

A framework to generate high quality animations of HEP events

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Summary

- Objectives
- Python code for Blender
- ALICE Open Data
- Animation display

Objectives

- Generate HEP animations
→ outreach and education

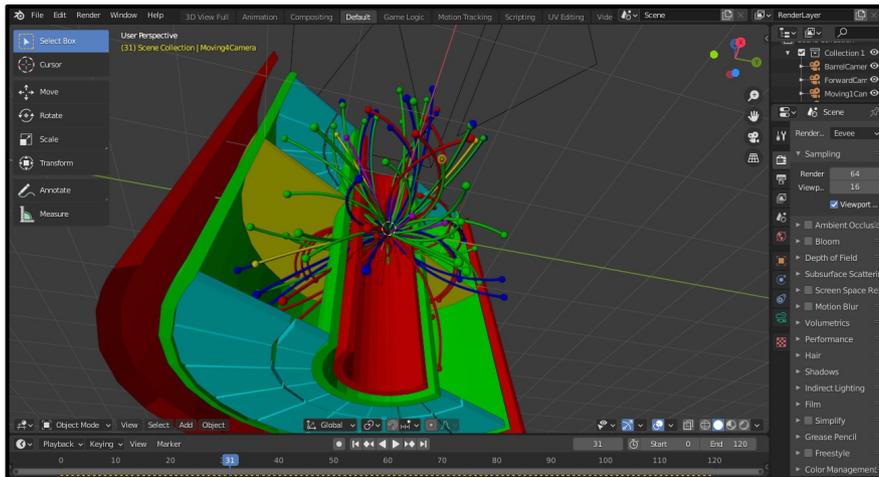
- List of particles kinematics → trajectories

The code

→ Object-oriented



→ 3D Modeling software

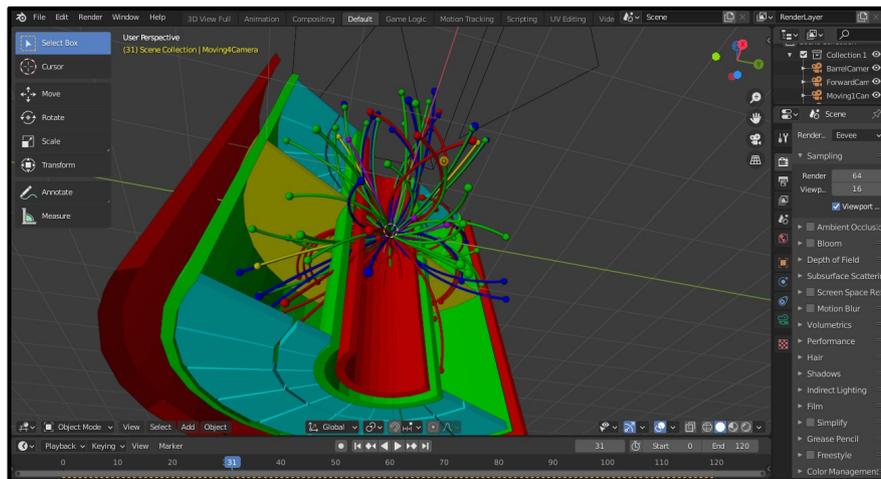


The code

→ Object-oriented



→ 3D Modeling software



→ Detector geometries

→ Particle representation

→ Different cameras

The *animationDriver* base class

- Sets video details:
 - duration, FPS, output path, resolution
 - simulated time

