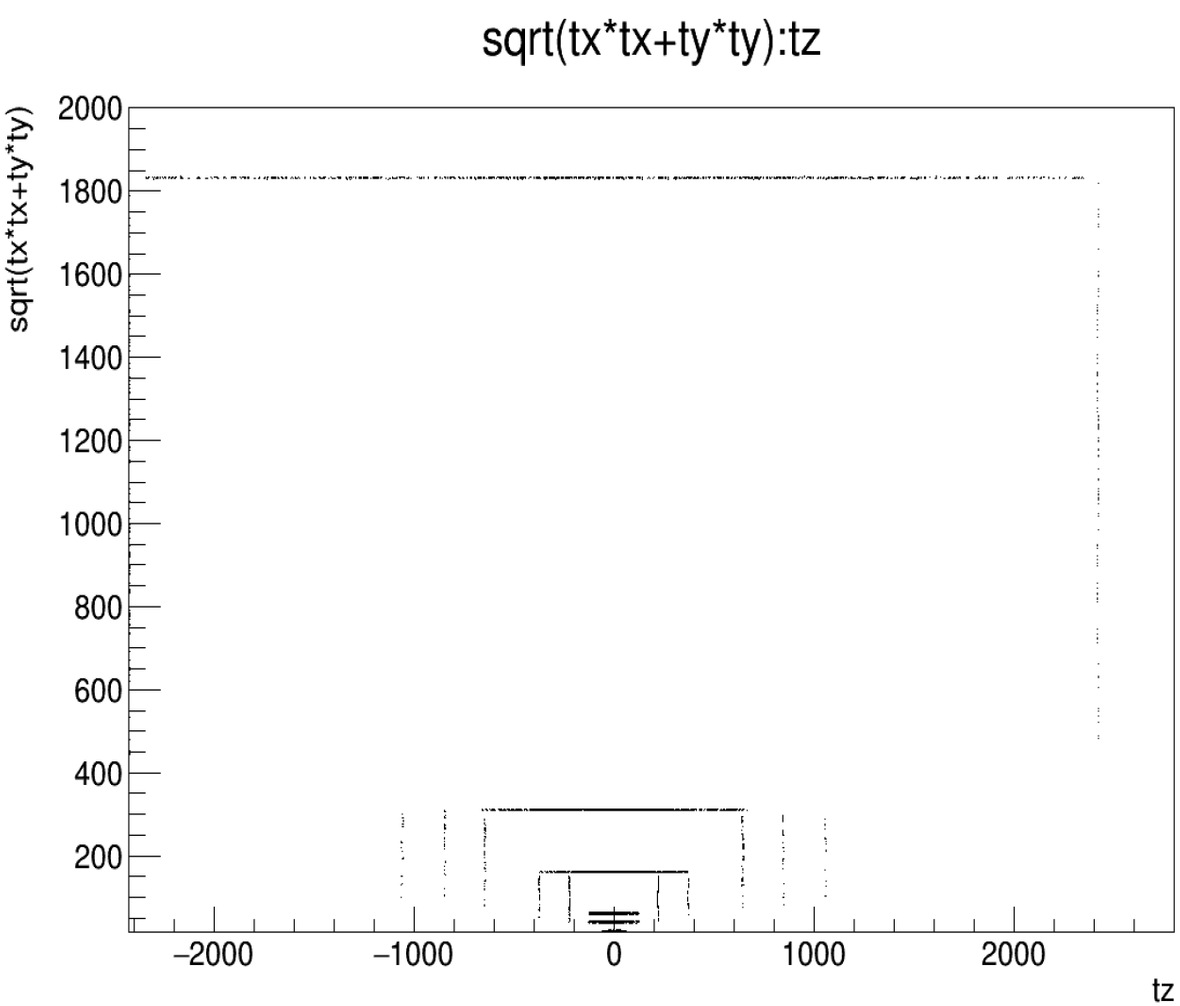
- hits:root hits (xyzt), δp(xyze), indices, ids

