SPD detector description and GeoModel

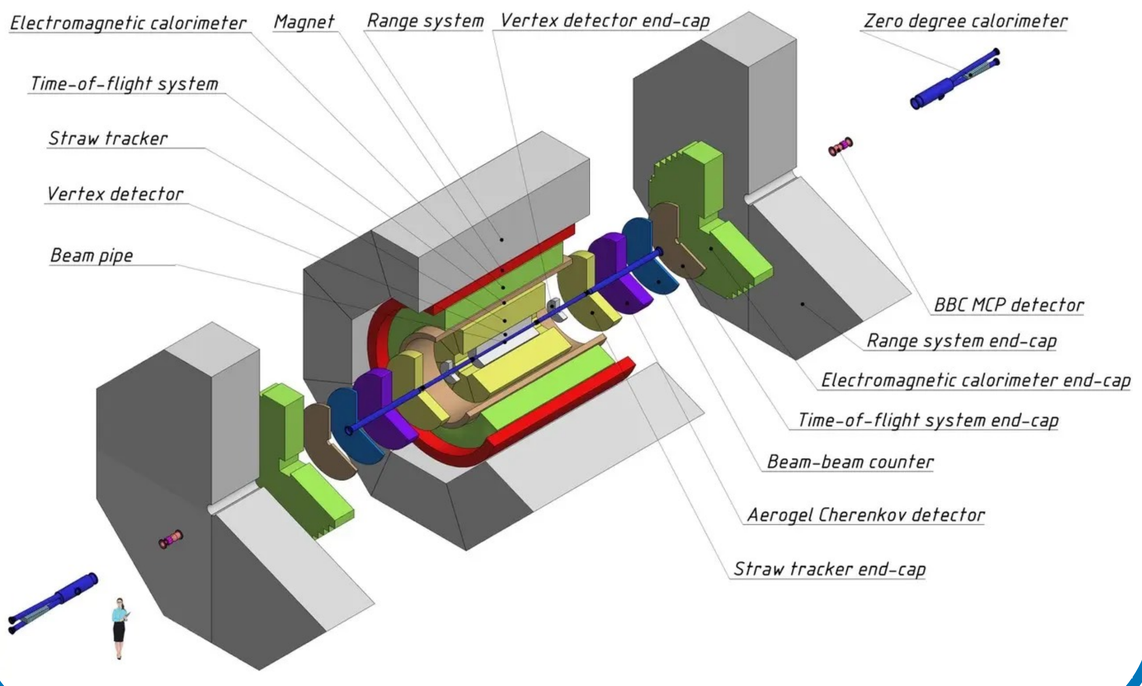
Aytadzh Allakhverdieva

INTERNATIONAL INTERGOVERNMENTAL ORGANIZATION
JOINT INSTITUTE FOR NUCLEAR RESEARCH

SPD (Spin Physics Detector)

The SPD is a planned spin physics experiment at the second interaction point of the NICA collider, which is under construction at JINR to study the spin structure of the proton and deuteron and the other spin-related phenomena with polarized proton and deuteron beams.

The main subsystems which will be installed at first stage are the Micromegas-based Central Tracker, Straw Tracker, Range system. Partial installation of Electromagnetic Calorimeter is also possible.



GeoModel

Detector description is an **essential** component in simulation, reconstruction, alignment and analysis of experimental data. *GeoModel* and *DD4Hep* are the most popular packages which allow us to create a description of the detector directly.

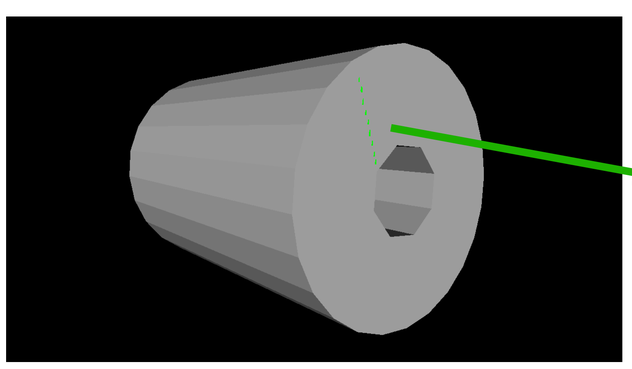
GeoModel package was chosen for SPD detector description, because it:

- it is a detector description and visualization toolkit for HEP;
- has been used by the ATLAS experiment since 2004;
- it provides flexibility;
- it allows to describe complicated geometry and materials;
- it allows to create and support different geometry versions;
- it provides an easy and transparent converting of a geometry description into Geant4 geometry description suitable for simulation.

Documentation is available at https://geomodel.web.cern.ch/home/.

