A fully modular framework for detector simulations in ROOT

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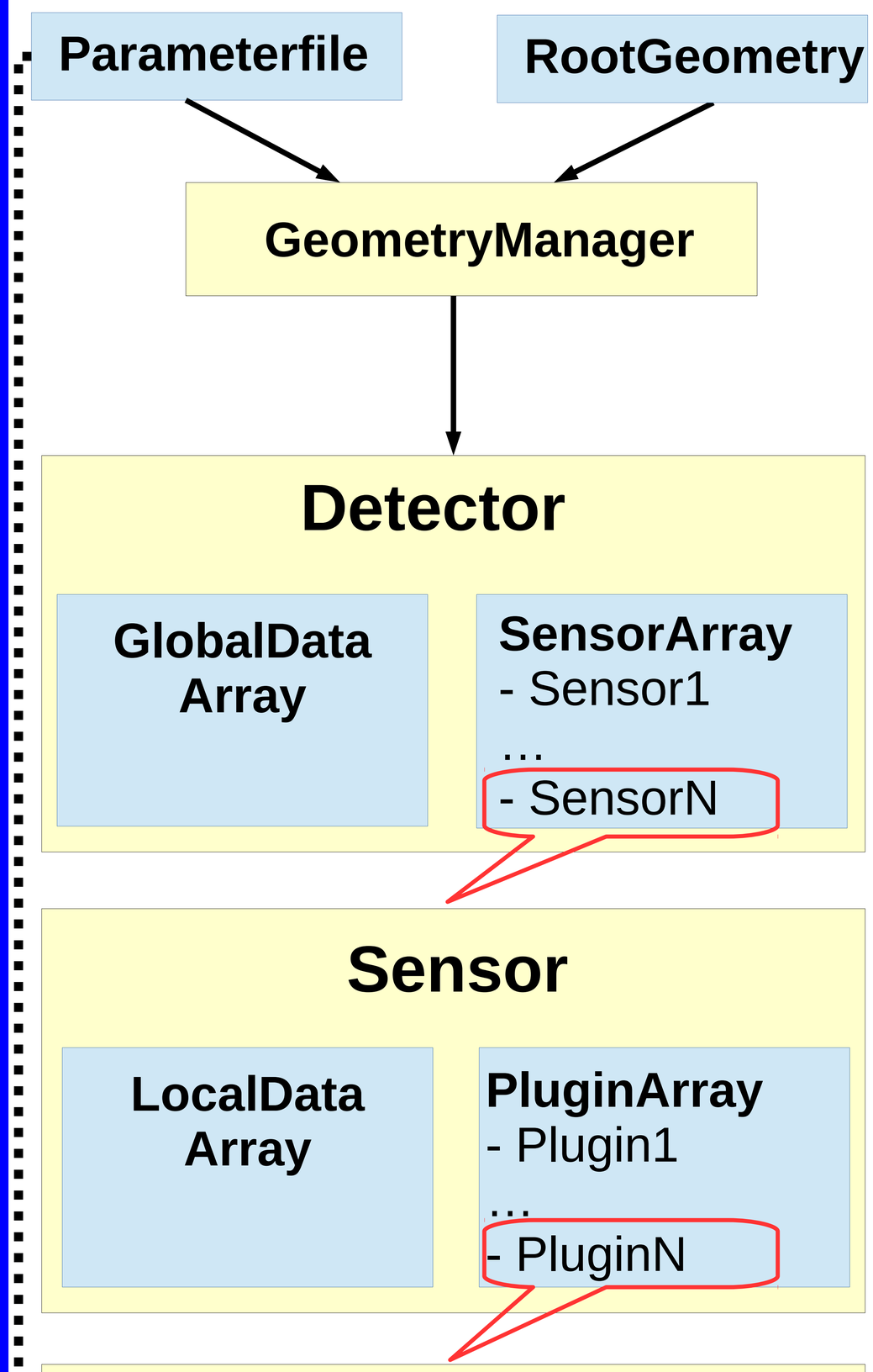
Compressed Baryonic Matter experiment at FAIR

Task:

Build a simulation model for the Micro Vertex Detector to compare and support ongoing sensor developments. Model should be flexible to allow for any changes in sensor technology. Parts of the simulation should be reusable with different setups as far as possible.

Solution:



GeometryManager:

* Reads ROOT Geometries and builds automatically the software representation based on the active volume as smallest building block
* A parameter file defines the setup e.g. used sensor model, plugin parameter, (mis-)alignment

Detector:

* Communication module between the detector simulation and ROOT Framework
* Handles the data distribution from ROOT to the individual sensors
* Calls the execution of the plugins inside the sensors
* ***Only part which is framework dependent***

Sensor:

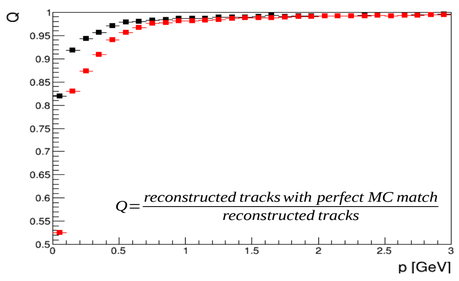
* Software representation of the smallest independent active volume of the detector. (E.g. a pixel sensor, gas chamber)
* Only has its own data
* Handles the transformation from global to local coordinates.
* ***Is independent of the used framework***

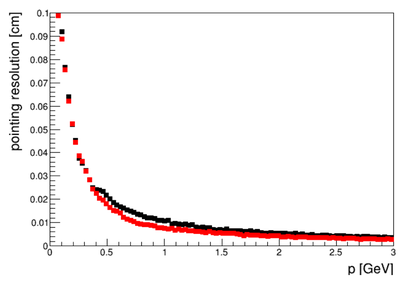
Plugin:

* Extensions to the sensor which provide the models to simulate the response, cluster finding, hit finding readout electronics e.g.
* Mathematical model and parameters are separated to allow to reuse models with different parameters

Use case in Cbm:

Used to simulate and compare two different geometry setups and different versions of sensors without any changes in the software needed.





Advantages of this model:

- Changes in geometry automatically are transferred into software
- Can test different parameter setups in parallel
- Sensors can be executed in parallel
- different response models can be tested in parallel
- Can be transferred to any ROOT based framework only Detector Class needs to be changed

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