Progress in simulation of the BM@N detectors

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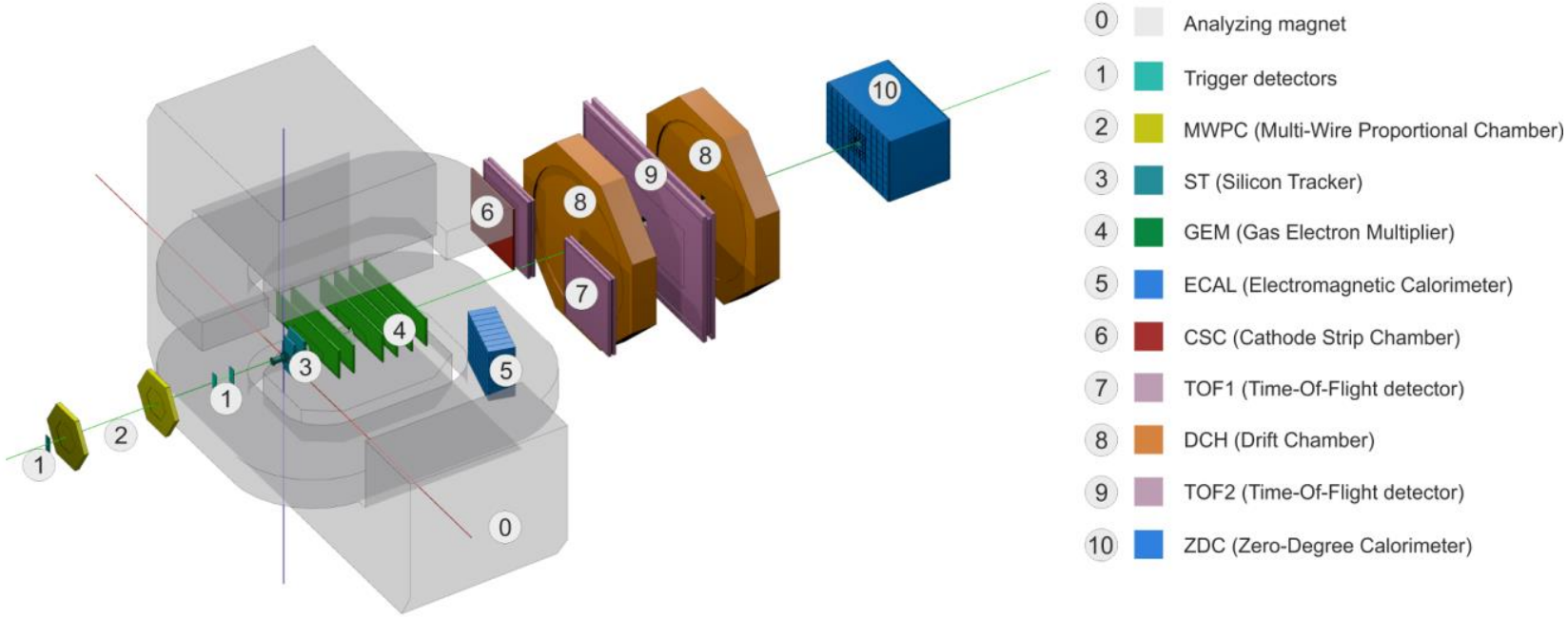
Tracking system of the BM@N experiment

