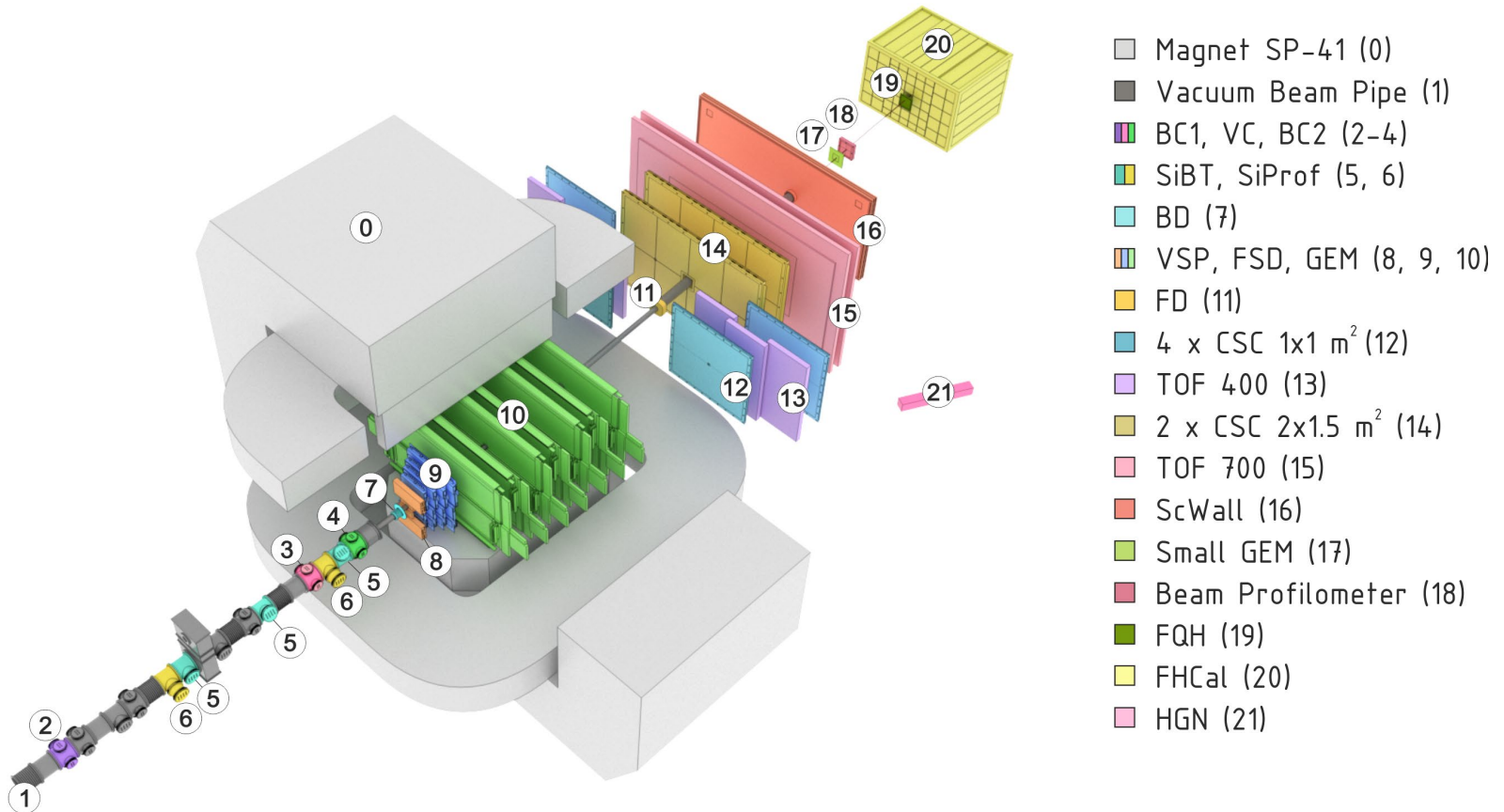


# **Geometry of hybrid tracker in the BM@N experiment for RUN-9**

Baranov Dmitry

# BM@N experiment

**BM@N (Baryonic Matter at Nuclotron)**  
is a fixed target experiment at the NICA accelerator complex

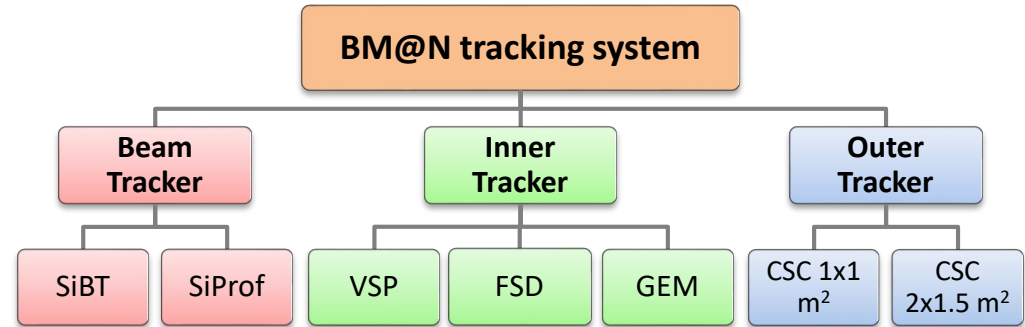


