

Status of the **BM@N** simulation and data reconstruction



Sergei Merts

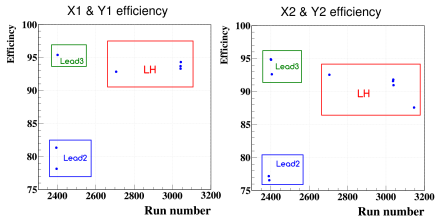
on behalf of BERDS Group

27/10/2020

Last half year's motto: "Monte Carlo is coming back"

SRC setup

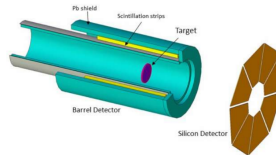
- Geometry, MC classes and simple hit producer added for arm triggers
- HP has to be tuned to reproduce experimental event selection
- Geometry, MC classes and HP have to be developed for BC_3 and BC_4 triggers



A.Driuk

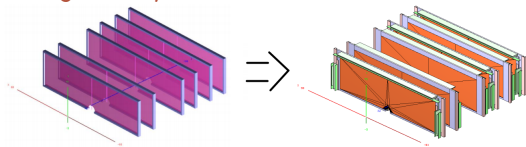
BM@N setup

- Geometry and MC classes added for BD and SiD
- Performance of BD and SiD for Au+Au collision is under study

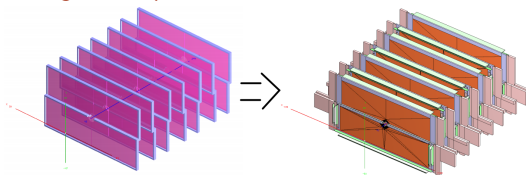


N.Lashmanov

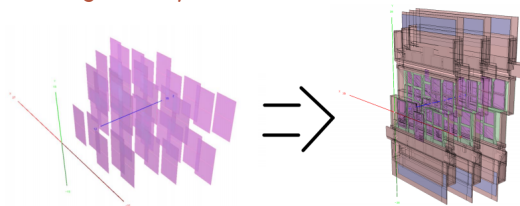
GEM geometry of 2018 run



GEM geometry of future run



Silicon geometry of future run



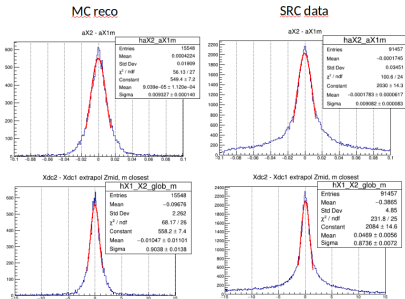
Passive elements added:

- frames
- electronics
- material layers in sensitive area

Impact of additional passive volumes on the simulation and reconstruction should be studied

Drift chambers

- Realistic response of DCH added in simulation procedure
- Tracking unified for SRC/BM@N/MC/EXP

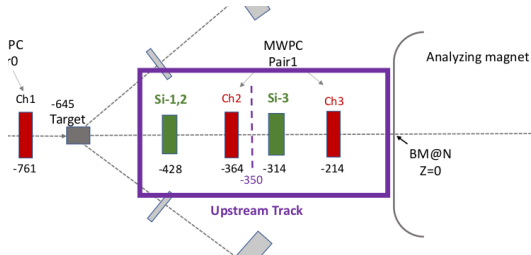


N.Voitishin, D.Baranov

S. Merts

Upstream detectors in SRC

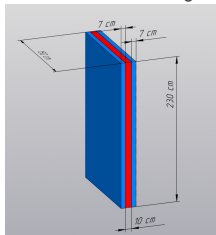
- Hit producers adapted to work with MC data
- Tracking need to be unified for MC/EXP



V.Lenivenko

SRC arm calorimeters

To separate protons from SRC reaction new calorimeters are designed

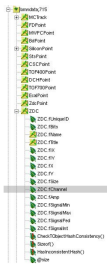


T.Atovullaev

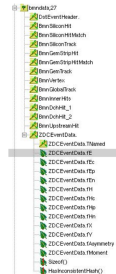
ZDC

- BmnZdcDigitizer added to be used in simulation
- BmnZdcAnalyzer added to be used in reconstruction