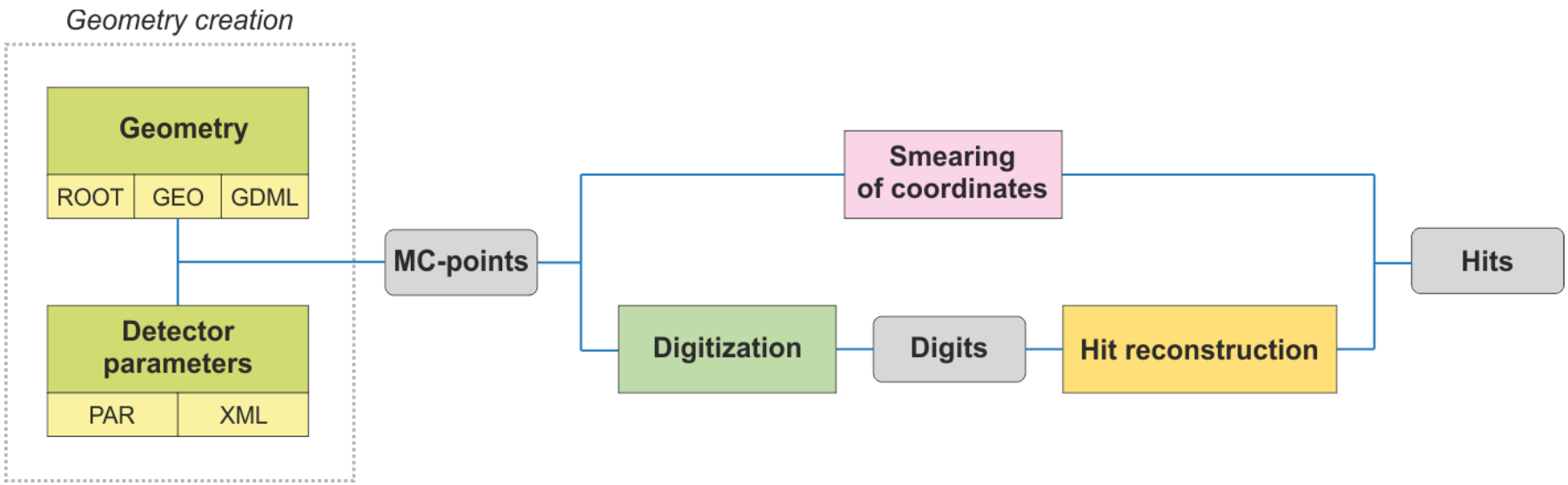
Setup of BM@N for RUN-7 in spring 2018



Detectors of the tracking system in BM@N:

- **GEM** (Gas Electron Multiplier)
- **SILICON** (Semi-conductor detector)
- **CSC** (Cathode Strip Chamber)
- **DCH** (Drift Chamber)

Detector simulation stages:

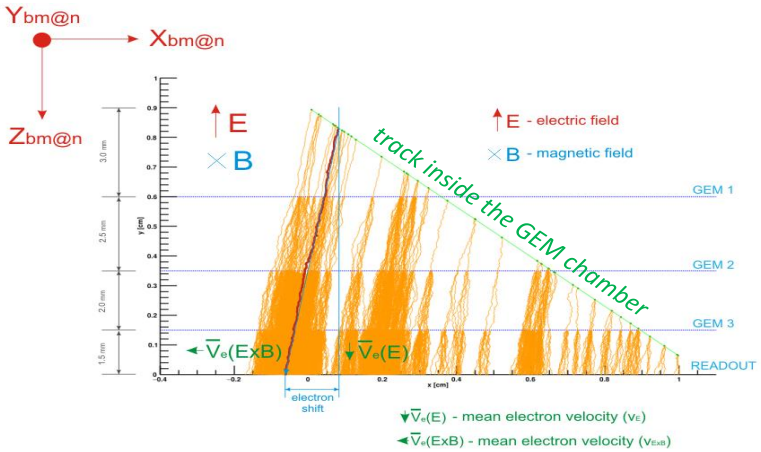


Scheme of the main stages of the simulation

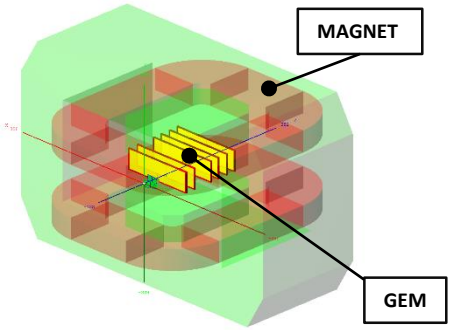
Simulation for GEM detector

GEM (Gas Electron Multiplier) is one the main detectors of the tracking system in BM@N

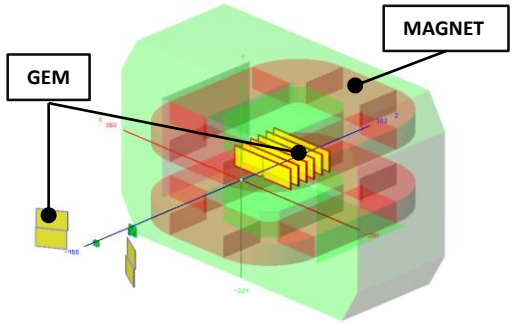
Because GEM chambers are placed inside the magnet we have to take into account the magnetic field influence