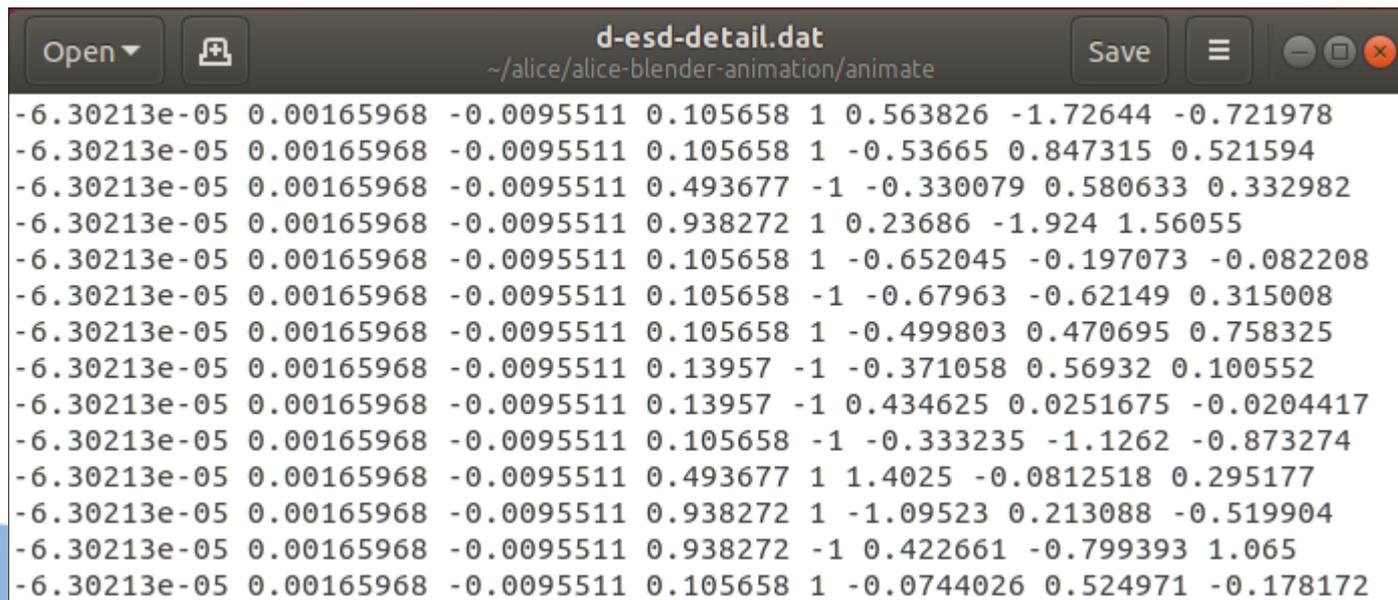
The *animationDriver* base class

→ Sets video details:

- duration, FPS, output path, resolution
- simulated time

→ Derived class *dataDriver*:

- reads relevant physics data

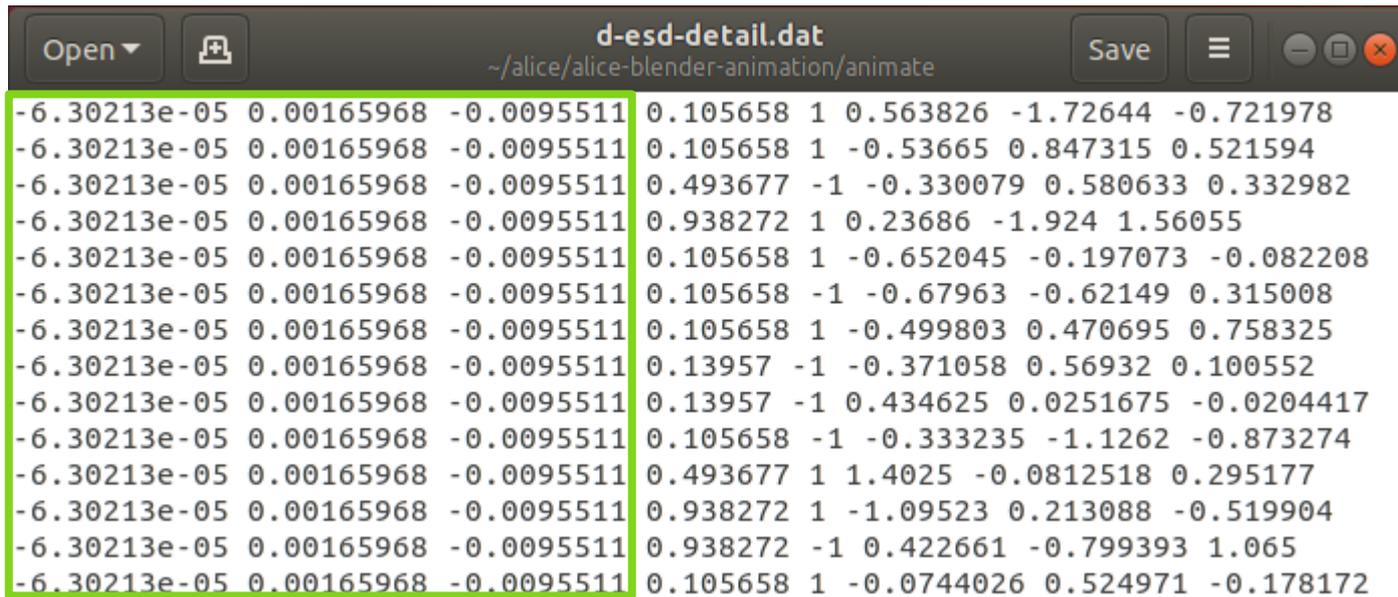


The screenshot shows a window titled "d-esd-detail.dat" with a file path of "~/alice/alice-blender-animation/animate". The window contains a table of data with 10 rows and 9 columns. The data is as follows:

-6.30213e-05	0.00165968	-0.0095511	0.105658	1	0.563826	-1.72644	-0.721978	
-6.30213e-05	0.00165968	-0.0095511	0.105658	1	-0.53665	0.847315	0.521594	
-6.30213e-05	0.00165968	-0.0095511	0.493677	-1	-0.330079	0.580633	0.332982	
-6.30213e-05	0.00165968	-0.0095511	0.938272	1	0.23686	-1.924	1.56055	
-6.30213e-05	0.00165968	-0.0095511	0.105658	1	-0.652045	-0.197073	-0.082208	
-6.30213e-05	0.00165968	-0.0095511	0.105658	-1	-0.67963	-0.62149	0.315008	
-6.30213e-05	0.00165968	-0.0095511	0.105658	1	-0.499803	0.470695	0.758325	
-6.30213e-05	0.00165968	-0.0095511	0.13957	-1	-0.371058	0.56932	0.100552	
-6.30213e-05	0.00165968	-0.0095511	0.13957	-1	0.434625	0.0251675	-0.0204417	
-6.30213e-05	0.00165968	-0.0095511	0.105658	-1	-0.333235	-1.1262	-0.873274	
-6.30213e-05	0.00165968	-0.0095511	0.493677	1	1.4025	-0.0812518	0.295177	
-6.30213e-05	0.00165968	-0.0095511	0.938272	1	-1.09523	0.213088	-0.519904	
-6.30213e-05	0.00165968	-0.0095511	0.938272	-1	0.422661	-0.799393	1.065	
-6.30213e-05	0.00165968	-0.0095511	0.105658	1	-0.0744026	0.524971	-0.178172	

The *animationDriver* base class

- Sets video details:
 - duration, FPS, output path, resolution
 - simulated time
- Derived class *dataDriver*:
 - reads relevant physics data



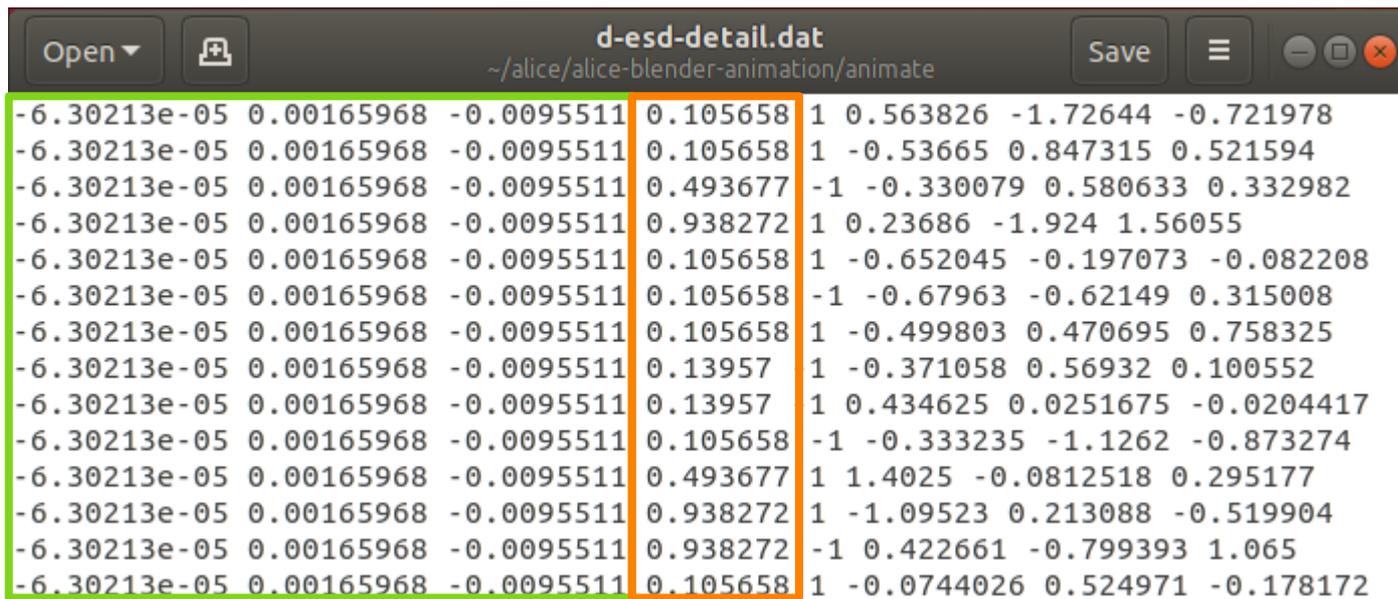
```
d-esd-detail.dat
~/alice/alice-blender-animation/animate

-6.30213e-05 0.00165968 -0.0095511 0.105658 1 0.563826 -1.72644 -0.721978
-6.30213e-05 0.00165968 -0.0095511 0.105658 1 -0.53665 0.847315 0.521594
-6.30213e-05 0.00165968 -0.0095511 0.493677 -1 -0.330079 0.580633 0.332982
-6.30213e-05 0.00165968 -0.0095511 0.938272 1 0.23686 -1.924 1.56055
-6.30213e-05 0.00165968 -0.0095511 0.105658 1 -0.652045 -0.197073 -0.082208
-6.30213e-05 0.00165968 -0.0095511 0.105658 -1 -0.67963 -0.62149 0.315008
-6.30213e-05 0.00165968 -0.0095511 0.105658 1 -0.499803 0.470695 0.758325
-6.30213e-05 0.00165968 -0.0095511 0.13957 -1 -0.371058 0.56932 0.100552
-6.30213e-05 0.00165968 -0.0095511 0.13957 -1 0.434625 0.0251675 -0.0204417
-6.30213e-05 0.00165968 -0.0095511 0.105658 -1 -0.333235 -1.1262 -0.873274
-6.30213e-05 0.00165968 -0.0095511 0.493677 1 1.4025 -0.0812518 0.295177
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-6.30213e-05 0.00165968 -0.0095511 0.938272 -1 0.422661 -0.799393 1.065
-6.30213e-05 0.00165968 -0.0095511 0.105658 1 -0.0744026 0.524971 -0.178172
```