*Configuration of the BM@N setup for RUN-9*

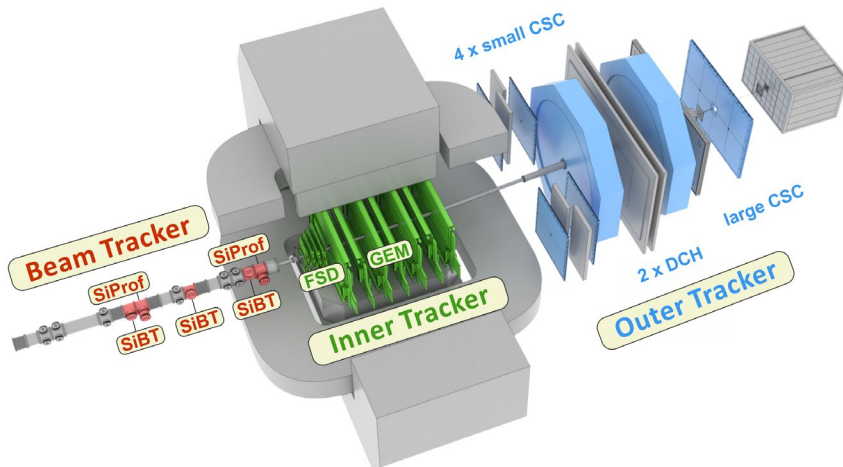
# Hybrid tracking system

**Hybrid Tracker** consists of three sections:

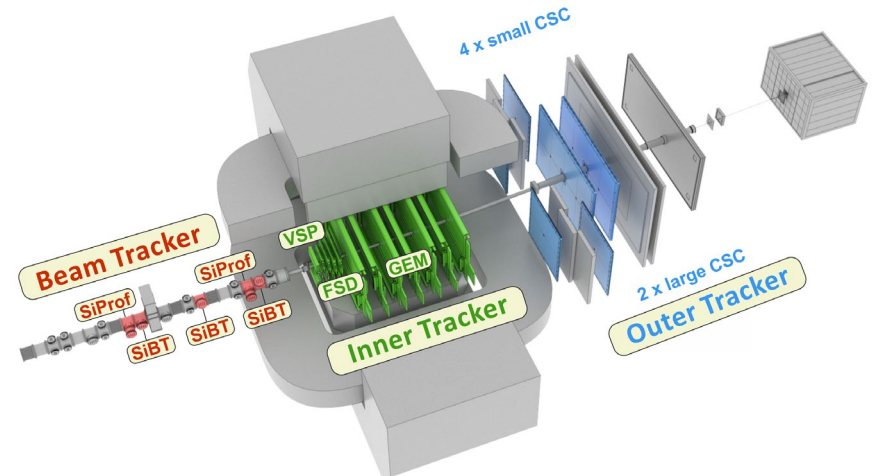
- **Beam Tracker** detectors
- **Inner Tracker** detectors
- **Outer Tracker** detectors