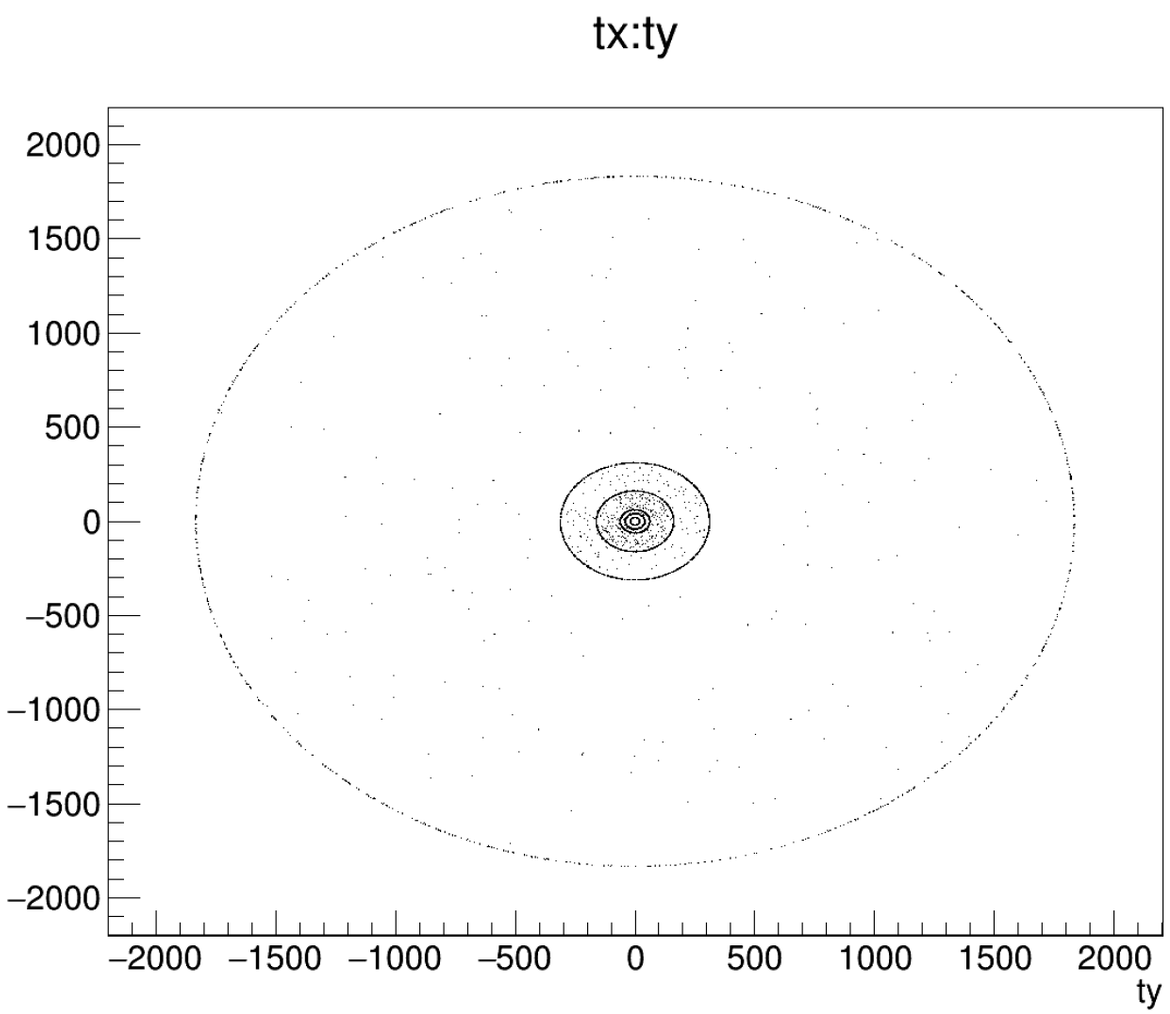




No TPC

hits.root

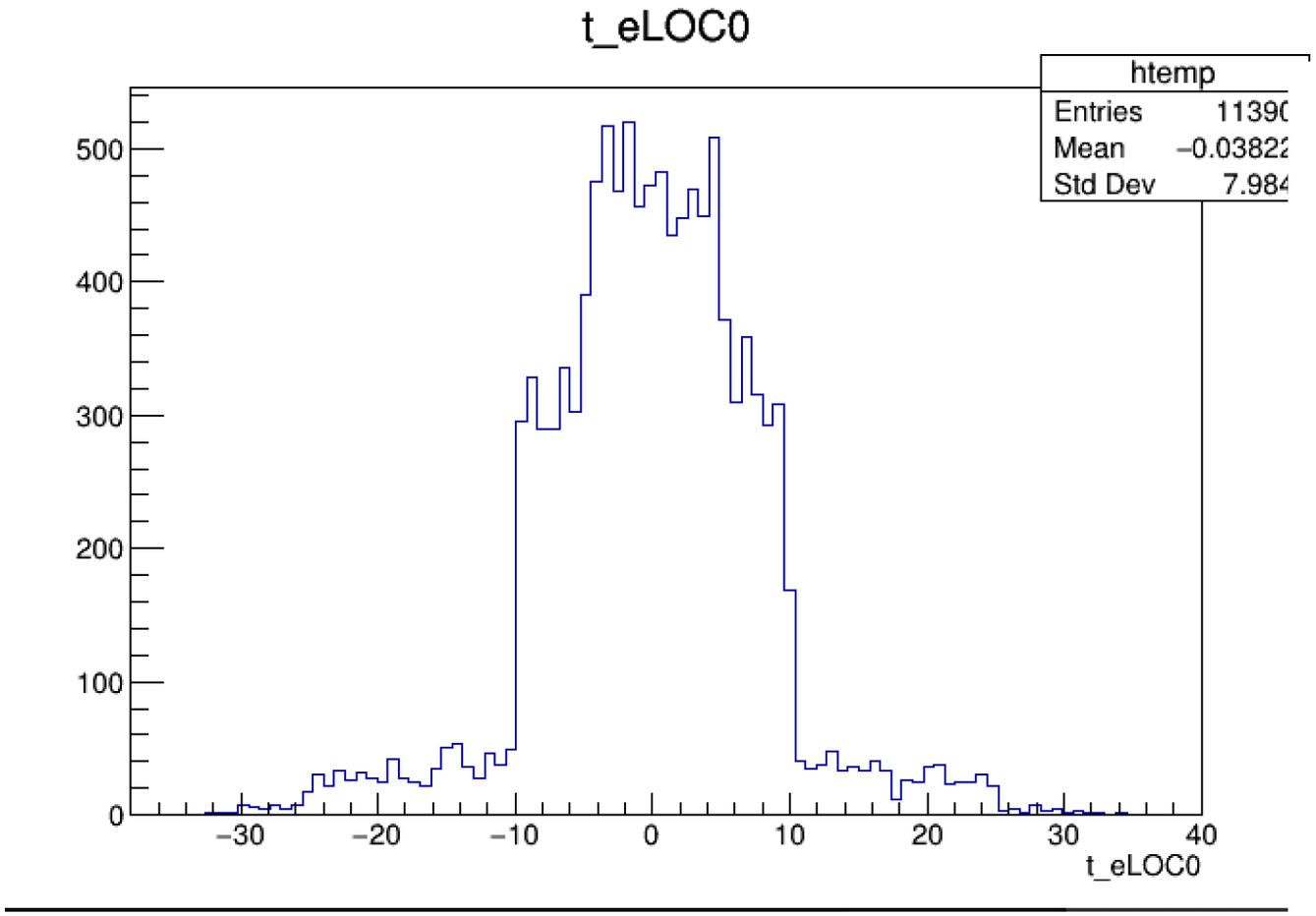