Realistic simulation in Garfield++: electron avalanches are shifted under the magnetic field inside a GEM chamber



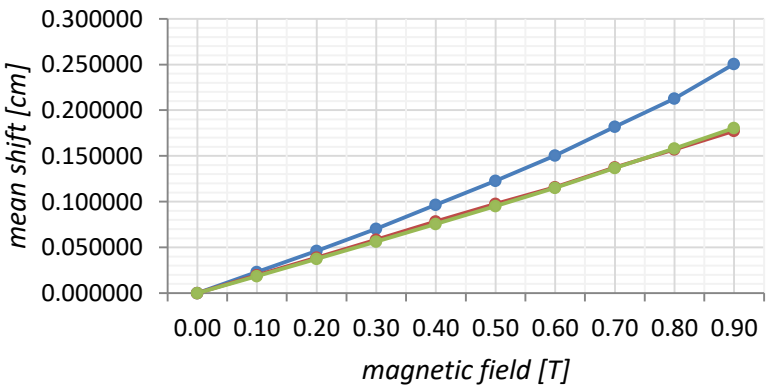
*GEM configuration for **RUN-7** (spring 2018)*

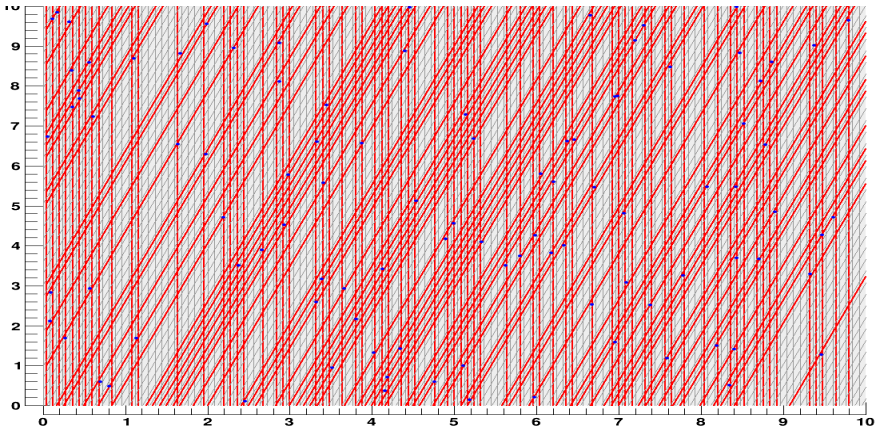


*GEM configuration for **SRC** (spring 2018)*

	GEM configuration	
	RUN-7	**SRC**
Geometry file	GEM_RunSpring2018.root	GEM_RunSRCSpring2018.root
Parameter file	GEM_RunSpring2018.xml	GEM_RunSRCSpring2018.xml
Pitch	**800 mμ**	
Stereo angle	**15 degrees**	
Chamber thickness	**9 mm**	

Dependence of the mean shift of hits on magnetic field



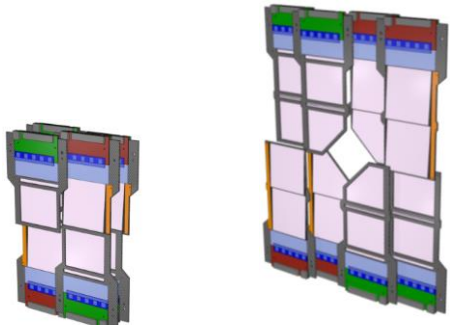


We find hits as intersections of active strips. Some of them are fakes.

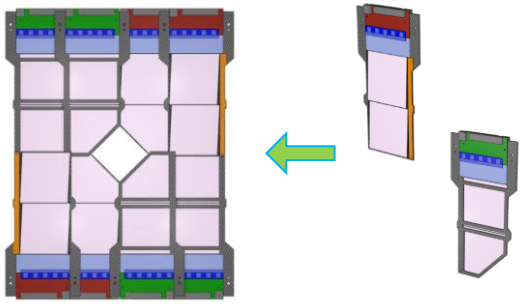
Simulation for SILICON detector

The main purpose of using **SILICON** detector in the BM@N experiment is to improve the efficiency of primary vertex reconstruction.