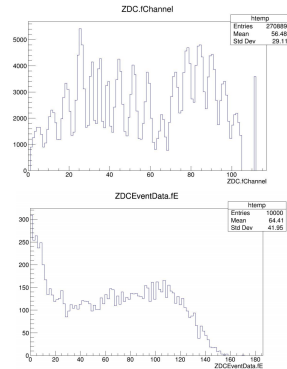
ZDC digitizer



ZDC analyzer

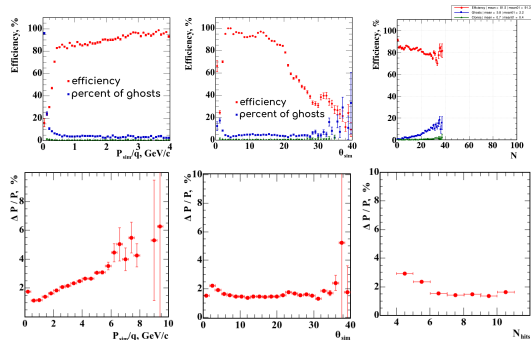
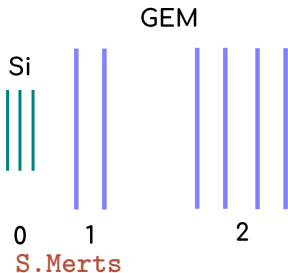


Output plots

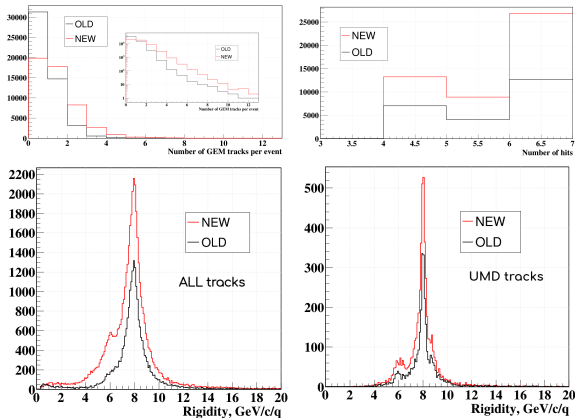


P. Alekseev

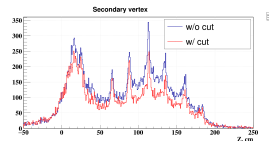
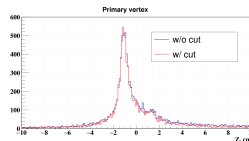
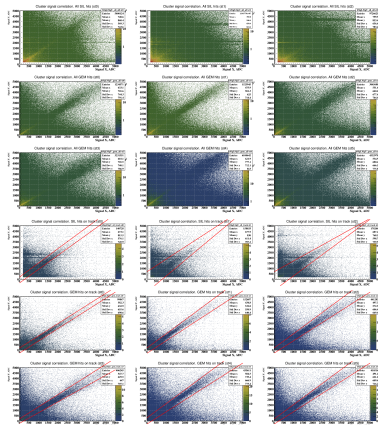
- Iterative approach over different zones
- Conditional combinatorial search for candidates
- Track parameters estimation by circle and update by KF



- Conditional combinatorial search for candidates over 6 stations
- Track parameters estimation by circle and update by KF



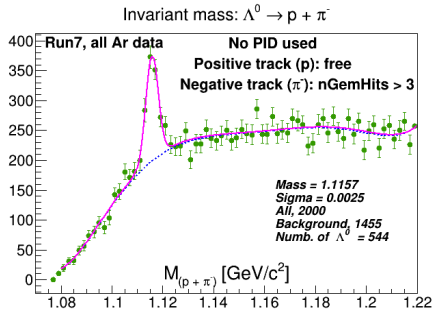
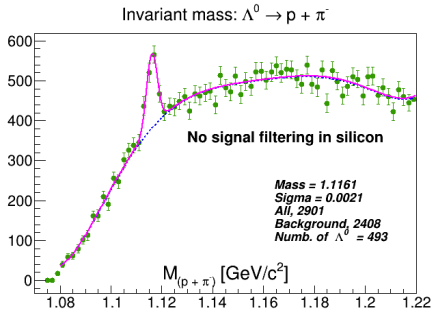
S.Merts



	W/ asym. cut	W/o asym. cut
Number of PV at [-3, 3]	8060 (4.0%)	8503 (4.3 %)
PV μ [-1.6, -0.7]	-1.11 cm	-1.08 cm
PV σ [-1.6, -0.7]	0.30 cm	0.32 cm
Number of tracks	317122	499824
Number of matched CSC hits	25009 (7.9%)	30490 (6.1%)
Number of matched TOF-400 hits	20994 (6.6%)	23246 (4.7%)
Number of matched TOF-700 hits	48591 (15.3%)	60260 (12.1%)
Number of matched DCH tracks	52429 (16.5%)	78783 (15.8%)
Full reconstruction time	92 s / 1000 ev	242 s / 1000 ev
Full reconstruction speed	10.9 ev/s	4.1 ev/s

