Status of Event Reconstruction and Detector Simulation in Xe Run

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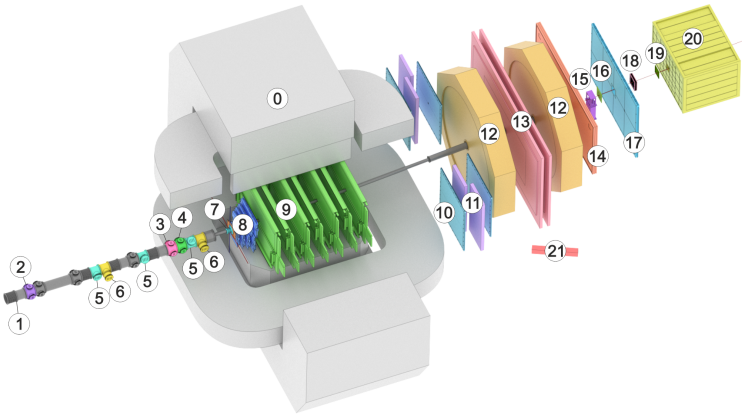
on behalf of BERDS Group

15/05/23



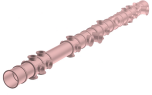
- Magnet SP-41 (0)
- Vacuum Beam Pipe (1)
- BC1, VC, BC2 (2-4)
- SiBT, SiProf (5, 6)
- Triggers: BD + SiMD (7)
- FSD, GEM (8, 9)
- CSC 1x1 m^2 (10)
- TOF 400 (11)
- DCH (12)
- TOF 700 (13)
- ScWall (14)
- FD (15)
- Small GEM (16)
- CSC 2x1.5 m^2 (17)
- Beam Profilometer (18)
- FQH (19)
- FHCal (20)
- HGN (21)

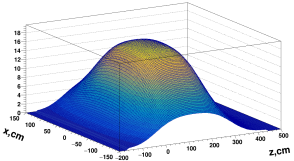
by D.Baranov

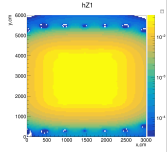
Subsystems status
Geometry and simulation

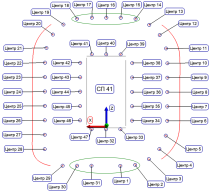
Beampipe and magnet

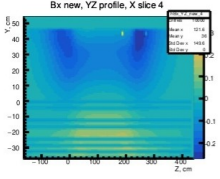
- Field measurements were made for 3 values of current on the magnet
- Current measurements were made in a wider coordinate range
- Magnetic field map is under preparation
- Geodetic measurements of the bolt positions helped align field inside the SP-41





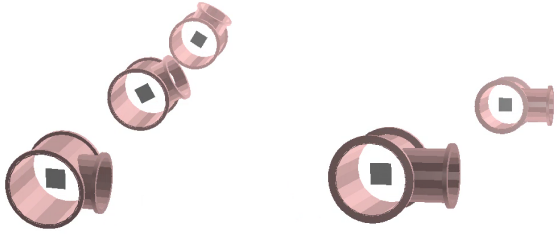






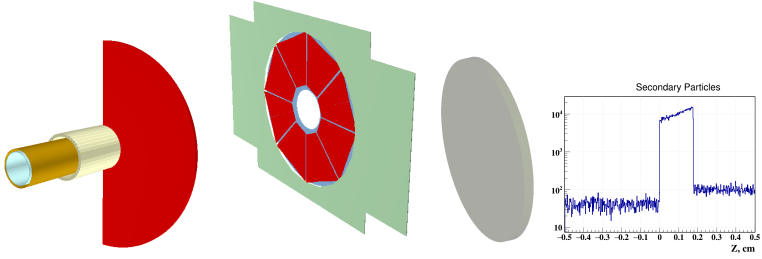
- ✓ Geometry of beampipe was implemented in simulation as a passive volume (`D.Baranov (JINR)`)
- ✓ Field map is ready and set as default for simulation and reconstruction (`S.Merts (JINR)`)
- ✗ There are some nonlinear areas (`S.Lebedeva (SPSU)`)
- ✗ Need to monitor consistency of the magnetic field between simulation and realistic effects in GEM

Upstream zone



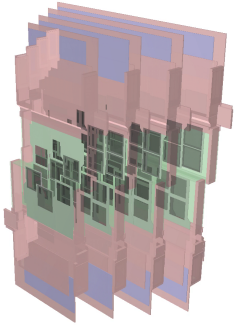
- ✓ Geometry of all upstream detectors was added in simulation (D.Baranov (JINR))
- ✗ There is no geometry for BC1, BC2 and VC
- ✗ Effects of passive volumes not used in simulation (events start in target)