**RUN-8 (2023-2024)**

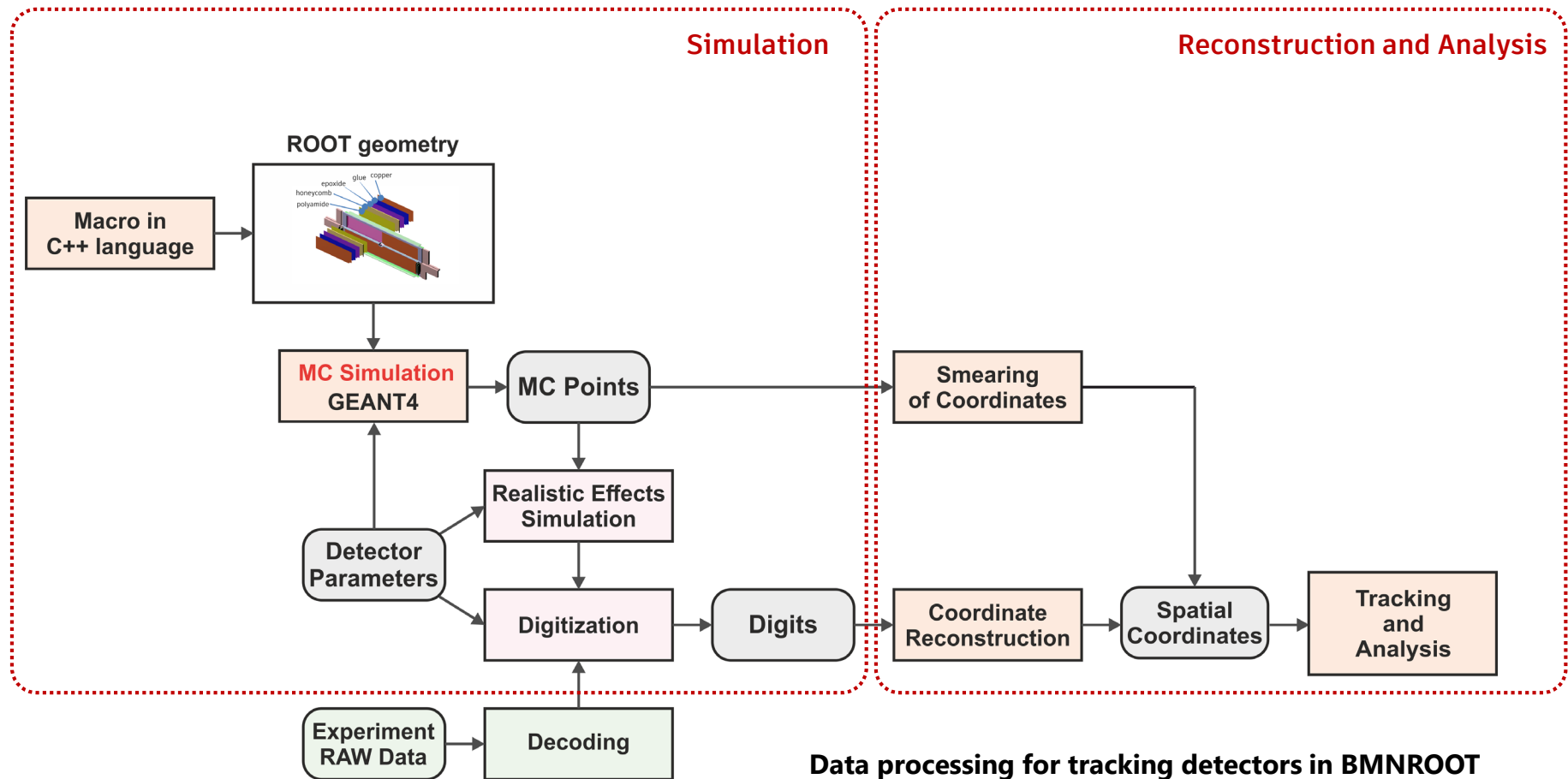


**RUN-9 (2025)**



# Detector geometry

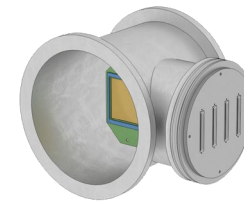
We use **ROOT format** to describe the geometry in BMNROOT software.  
**Geant4** transport engine is used as a basic tool to simulate the passage of charged particles through matter.



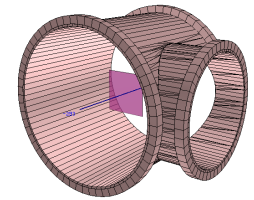
# Ion-Beam Tracker detectors

**Beam Tracker** (in front of the target) consists of:

- 3 x **SiBT** (**S**ilicon **B**eam **T**racker) detectors
- 2 x **SiProf** (**S**ilicon **P**rofilometer) detectors