Initial x,y,z (m)

The *animationDriver* base class

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d-esd-detail.dat									
~/alice/alice-blender-animation/animate									
-6.30213e-05	0.00165968	-0.0095511	0.105658	1	0.563826	-1.72644	-0.721978		
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-6.30213e-05	0.00165968	-0.0095511	0.105658	1	-0.0744026	0.524971	-0.178172		

Initial x,y,z (m)

mass
(GeV/c²)

The *animationDriver* base class

→ Sets video details:

- duration, FPS, output path, resolution
- simulated time

→ Derived class *dataDriver*:

- reads relevant physics data

Initial x (m)	Initial y (m)	Initial z (m)	mass (GeV/c ²)	charge								
-6.30213e-05	0.00165968	-0.0095511	0.105658	1	0.563826	-1.72644	-0.721978					
-6.30213e-05	0.00165968	-0.0095511	0.105658	1	-0.53665	0.847315	0.521594					
-6.30213e-05	0.00165968	-0.0095511	0.493677	-1	-0.330079	0.580633	0.332982					
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-6.30213e-05	0.00165968	-0.0095511	0.105658	1	-0.0744026	0.524971	-0.178172					

Initial x,y,z (m)

mass charge
(GeV/c²)

The *animationDriver* base class

- Sets video details:
 - duration, FPS, output path, resolution
 - simulated time
- Derived class *dataDriver*:
 - reads relevant physics data

Initial x, y, z (m)	mass (GeV/c ²)	charge	Initial p _x , p _y , p _z (GeV/c)
-6.30213e-05	0.00165968	-0.0095511	0.105658 1 0.563826 -1.72644 -0.721978
-6.30213e-05	0.00165968	-0.0095511	0.105658 1 -0.53665 0.847315 0.521594
-6.30213e-05	0.00165968	-0.0095511	0.493677 -1 -0.330079 0.580633 0.332982
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-6.30213e-05	0.00165968	-0.0095511	0.105658 1 -0.0744026 0.524971 -0.178172

Initial x, y, z (m)

mass charge
(GeV/c²)

Initial p_x, p_y, p_z
(GeV/c)

The *particle* base class

- Stores basic information of particles
 - position, charge, mass

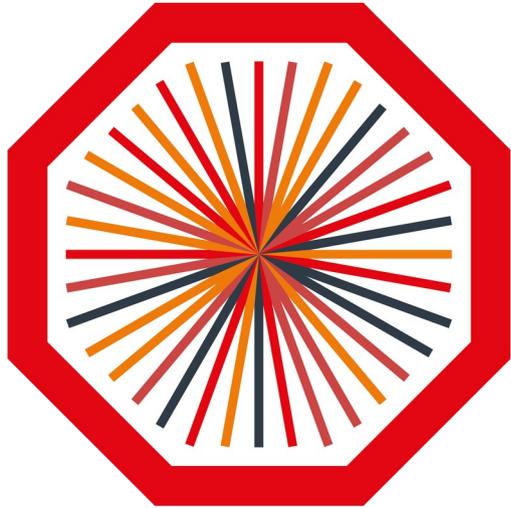
The *particle* base class

- Stores basic information of particles
 - position, charge, mass
- Defines its type
 - electron, pion, muon, proton, kaon