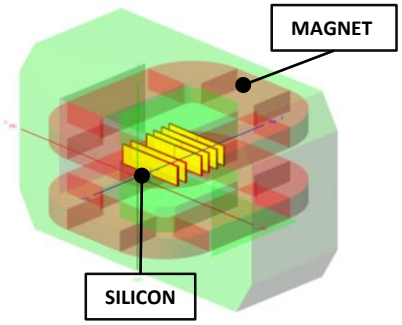
Due to a small sensitive thickness of detector (about 300 microns) we did not apply Garfield++ for detailed simulation. Instead of that we use a simplified method based on Gaussian smearing.



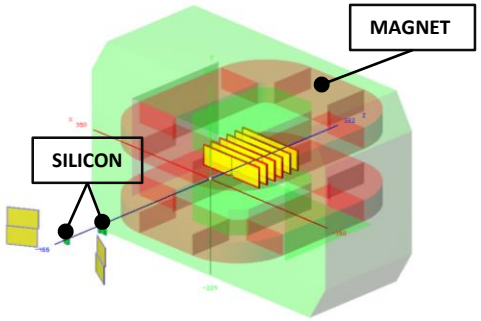
SILICON detector consists of three planes



Each plane comprises SI-modules



*SILICON configuration for **RUN-7** (spring 2018)*



*SILICON configuration for **SRC** (spring 2018)*

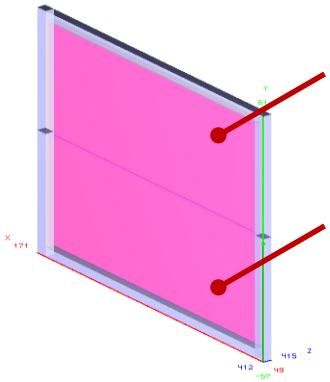
	SILICON configuration	
	RUN-7	**SRC**
Geometry file	SI_RunSpring2018.root	SI_RunSRCSpring2018.root
Parameter file	SI_RunSpring2018.xml	SI_RunSRCSpring2018.xml
Pitch	**~100 mμ**	
Stereo angle	**2.5 degrees**	
Chamber thickness	**~300 mμ**	

The silicon detector as well as GEM has micro-strip readout. So the hit reconstruction procedure is almost the same.

Simulation for CSC detector

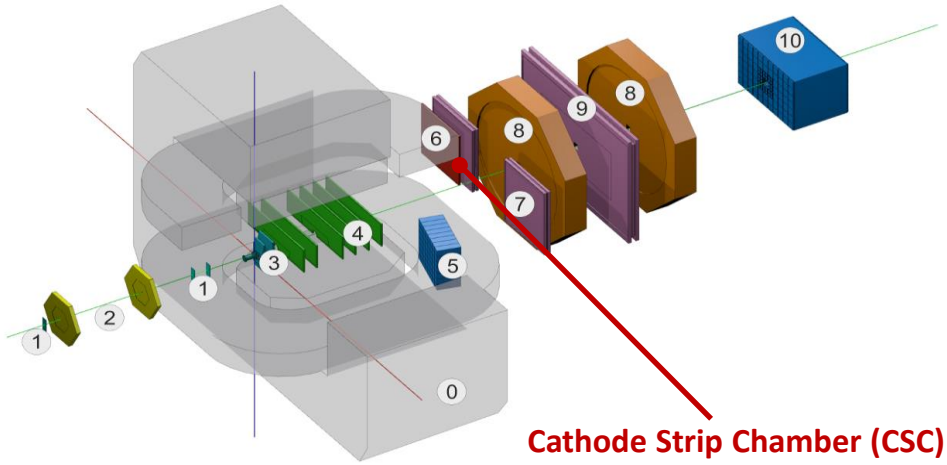
CSC (Cathode Strip Chamber) is one more detector included in the tracking system of the BM@N setup.

In the recent run of the BM@N experiment we have one plane of the CSC detector. This plane consists of two independent modules: upper and lower.