GMClash

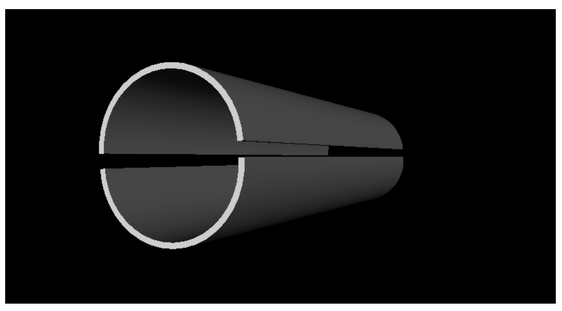
Overlapping volumes means that some locations in space don't have a unique, well-defined identity: they belong to two different volumes simultaneously. Detecting overlapping volumes is important for correct simulation, reconstruction and alignment. **gmclash** application is a standalone Geant4-based tool to detect overlaps in GeoModel-based geometries at all levels of volume hierarchies.



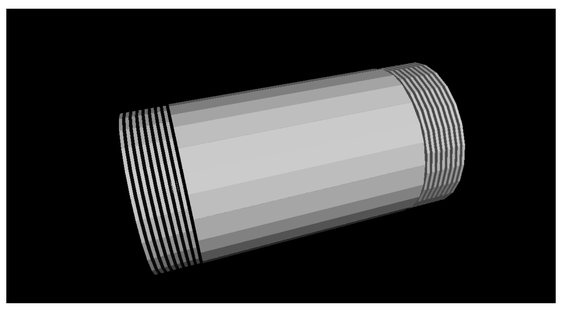
Green points are standalone overlap points visualization overlayed to the geometry.

Current status of the full SPD geometry description

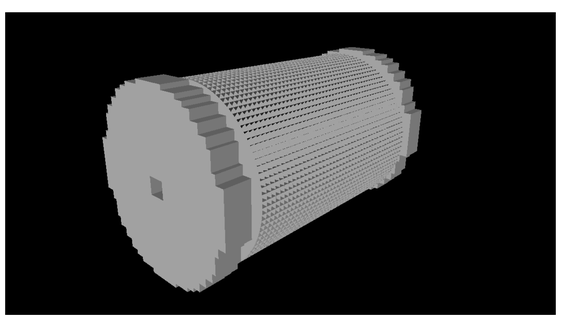
The SPD geometry description on subsystems level without their inner structure is ready currently. Second step to the full SPD geometry description is description of inner structure of first stage subsystems. These visualizations are based on a detailed description of the subsystem inner structure. For example, the description of the Straw Tracker includes a description of the location of more than 26 thousand gas tubes. And the description of the Electromagnetic Calorimeter includes a description of the location of more than 4 thousand cells.



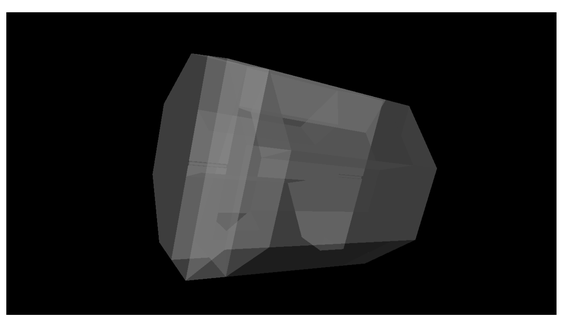
Micromegas-based Central Tracker



Straw Tracker



Electromagnetic Calorimeter



Range System (in progress)

Using of detector model in reconstruction

One of the requirements for SPD geometry description is the possibility of using the same geometry description in simulation and reconstruction. In the simulation case we can use Geant4 navigation tools. In the reconstruction case we don't have ready-made tools. The GeoModel developers are working on this.

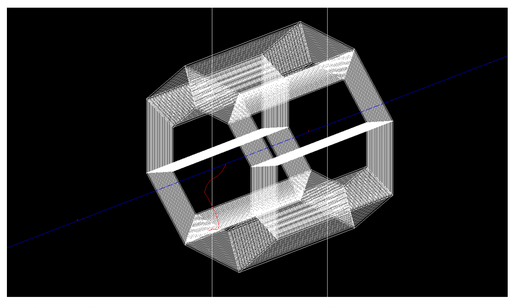
For now it is suggested to use next **navigation system**:

- creating of unique identifier for each detector element;
- providing access to data via identifier.

Using of detector model in simulation

Converting GeoModel geometry to Geant4 geometry

The mechanism of interaction with GeoModel contains a creation of geometry description and writing it into local file. Further using of geometry description occurs through accessing to this file.



Using the Range System detector model in simulation

Sensitive detector in Geant4

Unfortunately, GeoModel doesn't know what sensitive volumes are. This mechanism decides problem with sensitive volumes.