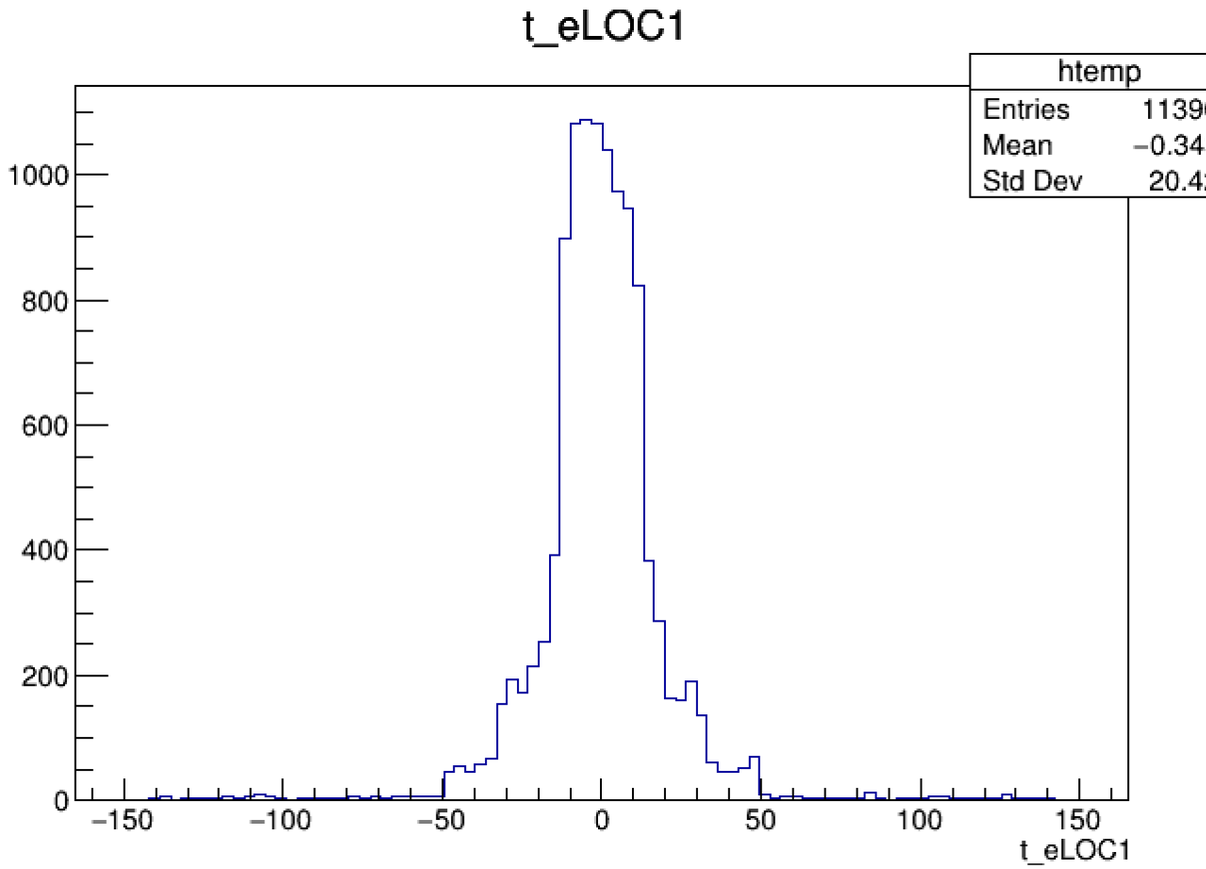


No TPC

tracks.root