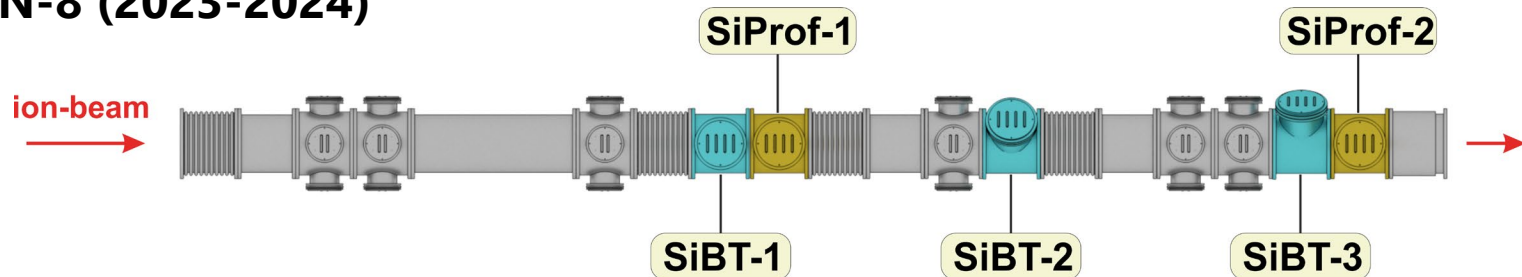


SiBT + metal box

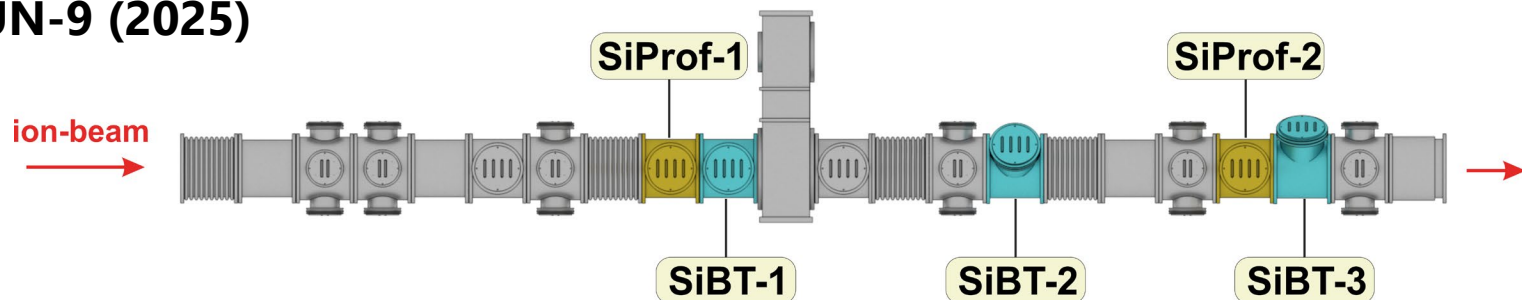


ROOT geometry

## RUN-8 (2023-2024)



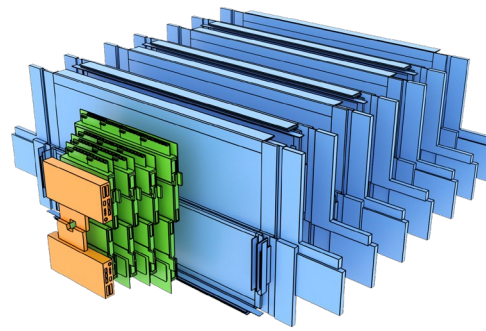
## RUN-9 (2025)



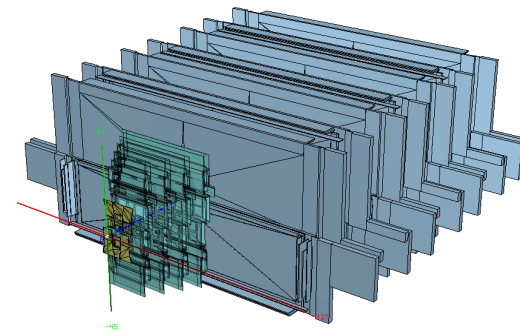
# Inner Tracker detectors

**Inner Tracker** consists of detectors located inside SP-41 magnet :

- **VSP** (Vertex Silicon Plane)
- **FSD** (Forward Silicon Detector)
- **GEM** (Gas Electron Multiplier)



