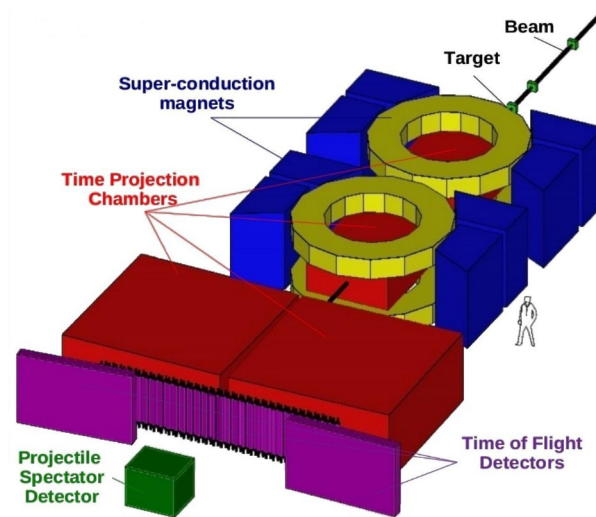
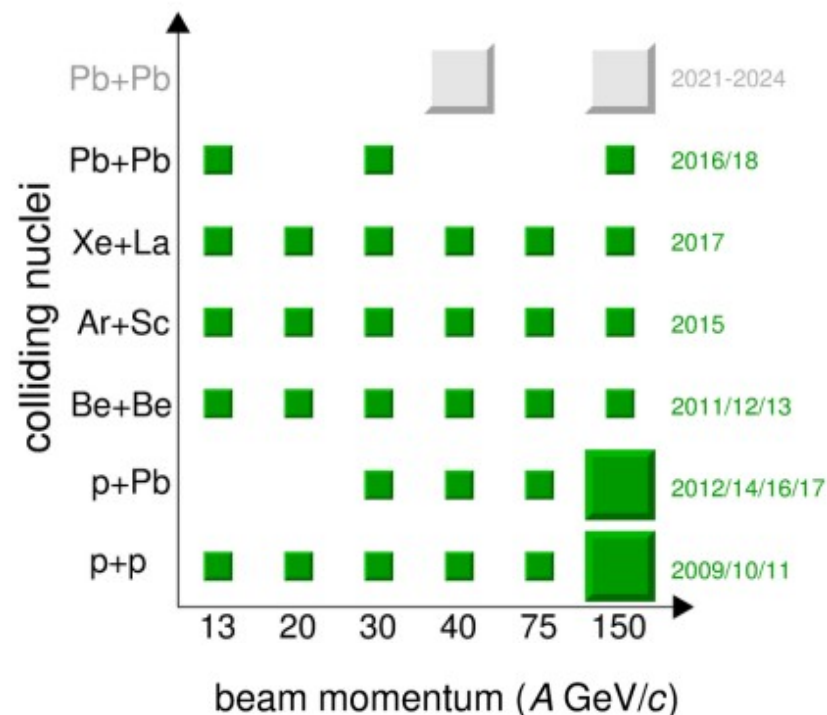


Upgrade of Projectile Spectator Detector at NA61/SHINE experiment

Sergey Morozov on behalf of INR RAS, Moscow



NA61/SHINE experiment at CERN SPS



NA61/SHINE facility:

