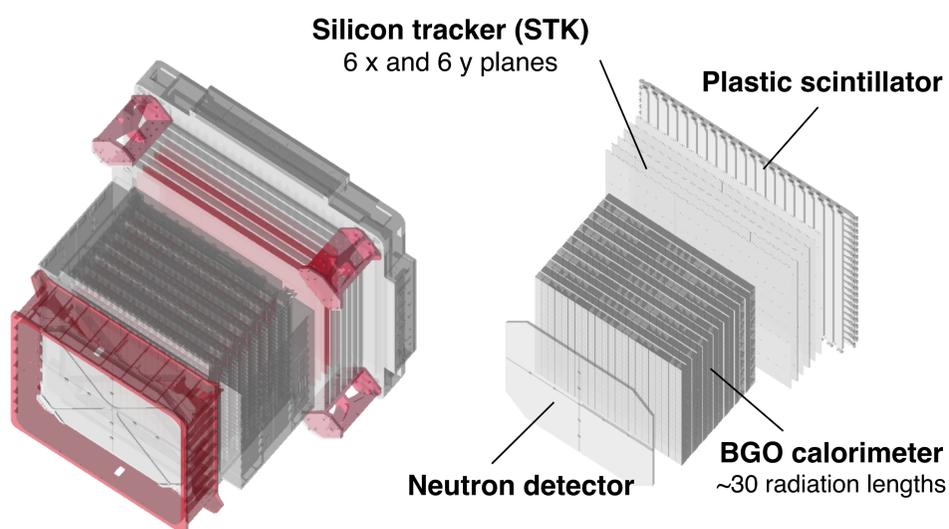


Software framework and reconstruction software of DAMPE mission

DAMPE

Dark Matter Particle Explorer (DAMPE) is a satellite-borne particle detector mission with a launch scheduled for the end of 2015.

It consists of silicon-tungsten tracker-converter (STK), BGO calorimeter, plastic scintillator serving as anti-coincidence unit and neutron detector. Total thickness of about 30 radiation lengths makes DAMPE the deepest calorimeter in space.

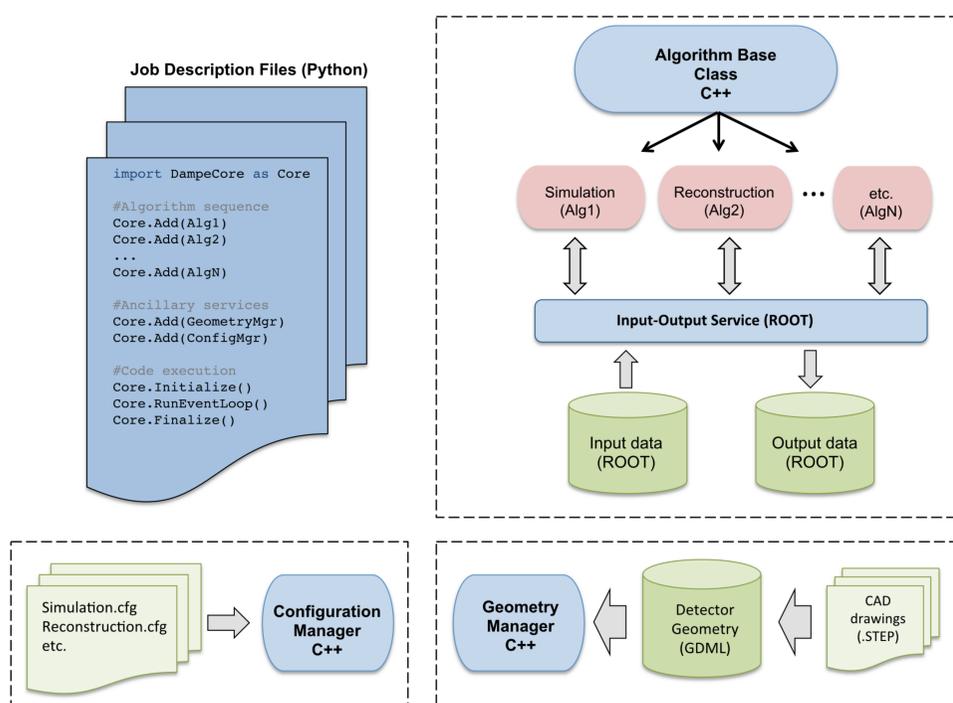


Detector geometry (geant4): whole (left); sensitive detectors only (right)

Software framework

Core part of software is written in C++, management part is done in Python (boost-python libraries are used to bridge between two).

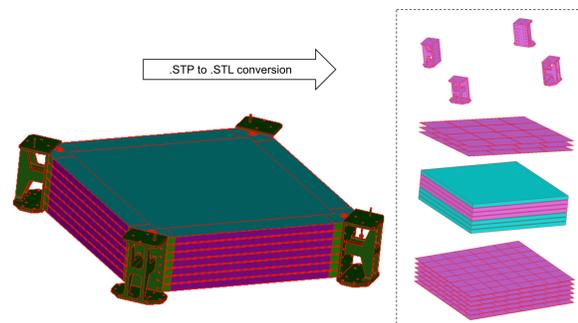
All algorithms including simulation and reconstruction are inherited from the same base class. Computing jobs are defined via python job option files, while more general settings are stored in the configuration files.



Block diagram of the DAMPE offline software

Geometry model

Detector geometry is implemented in GDML format (Geometry Description Markup Language) and obtained directly from the CAD engineering drawings. Conversion to GDML is done in few steps. First, CAD drawings (.step) are exploded into .stl files, where each file represents one component made of single material:



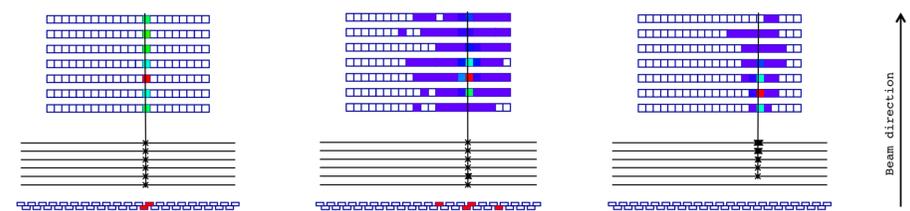
Next, each .stl part is converted into GDML using CADMESH [1]. Finally, Sensitive parts are parsed and converted into simple geometries instead of tessellated ones.

Reconstruction

Particle reconstruction starts in BGO. Shower direction is propagated to STK, and, if a hit is found in the STK within a certain window, a track seed is formed and filtered further using the adaptation of Kalman technique [2].

An iterative procedure is performed looping over all STK planes looking for different tracks, while “seed” hits of previously reconstructed tracks are removed from the list.

Ghost tracks are eliminated: if two tracks are crossing each other, a lower quality track (the one having less hits or lower χ^2) is considered as ghost and subsequently removed. At the same time “forks” in the direction towards BGO are kept to allow for photons converting to e^+e^- pairs.



Displays of reconstructed events (beam test at the SPS, CERN): muon (left), electron (middle), photon (right)

CONCLUSION

Custom software framework has been developed for the DAMPE experiment. Among others, it features a unique method for geometry implementation from the CAD engineering drawings without suffering an overhead of dealing with tessellated solids.

References:

- [1] C.Poole <https://github.com/christopherpoole/cadmash>
- [2] R. Fruhwirth DOI: 10.1016/0168-9002(87)90887-4