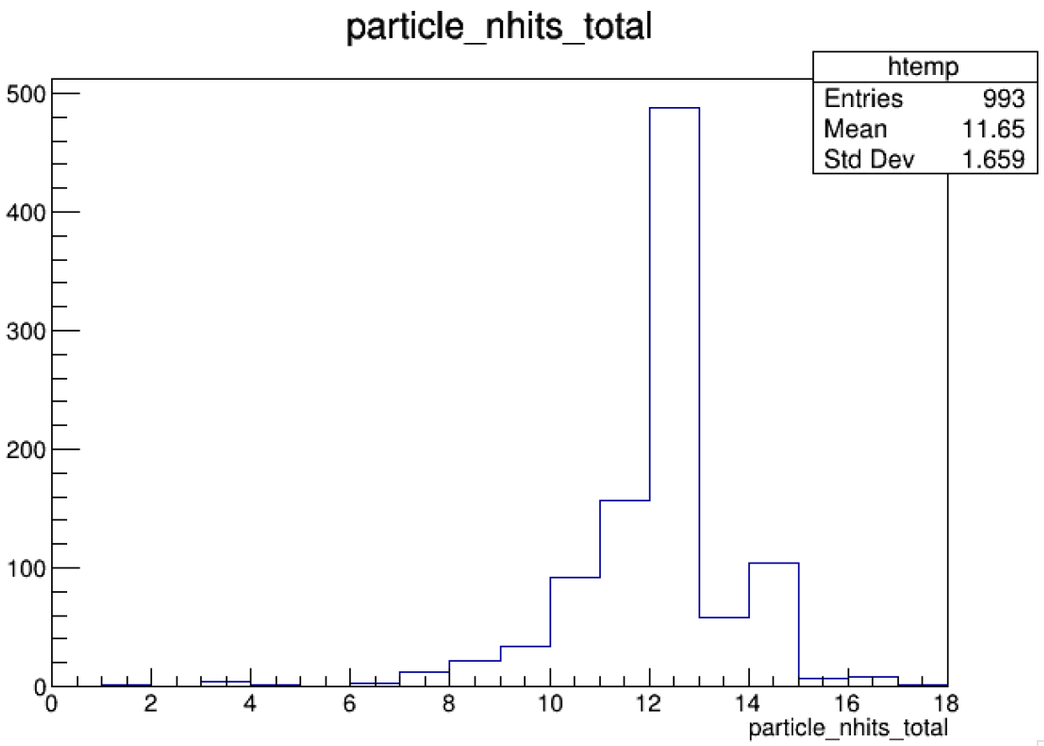
- Many information: smear, smooth, fit, …