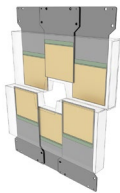
Inner Tracker detectors



Detailed ROOT geometry of Inner Tracker

## VSP

microstrip  
semiconductor detector

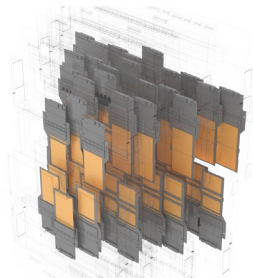


6 silicon modules (STS)

sensor thickness: **300  $\mu\text{m}$**   
strip pitch:  $\approx$  **58  $\mu\text{m}$**   
stereo angle between strips: **7.5°**

## FSD

microstrip  
semiconductor detector

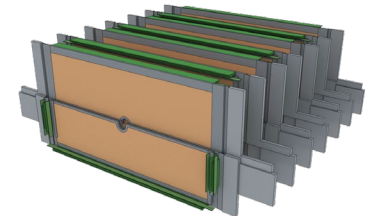


48 silicon modules

sensor thickness: **300  $\mu\text{m}$**   
strip pitch:  $\approx$  **100  $\mu\text{m}$**   
stereo angle between strips: **2.5°**

## GEM

microstrip  
gaseous detector



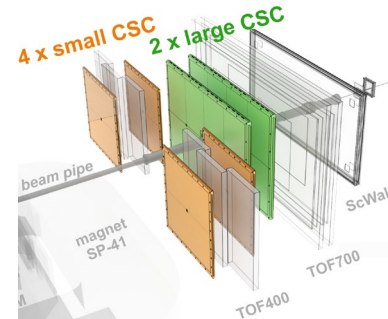
14 gas-filled chambers

gas volume thickness: **9 mm**  
strip pitch: **800  $\mu\text{m}$**   
stereo angle between strips: **15°**

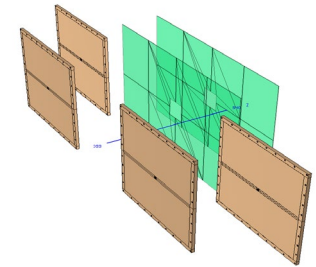
# Outer Tracker detectors

**Outer Tracker** consists of detectors located behind the magnet :

- 4 x **small CSC** (Cathode Strip Chamber)
- 2 x **large CSC** (Cathode Strip Chamber)



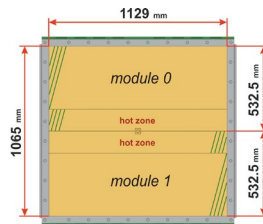
Outer Tracker detectors



Detailed ROOT geometry of Outer Tracker

## Small CSC

microstrip  
gaseous detector

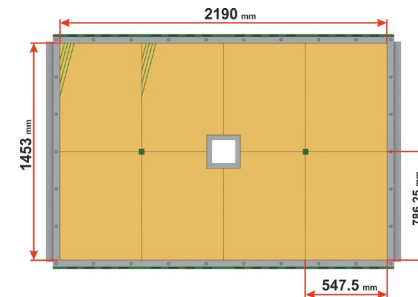


4 gas-filled chambers

gas volume thickness: **7.2 mm**  
strip pitch: **2.5 mm**  
stereo angle between strips: **15°**

## Large CSC

microstrip  
gaseous detector



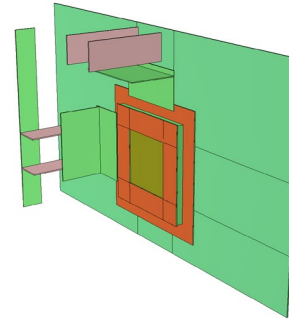
2 gas-filled chambers

gas volume thickness: **6 mm**  
strip pitch: **2.5 mm**  
stereo angle between strips: **15°**

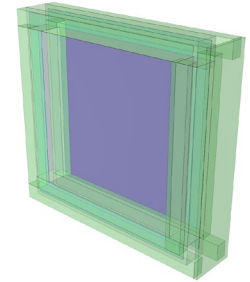
# Beam Profilometers (behind the magnet)

Beam profilometers located behind the magnet :

- **Small GEM**
- **Gas Beam Profilometer**



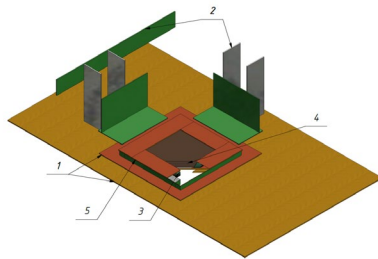
Detailed ROOT geometry  
of small GEM



Detailed ROOT geometry  
of Gas Beam Profilometer

## Small GEM

microstrip  
gaseous detector



gas-filled chamber

active gas area: **10 x 10 cm**  
gas volume thickness: **9 mm**  
strip pitch: **0.4 mm**  
stereo angle between strips: **90°**