*CSC configuration for **RUN-7** (spring 2018)*

At the moment for this detector we have only the simplified simulation based on Gaussian smearing. Later we are going to use Garfield++ to get more realistic simulation.

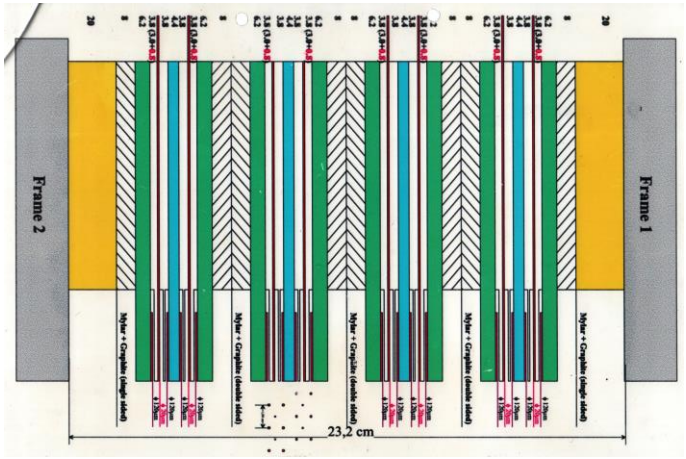


CSC chamber position in the BM@N setup: RUN-7 and SRC

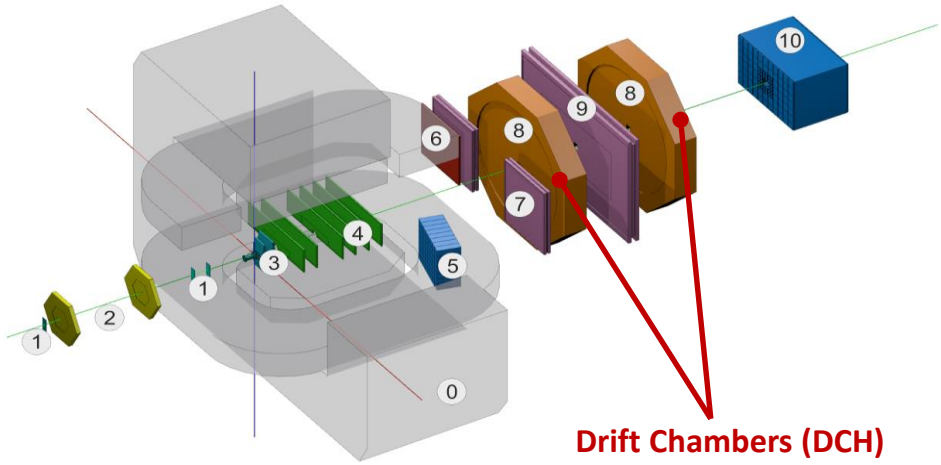
	SILICON configuration	
	RUN-7	**SRC**
Geometry file	CSC_RunSpring2018.root	CSC_RunSRCSpring2018.root
Parameter file	CSC_RunSpring2018.xml	CSC_RunSRCSpring2018.xml
Pitch	**2.5 mm**	
Stereo angle	**15 degrees**	
Chamber thickness	**7.6 mm**	

Simulation for DCH detector

DCH (Drift Chamber) detector comprises two independent drift chambers with a multi-wire structure. Each chamber has 8 wire-planes oriented to each other at the angle of 45 degrees.