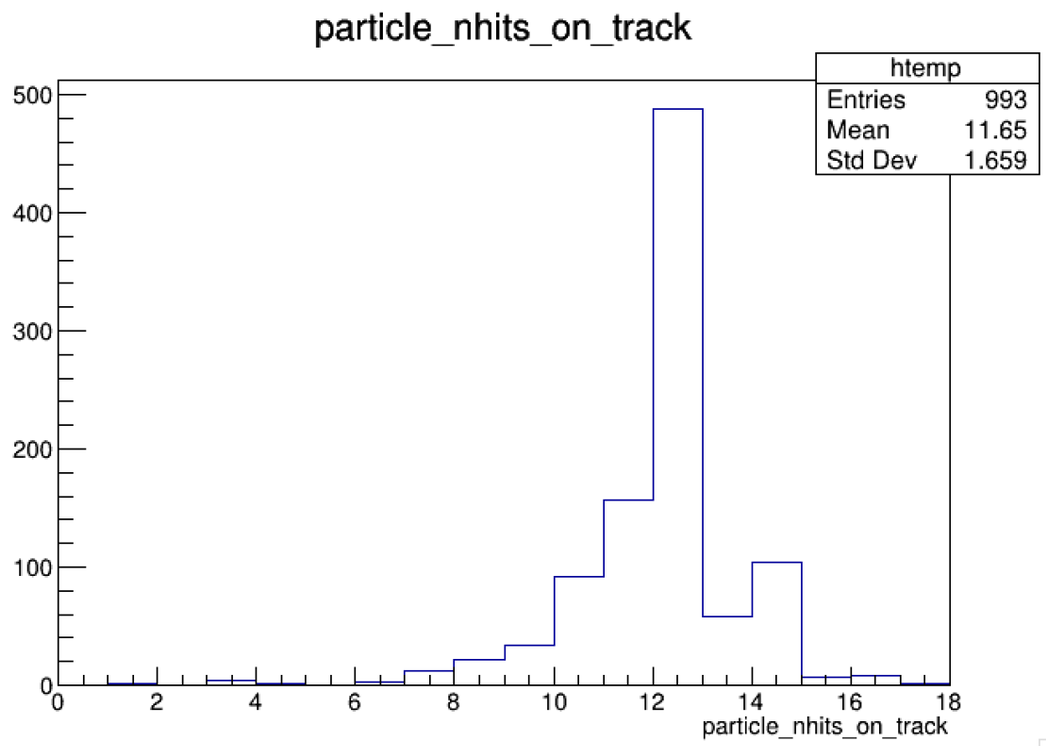




performance_track_finder.root