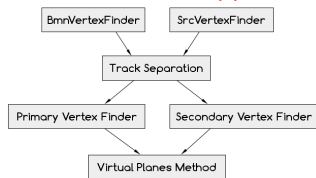
PLAN: To add filtration of hits for the SRC data

S.Merts, V.Plotnikov



P. Batyuk

New vertex finder approach



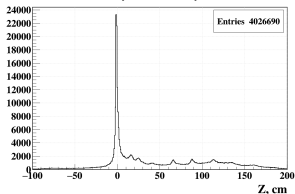
Virtual planes method

- 1 Extrapolate reconstructed tracks to set of $\{z_k\}_0^{N_{\text{planes}}}$ by Kalman Filter around initial estimation: $Z_v^{\text{init}} - R < z_k < Z_v^{\text{init}} + R$
- 2 Calculate distance between each pair of points on plane k :
$$d_{ij}^k = \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2}$$
- 3 Calculate mean distance for each plane: $d^k = \sum d_{ij}^k / N_{\text{pairs}}$
- 4 Fit $d^k(z_k)$ by parabolic function and find z_{min}
- 5 Reduce R by factor *speed*: $R = R/\text{speed}$
- 6 Repeat 1-5 until required accuracy is achieved

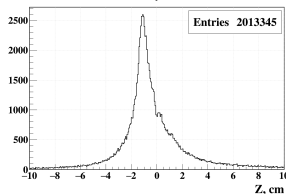
S.Merts, N.Kakhanovskaya

In parallel new combinatorial approach was proposed and implemented in BmnRoot by M.Zavertyaev and I.Gabdrakhmanov

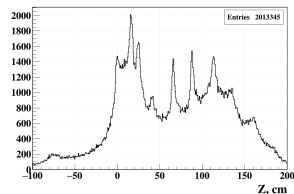
Primary and secondary vertex



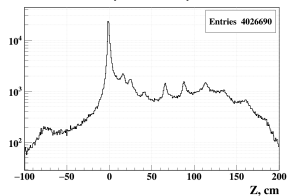
Primary vertex



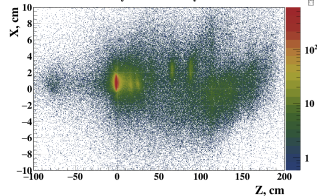
Secondary vertex



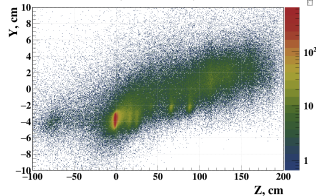
Primary and secondary vertex

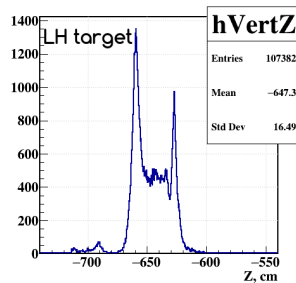
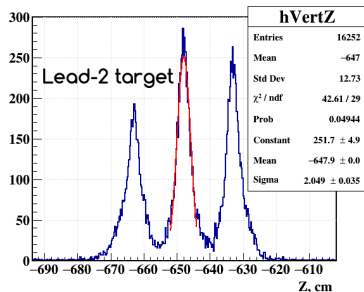
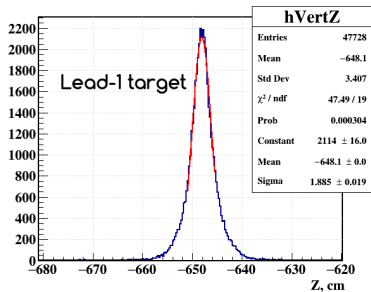