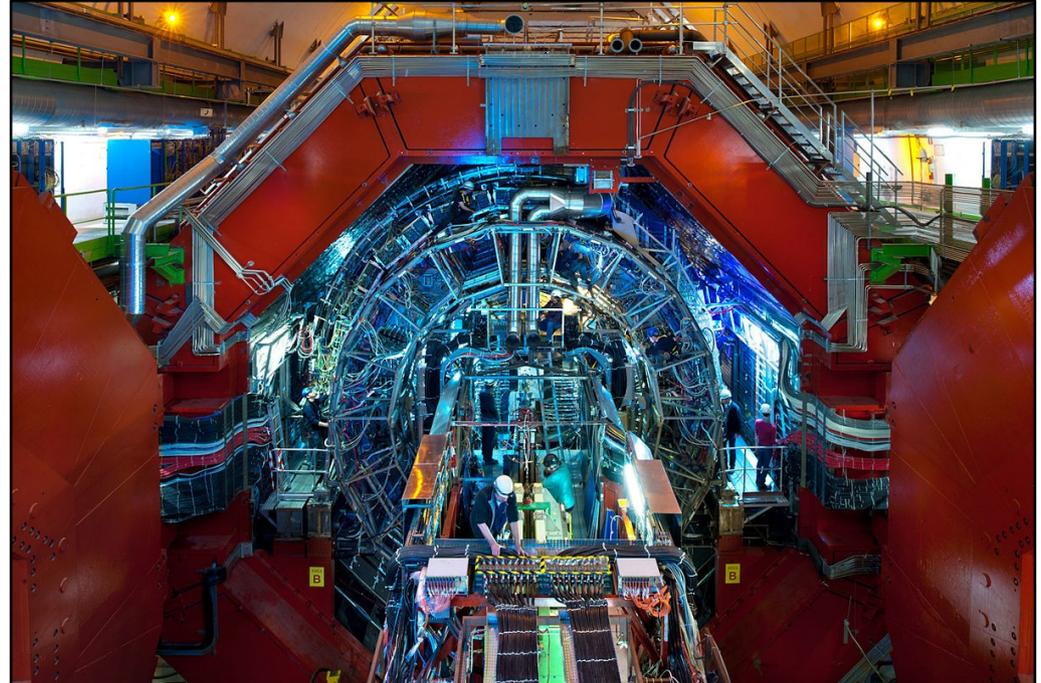
The *particle* base class

- Stores basic information of particles
 - position, charge, mass
- Defines its type
 - electron, pion, muon, proton, kaon
- Derived class *ParticlePropagator*:
 - helix track propagation
 - near center of ALICE detector