## Gas Beam Profilometer

multi-wire  
gaseous detector



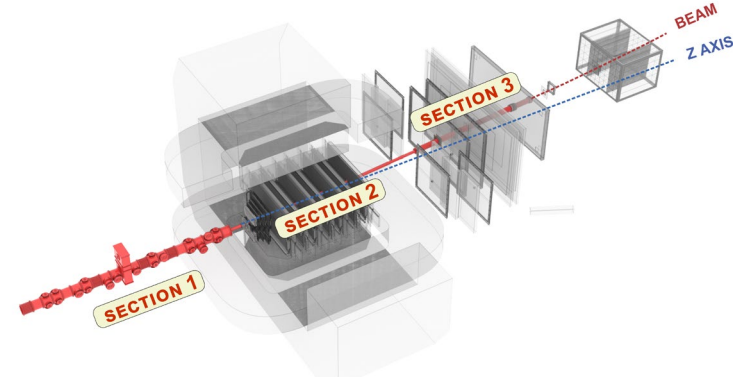
gas-filled chamber

active gas area: **20.7 x 20.7 cm**  
gas volume thickness: **30 mm**  
wire pitch: **2 mm**  
stereo angle between wires: **90°**

# Vacuum Beam Pipe

**Vacuum Beam Pipe** consists of three sections:

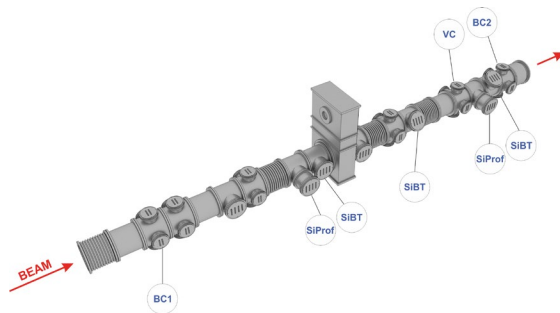
- **First section** (in front of the target)
- **Second section** (behind the target)
- **Third section** (behind the magnet)



**ROOT geometry  
of Vacuum Beam Pipe**

## First section

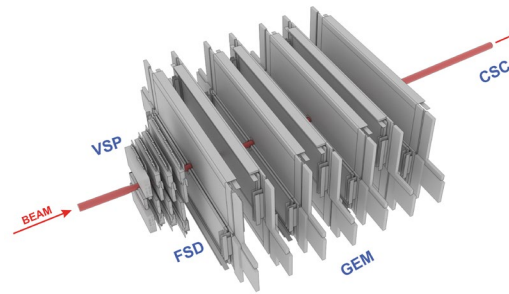
-



22 steel and aluminum boxes

## Second section

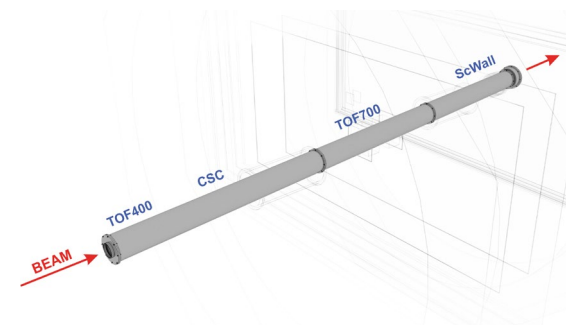
-



4 sections of carbon tube

## Third section

-



3 sections of aluminum tube

# What has been done

## ❑ Geometry of hybrid tracker detectors for RUN-9:

In front of the target:

- **SiBT** (Silicon Beam Tracker)
- **SiBProf** (Silicon Beam Profilometer)

Inner Tracker:

- **VSP** (Vertex Silicon Plane based on STS modules)
- **FSD** (Forward Silicon Detector)
- **GEM** (Gas Electron Multiplier)

Outer Tracker:

- **Small CSC** (Small Cathode Strip Chamber)
- **Large CSC** (Large Cathode Strip Chamber)

## ❑ Geometry of Beam profilometers (behind the magnet):

- **Small GEM** (detailed geometry)
- **Gas Beam Profilometer** (detailed geometry)

## ❑ Geometry of Vacuum Beam Pipe:

- Metal boxes of the first pipe section (in front of the target)

**Thank you for your attention...**