Primary and secondary vertex

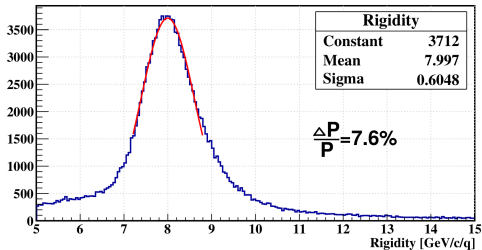


Primary and secondary vertex

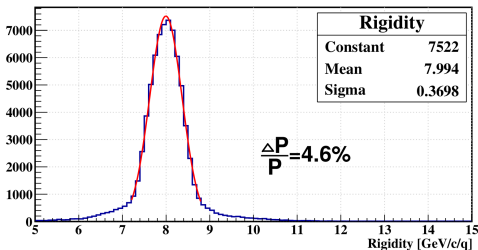




M-tracks

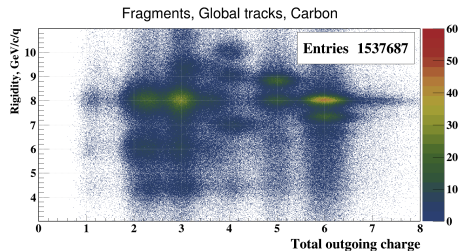
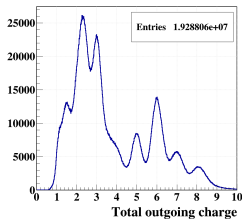
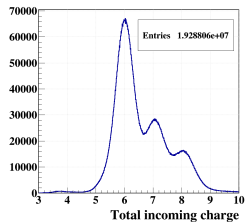


UMD-tracks



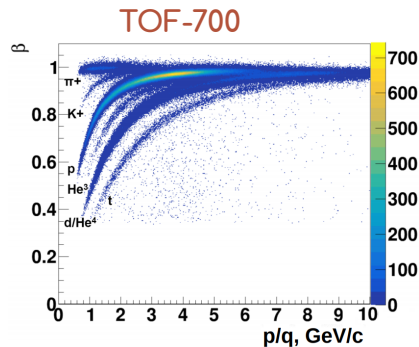
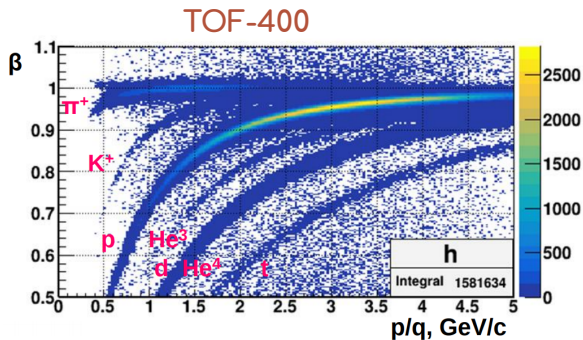
S.Merts, V.Lenivenko, N.Voitishin

PLAN: To implement this for BM@N reconstruction



T.Atovullaev, S.Merts, A.Driuk

PLAN: To implement beam counters into simulation to get FID in MC



L.Kovachev, V.Plotnikov

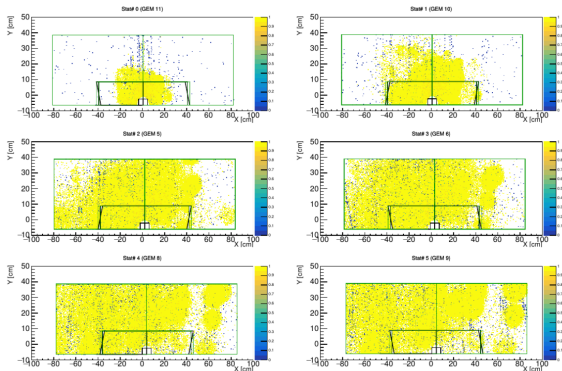
PLAN: To implement PID into standard reconstruction chain

Inserting MC tracks/hits/digits into experimental data to estimate reconstruction efficiency

The study is ongoing for

- lambda analysis in Run-6 data produced by L1 tracking (Yu.Stepanenko)
- lambda analysis in Run-7 data produced by BMN tracking (P.Batyuk)
- K^+ & π^+ identification in Run-7 data produced by L1 tracking (L.Kovachev, V.Plotnikov)

Signal rescaling procedure is implemented by I.Gabdrakhmanov



Prerelease of the reconstructed experimental data:

`/eos/nica/bmn/exp/dst/run7/prerelease`

Monte Carlo is coming back, so we have to

- add **realistic effects** to simulation of all subdetectors
- unify reconstruction chain for both MC and experimental **data source**
- unify data format for **two tracking outputs**.
- **Tracking challenge!** We have 1.5 year to develop fast, flexible, scalable tracking to deal with high multiplicity.