QA of the Pb-Pb data collected by the NA61/SHINE at CERN

Petr Parfenov (MEPhI), Ilya Selyuzhenkov (MEPhI/GSI),
Viktor Klochkov (GSI/Frankfurt Uni.) and Arkadiy Taranenko (MEPhI)

Abstract

Experimental data of the colliding heavy nuclei in the NA61/SHINE energy range is crucial for defining thermodynamical properties of the nuclear matter. Main goal of the analysis is to compare results from different experiments. Thus, one needs to generalize both used methods and data structure. For that, Pb-Pb data from NA61/SHINE experiment is converted into general DataTree structure that could be implemented in any experiment with heavy-ion collisions.

NA61/SHINE experiment

Main subsystems of the NA61/SHINE experiment at CERN SPS:

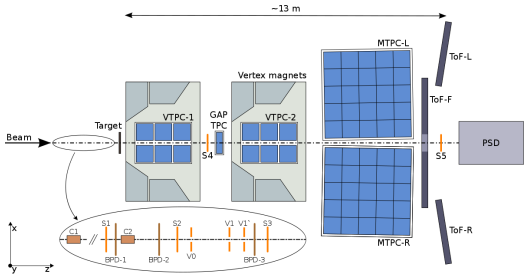
- 4 large volume TPC;
- TOF;
- PSD calorimeter;
- Trigger and beam monitoring system;
- Two super-conducting dipole magnets.

Experimental setup

In this QA analysis was used Pb-Pb collisions, which were proposed in the framework of extended NA61/SHINE physics program [1]:

- $E_{beam} = 13\ AGeV$, $N_{ev} = 5 \cdot 10^5$;
- $E_{beam} = 30\ AGeV$, $N_{ev} = 1 \cdot 10^6$.

Further results will be presented for $E_{beam} = 13\ GeV$.
Earlier, Pb-Pb collisions without magnetic field were studied [2].

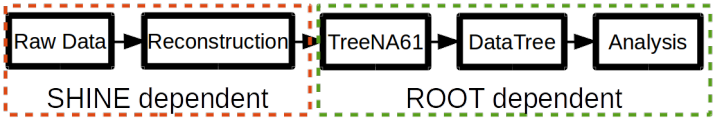


Data and analysis flow

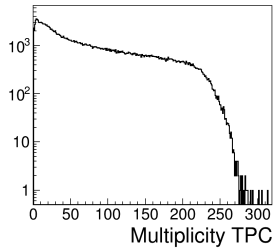
DataTree consists of several main classes used in this conversion:

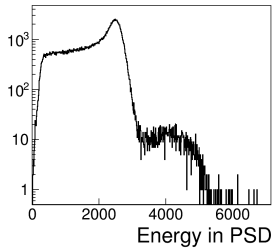
- DataTreeEvent (main class, parameters of the event);
  - DataTreeTrack (tracks in the TPC);
  - DataTreePSDModule (properties of PSD Modules);
    - DataTreePSDSection (additional sub-class);
  - DataTreeTrigger (information about triggers).

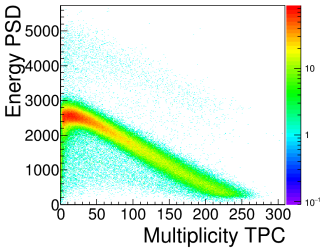
Total conversion includes several steps: raw data reconstructed into "reco" files, then into standard root file ("TreeNA61") via SHINE software. TreeNA61 files are converted into "DataTree" structure. After all, one does general analysis using detector-independent "DataTree" files.

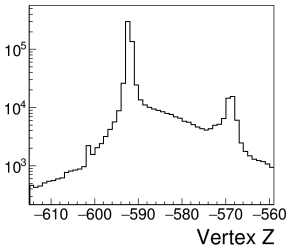


Event QA







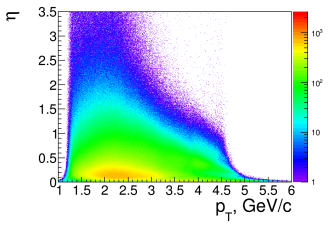


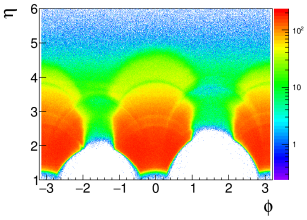
Event cuts:

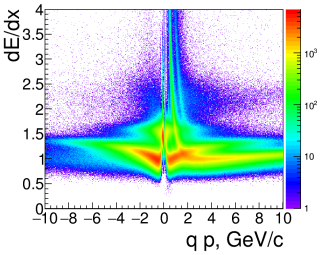
- min bias trigger;
- Vertex quality;
- $-594 < Z_{vtx} < -590$;
- $-0.8 < Y_{vtx} < 0.4$;
- $-1.1 < X_{vtx} < 0$;

Strong anti-correlation between energy deposition in PSD modules and multiplicity in TPC detectors shows that both PSD and TPC can be used for centrality determination. Needed further investigation since the presence of outliers in these correlation.

Track QA







Used track cuts:

- $10 < N_{hits}^{MTPC} < 90\ ||\ N_{hits}^{MTPC} = 0$;
- $N_{hits}^{VTPC1} > 10\ ||\ N_{hits}^{VTPC1} = 0$;
- $10 < N_{hits}^{VTPC2} < 72\ ||\ N_{hits}^{VTPC2} = 0$;
- $\chi^2/NDF < 10$;
- $(DCA_x^2 + DCA_y^2) < 9$.

Strong anisotropy (ϕ-η) should be corrected in the further analysis.
dE/dx-$q \cdot p$ plot will be used for particle identification.

Summary

To generalize analysis procedures, experimental data was converted into DataTree structure.
Basic QA for events and tracks was provided. Centrality can be determined via TPC and PSD detectors. PID can be done via dE/dx-$q \cdot p$ plot.
For anisotropic acceptance, corrections will be used (see O. Golosov poster).

References

[1] Abgrall, N [NA61/SHINE Collaboration], Report from the NA61/SHINE experiment at the CERN SPS, http://cds.cern.ch/record/1955138.
[2] A. Aduszkiewicz et al. [NA61/SHINE Collaboration], Beam momentum scan with Pb+Pb collisions, CERN-SPSC-2015-038; SPSC-P-330-ADD-8, https://cds.cern.ch/record/2059811