ALICE detector



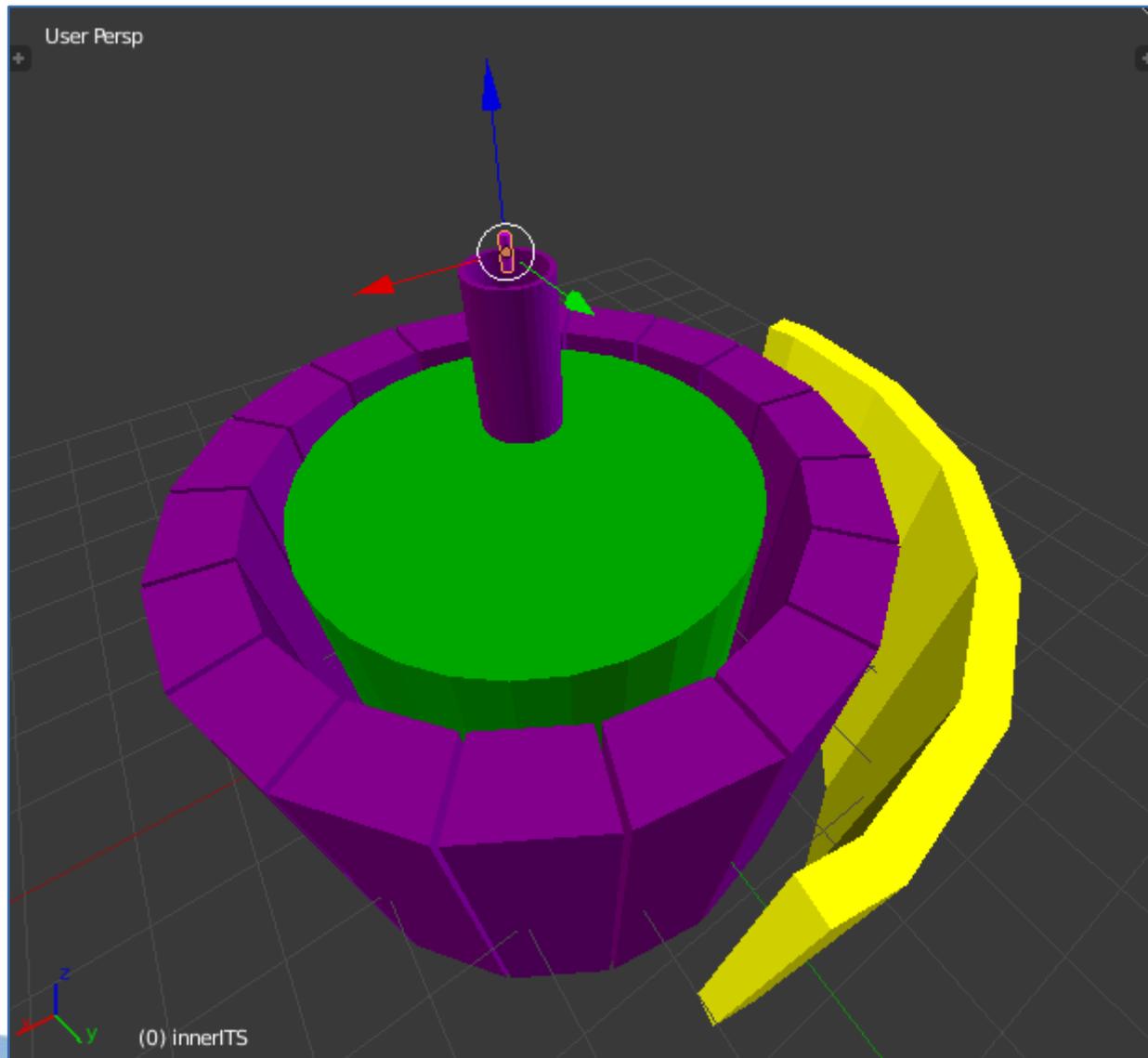
ALICE



→ A Large Ion Collider Experiment

→ Quark-gluon plasma

ALICE geometry



Getting the data



CERN Open Data Portal



Filter events

ALICE × root × PbPb ×

Include on-demand datasets

Filter by type

- Dataset 6
- Collision 6

Filter by experiment

- ALICE 6

Filter by year

- 2010 6

Filter by file type

- root 6

Filter by collision type

- PbPb 6
- pp 8

Filter by collision energy

- 2.76TeV 6

Getting the data



CERN Open Data
Portal



Select sample

LHC2010h_PbPb_ESD_138275

Pb-Pb ESD data sample at the collision energy of 2.76 TeV per nucleon pair from RunH of 2010. Run period from run number 138275....

Dataset Collision ALICE

LHC10h_PbPb_ESD_139038

Pb-Pb ESD data sample at the collision energy of 2.76 TeV per nucleon pair from RunH of 2010. Run period from run number 139038....

Dataset Collision ALICE

LHC10h_PbPb_ESD_139465

Pb-Pb ESD data sample at the collision energy of 2.76 TeV per nucleon pair from RunH of 2010. Run period from run number 139465....

Dataset Collision ALICE

LHC10h_PbPb_ESD_139173

Pb-Pb ESD data sample at the collision energy of 2.76 TeV per nucleon pair from RunH of 2010. Run period from run number 139173....

Dataset Collision ALICE

LHC10h_PbPb_ESD_139437

Pb-Pb ESD data sample at the collision energy of 2.76 TeV per nucleon pair from RunH of 2010. Run period from run number 139437....

Dataset Collision ALICE

Getting the data

Choose ESD file



CERN Open Data Portal

List of files

AliESDs.root

378.8 MB



AliESDs.root

410.2 MB



AliESDs.root

386.4 MB



« < 815 816 817 818 819 > »

Description

Pb-Pb ESD data sample at the collision energy of 2.76 TeV per nucleon pair from RunH of 2010. Run period from run number 139437.

Dataset characteristics

882159 events. **4093** files. **1.6 TB** in total.