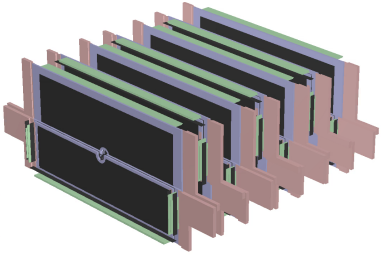
Target zone



- ✓ Beam angle (in X direction) is set by estimations of (`INR group`)
- ✓ ION generator adopted to work with Xe beam
- ✗ Beam angle (in Y direction) and XY smearing should be estimated and set

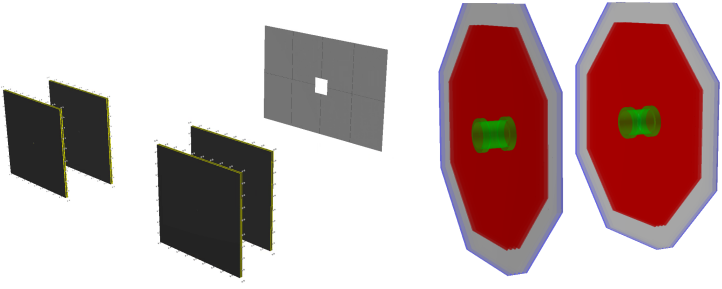
Inner tracker zone





- ✓ Realistic geometry of FSD and GEM was added in simulation
- ✓ Realistic effects (avalanches+lorentz) for GEM were implemented in simulation
- ✓ Smearing of MC-points for FSD is used in simulation
- ✗ By default not the latest version of FSD+GEM geometry used in simulation by the reason of tracking/alignment
- ✗ Additional passive volumes (in big polar angles) of GEM support system should be added to geometry
- ✗ Charge dependence of signal has to be implemented

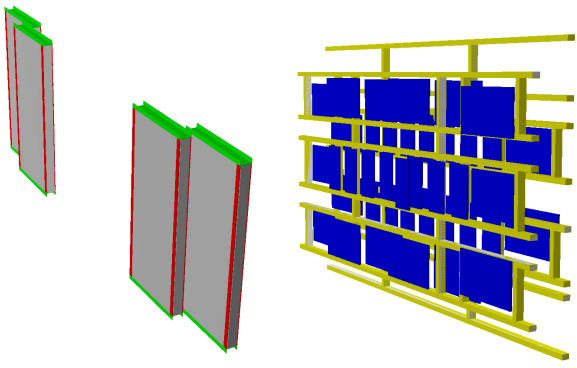
Downstream zone. Coordinate detectors



- ✓ Realistic geometries of DCH and CSC were added in simulation
- ✓ Smearing of MC-points with "left-right uncertainty"for DCH is used in simulation
- ✓ Smearing of MC-points for CSC is used in simulation

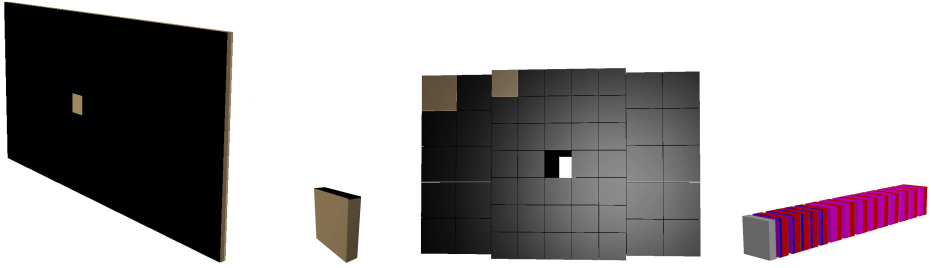
D.Baranov (JINR)

Downstream zone. Time detectors



- ✓ Realistic geometries of TOF700 with support (Y.Petukhov (JINR))
- ✓ Realistic geometries of TOF400 with boxes (NEW) (M.Rumyantsev (JINR))
- ✓ Smearing of MC-points is used in simulation

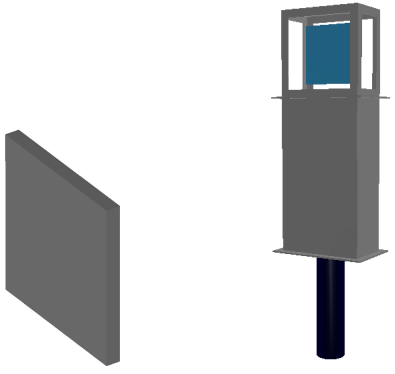
Downstream zone. Energy detectors



✓ Geometries of ScWall+HODO+FHCal added in simulation
✓ Geometry of HGN (nDet) prototype added in simulation
✗ There is no digi production for nDet