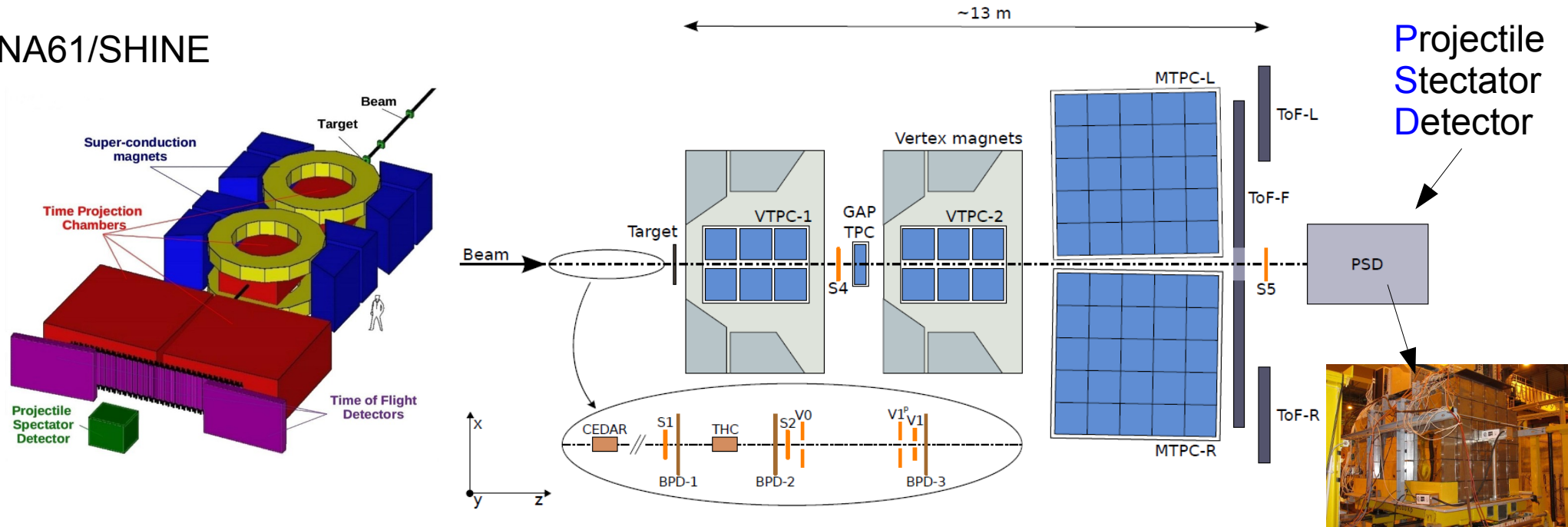
- accelerator chain, beam line and detectors
- hadron production spectrometer for h+p, h+A, A+A
- energies: 13 – 150 AGeV/c (400)
- precise measurements of produced particles (charge, mass, momentum)

Physics program beyond 2020:

- open charm (D-meson production) measurements
- first measurement in 2022: Pb+Pb at 150 AGeV, high intensity beam