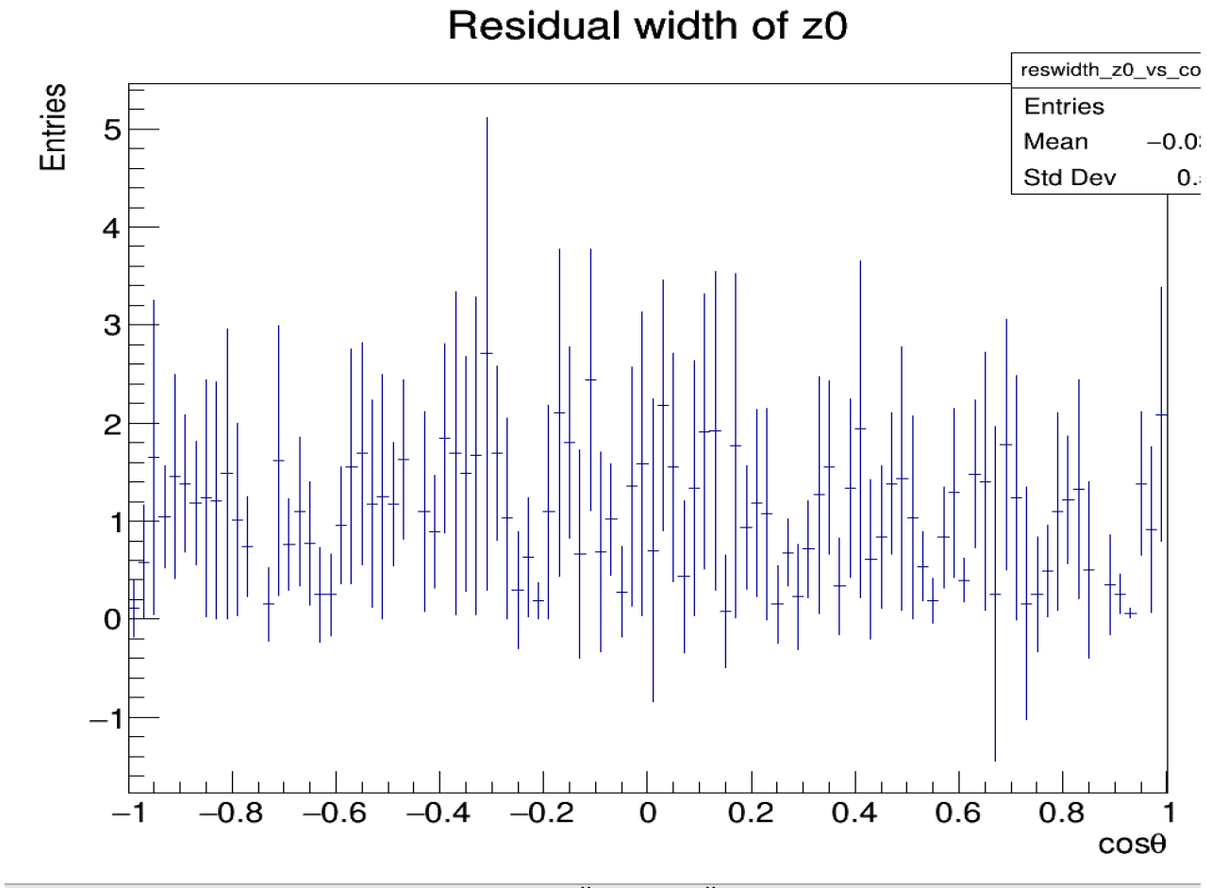
- hits:root hits (xyzt), δp(xyze), indices, ids