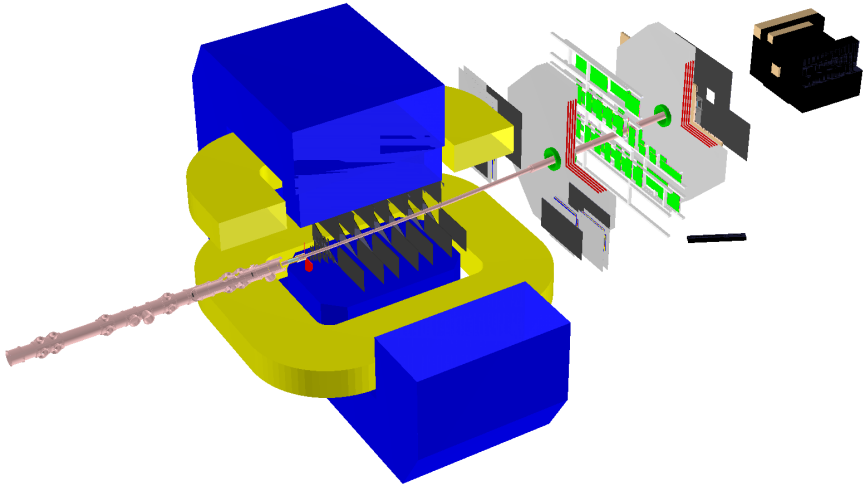
`group of INR RAS`

Downstream zone. Two special ones



- ✓ Realistic geometry of FD with support implemented (`N.Lashmanov (JINR)`)
- ✓ Simplified geometry of small GEM added in simulation (`D.Baranov (JINR)`)
- ✓ Realistic effects are used in simulation for small GEM (`D.Baranov (JINR)`)
- ✗ There is no digi production for FD

Detector setup. Simulation view

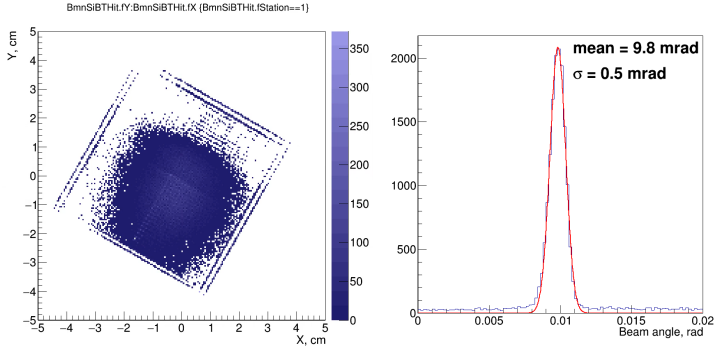


Summary table to work with MC data

Detector	Geometry	MC classes	Digitizer
Beampipe	✓	—	—
Target	✓	—	—
SiBT	✓	✓	✓
SiProf	✓	✓	✓
BC	✗	✗	✗
VC	✗	✗	✗
SiMD	✓	✓	✓
BD	✓	✓	✓
FD	✓	✓	✗
FSD	✓	✓	✓
GEM	✓	✓	✓
CSC	✓	✓	✓
LCSC	✓	✓	✓
DCH	✓	✓	✓
TOF-400	✓	✓	—
TOF-700	✓	✓	—
NeutDet	✓	✓	✗
FHCal	✓	✓	✓
HODO	✓	✓	✓
ScWall	✓	✓	✓

Subsystems status
Local reconstruction

Upstream and target zones



- ✓ Hit reconstruction was added for SiBT and SiProf (`D.Baranov (JINR)`)
- ✓ Beam track reconstruction was added for SiBT (`S.Merts (JINR), A.Dryuk (SPSU)`)
- ✗ How to use SiBT in real (not beam only) simulation? (events start in target)
- ✗ There is no the structure to store trigger information

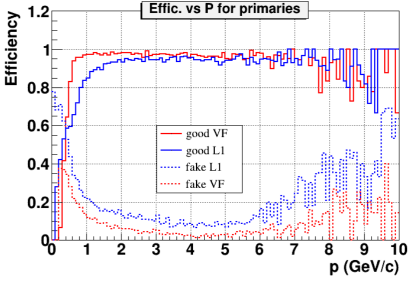
Inner tracker zone

Hit reconstruction

✓ Clusters and hits are reconstructed in so called BMN format and converted into so called CBM format (unified hits)
✓ Hits store a set of links to parent clusters
✓ Possibility to have "one-side" hits (pseudo-hits) added both for FSD and GEM