Processing ALICE data

ALIROOT



Macros



```
d-esd-detail.dat
~/alice/alice-blender-animation/animate
Open Save
-6.30213e-05 0.00165968 -0.0095511 0.105658 1 0.563826 -1.72644 -0.721978
-6.30213e-05 0.00165968 -0.0095511 0.105658 1 -0.53665 0.847315 0.521594
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-6.30213e-05 0.00165968 -0.0095511 0.105658 1 -0.0744026 0.524971 -0.178172
```

Data as text

Workflow

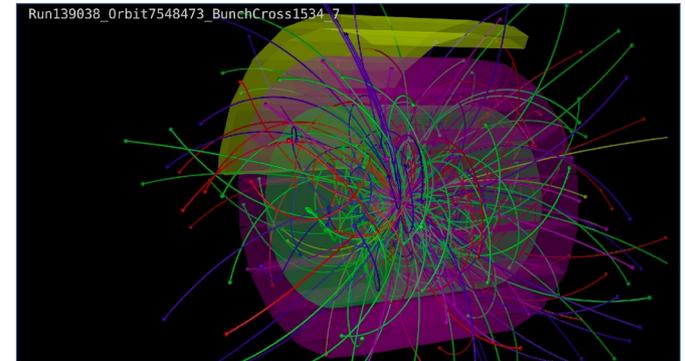
Events data



`workflow_sketch.sh`



Results

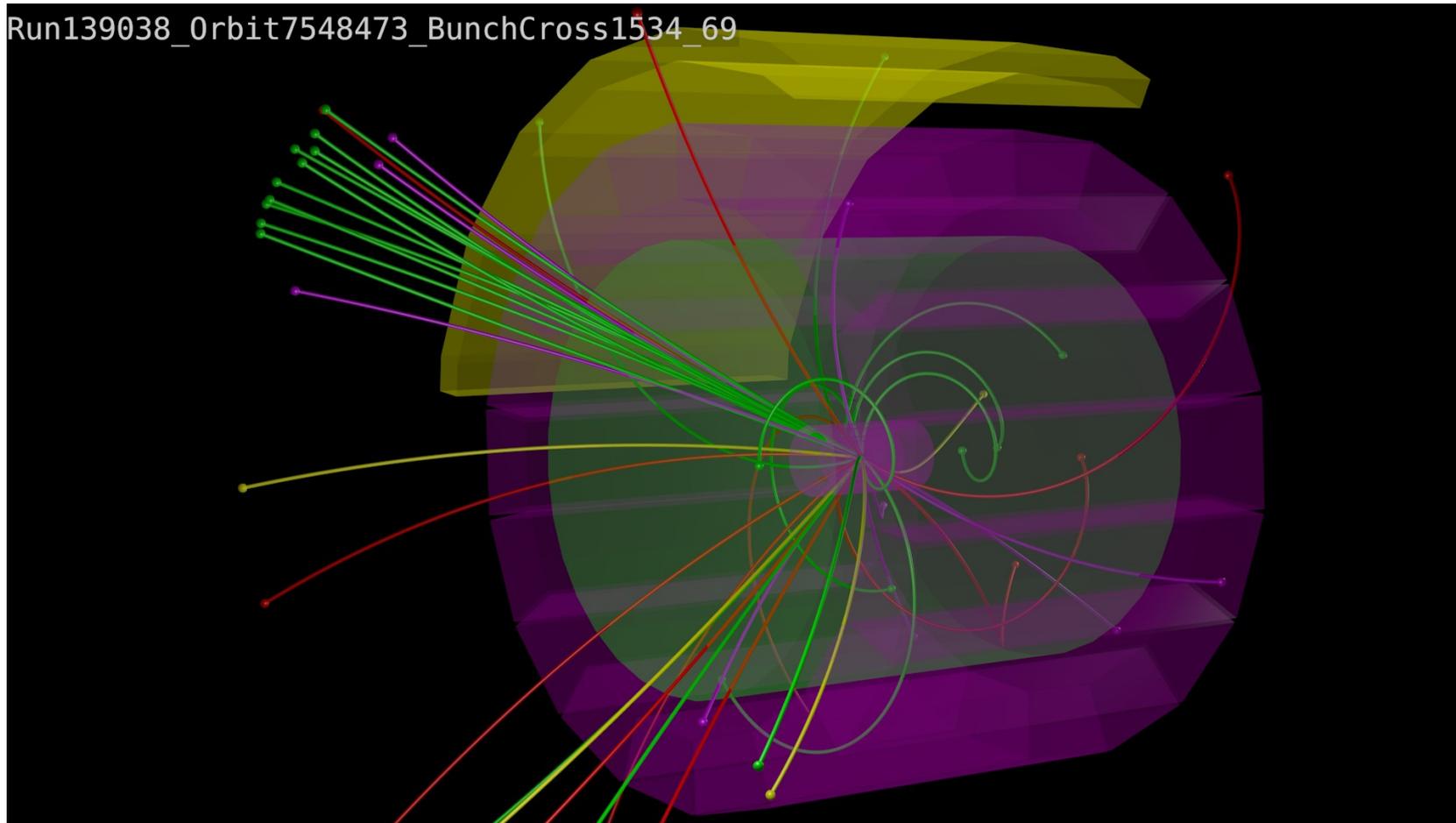


Media

→ Custom use options

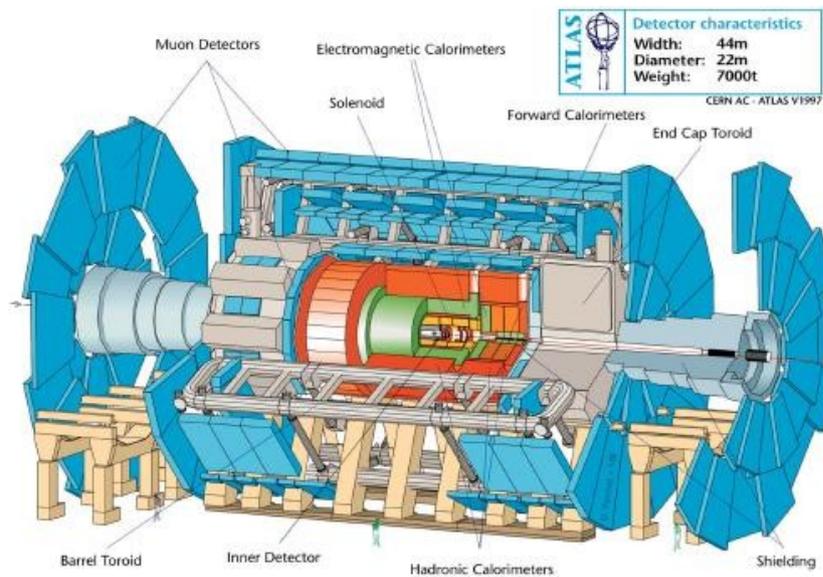