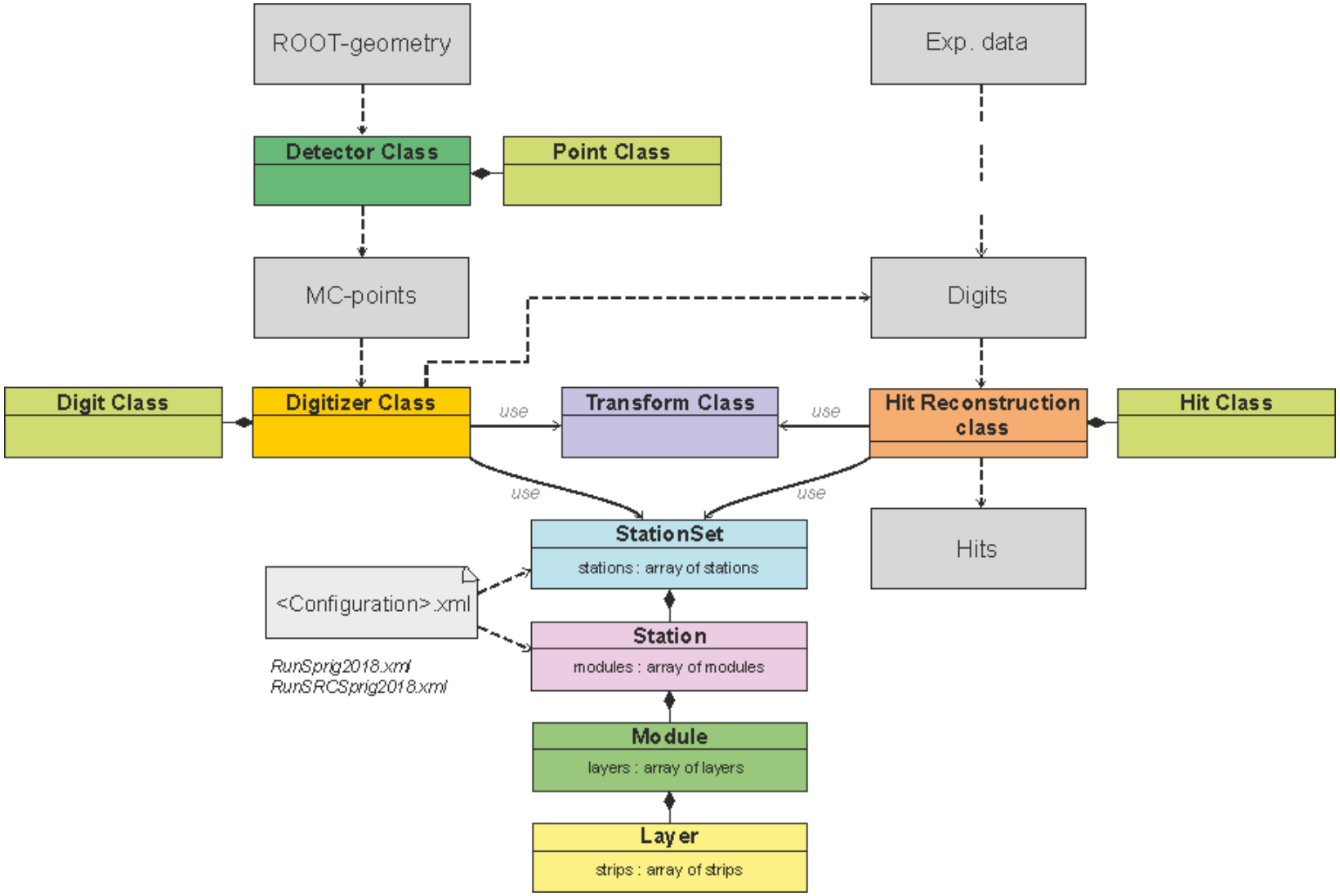
Inner structure of one drift chamber



CSC chamber position in the BM@N setup: RUN-7 and SRC

	DCH configuration	
	RUN-7	**SRC**
Geometry file	DCH_RunSpring2018.root	DCH_RunSRCSpring2018.root
Parameter file	DCH_RunSpring2018.xml	DCH_RunSRCSpring2018.xml
Pitch	**1.0 cm**	
Stereo angle	**45 degrees**	
Chamber thickness	**23.2 cm**	

Program implementation of processing procedures



Scheme of program implementation for simulation and reconstruction procedures. Such program structure allows us to make some changes in any part with minimal modifications in other parts.

Conclusion

Brief overview: features of data processing for simulated detectors

	GEM	SILICON	CSC	DCH
Detector type	gaseous	semi-conductor	gaseous	gaseous
Readout type	micro-strips	micro-strips	micro-strips	multi-wires
Geometry format	ROOT	ROOT	ROOT	ROOT
Parameters description	XML file	XML file	XML file	constants embedded in code
Simulation	realistic based on Garfield+	simplified based on Gaussian smearing	simplified based on Gaussian smearing	simplified based on Gaussian smearing with distance dependence
Hit reconstruction	strip intersections	strip intersections	strip intersections	track segments

Thank you for your attention…