Tracking

✓ The default tracking engine is Vector Finder now (I hope it's the last one)
✓ It is not the "black box" for us and gives better efficiency
✗ It is still rather slow (welcome to optimize it)
✓ Possibility to skip stations in tracking added

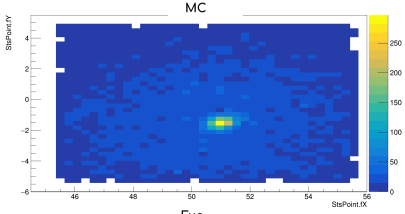


D.Baranov (JINR), A. Zinchenko (JINR), S.Merts (JINR)

Downstream zone

Coordinate detectors

- ✓ Clusters and hits are reconstructed in CSC for MC and Exp data
- ✓ CSC hits store a links to parent clusters
- ✓ Possibility to have "one-side"hits (pseudo-hits) added for CSC
- ✓ Track reconstruction in DCH for MC case is implemented
- ✗ Track reconstruction in DCH for Exp data isn't implemented yet due to huge combinatorics (work is ongoing)
- ✓ Full chain reconstruction developed for small GEM (as for big ones)
- ✓ Small GEM helps to align beam in simulation (great finding!)



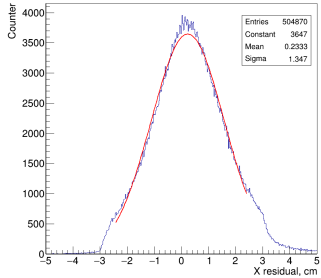
Time detectors

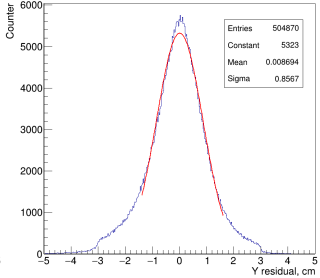
- ✓ Hits with smeared coordinates and time are reconstructed in both TOF systems for MC case
- ✓ First level calibrations were done for TOF-700 for Exp data reconstruction
- ✗ Reconstruction of TOF-400 hits for Exp data is still under development

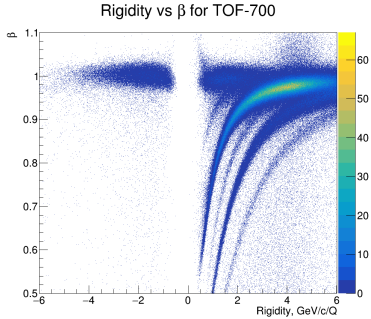
Energy detectors

- ✓ Hit/digit reconstruction implemented for FHCal, HODO and ScWall
- ✗ There is no reconstruction for nDet

Global tracking







✓ New matching approach is used. All possible pairs (hit-track) are created and the true nearest one used.

✗ Only TOF-700 added in Global Track for Xe run

Summary table for RECO of Exp data

Detector	Local hits/tracks	Is in Global track	Alignment	Comments
SiBT	✓	—	✓	
TRIGGERS	✓✗	—	—	Transfer from DIGI to DST
FSD	✓	✓	✓	
GEM	✓	✓	✓	
CSC	✓	✗	✗	
LCSC	✓	✗	✗	
DCH	✗	✗	✗	
TOF-400	✗	✗	✗	
TOF-700	✓	✓	✓	
NeutDet	✗	✗	✗	
FHCal	✓	✗	✗	
HODO	✓	✗	✗	
ScWall	✓	✗	✗	

Summary and plans

- ✗ Nonlinear areas in magnetic field map
- ✗ There is no geometry for BC1, BC2 and VC
- ✗ Effects of passive volumes in upstream zone were not used in simulation
- ✗ Using of SiBT in physics simulation and reconstruction
- ✗ Estimation of beam parameters
- ✗ Additional passive volumes (in big polar angles) for GEM
- ✗ Charge dependence of signal in GEM detectors
- ✗ Digits (or other integral event information) need to be prepared for FD
- ✗ There is no the structure to store trigger information in DST
- ✗ Vector Finder tracking is rather slow
- ✗ Reconstruction for DCH, TOF-400 and nDet
- ✗ Alignment of outer detectors
- ✗ Subdetectors efficiency estimation

Thank yuo!

Backup

Efficiency of FSD