Running Examples

→ Minimum Average P_z (z-momentum)



Room for improvement

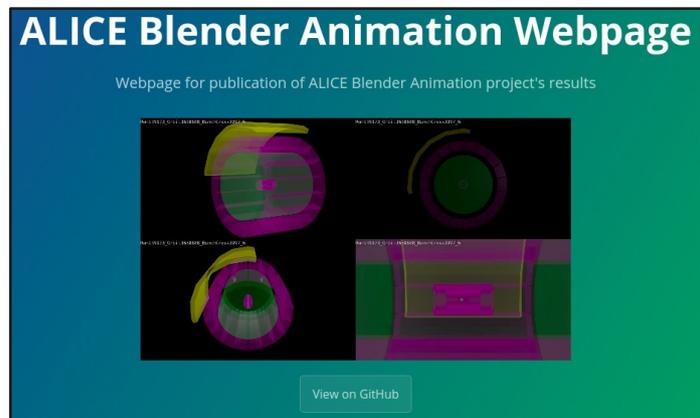
- Secondary vertexing and decays
- Pythia and Hijing generators
- Animate events from different experiments



How can *you* use it?

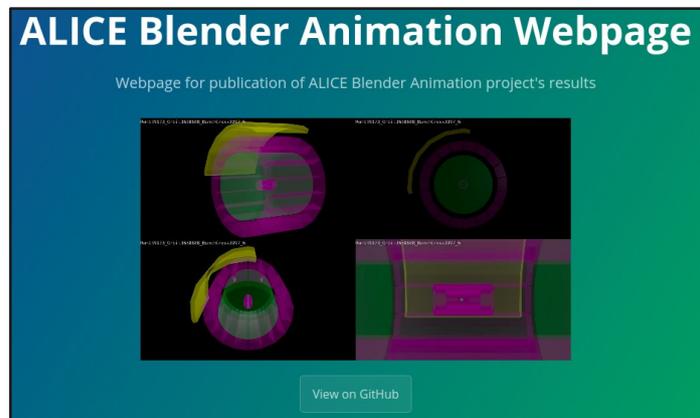
→ Search for existing animations

→ <https://animalicedata.github.io/sampleanimations/>



How can *you* use it?

- Animate your own selected events
- Search for existing animations
 - <https://animalicedata.github.io/sampleanimations/>



- Modify software to match your needs
 - GNU General Public License



Open Science