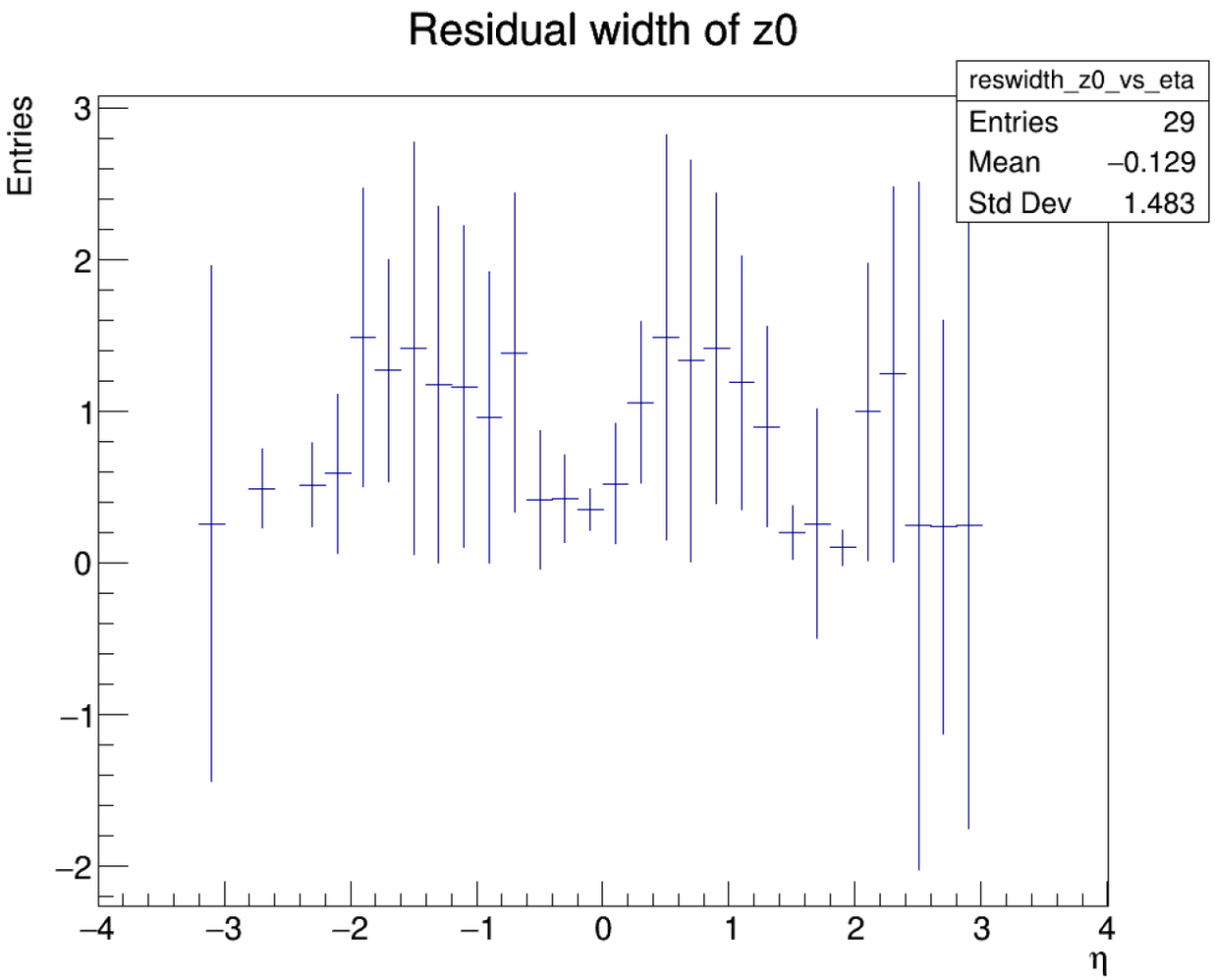




performance_track_fitter.root

- Resolutions: cos theta implemented





Summary & Plan

- Geometry implemented, need validation in new version
- Generator option for e^+e^- collision
- Plan
  - Fix TPC problem in new version, validate geometry
  - More sophisticated digitization
  - Give some performance results
  - …