Upgrade of Projectile Spectator Detector at NA61/SHINE experiment

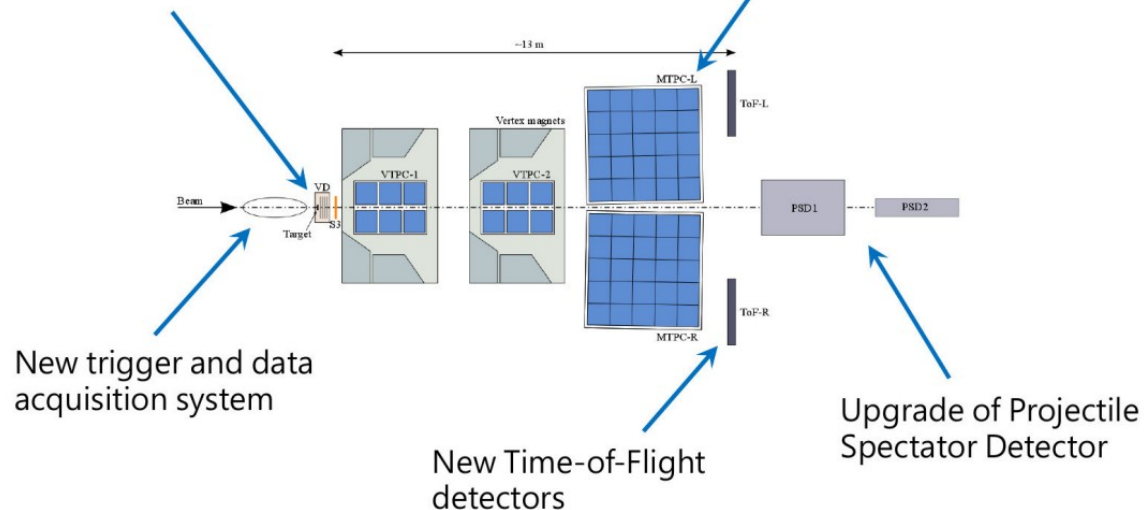
NA61/SHINE



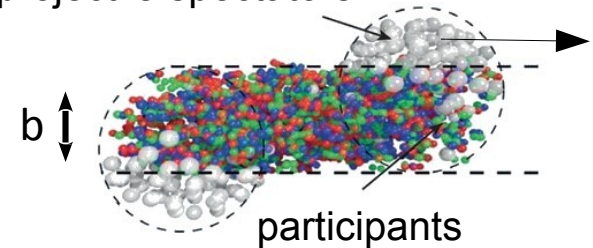
Upgrade of NA61/SHINE experiment

Construction of Vertex Detector (VD) for D^0 , \bar{D}^0 decay reconstruction

Replacement of the TPC read-out electronics to increase data rate to 1 kHz



projectile spectators

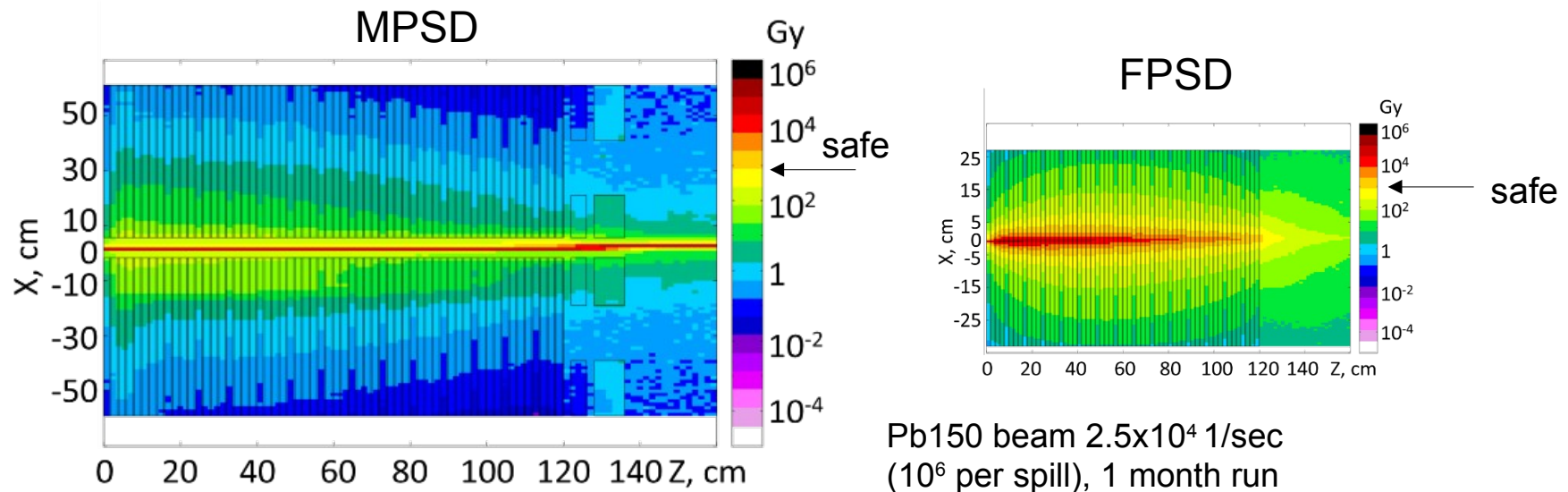
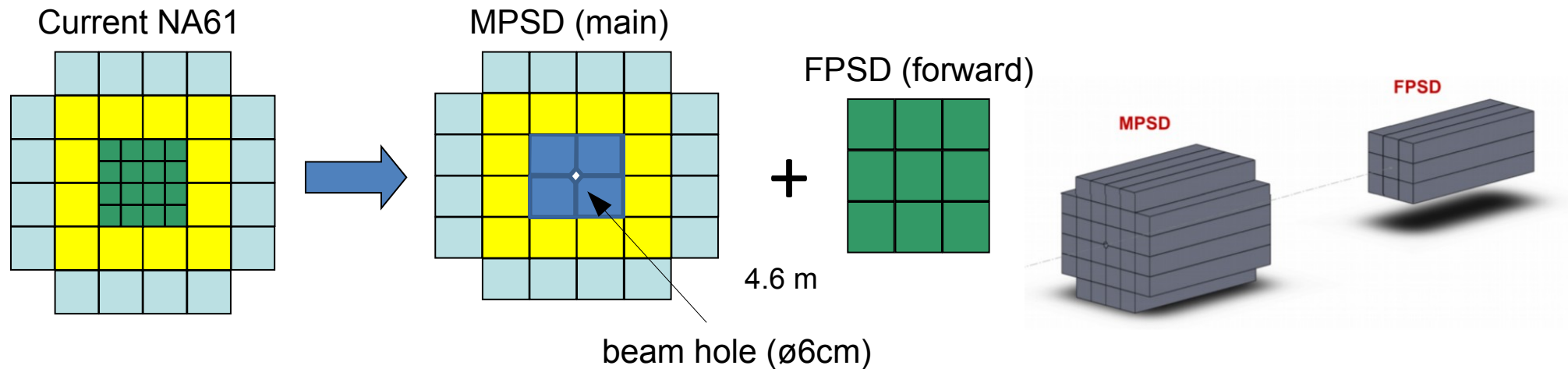


Main goals of PSD:

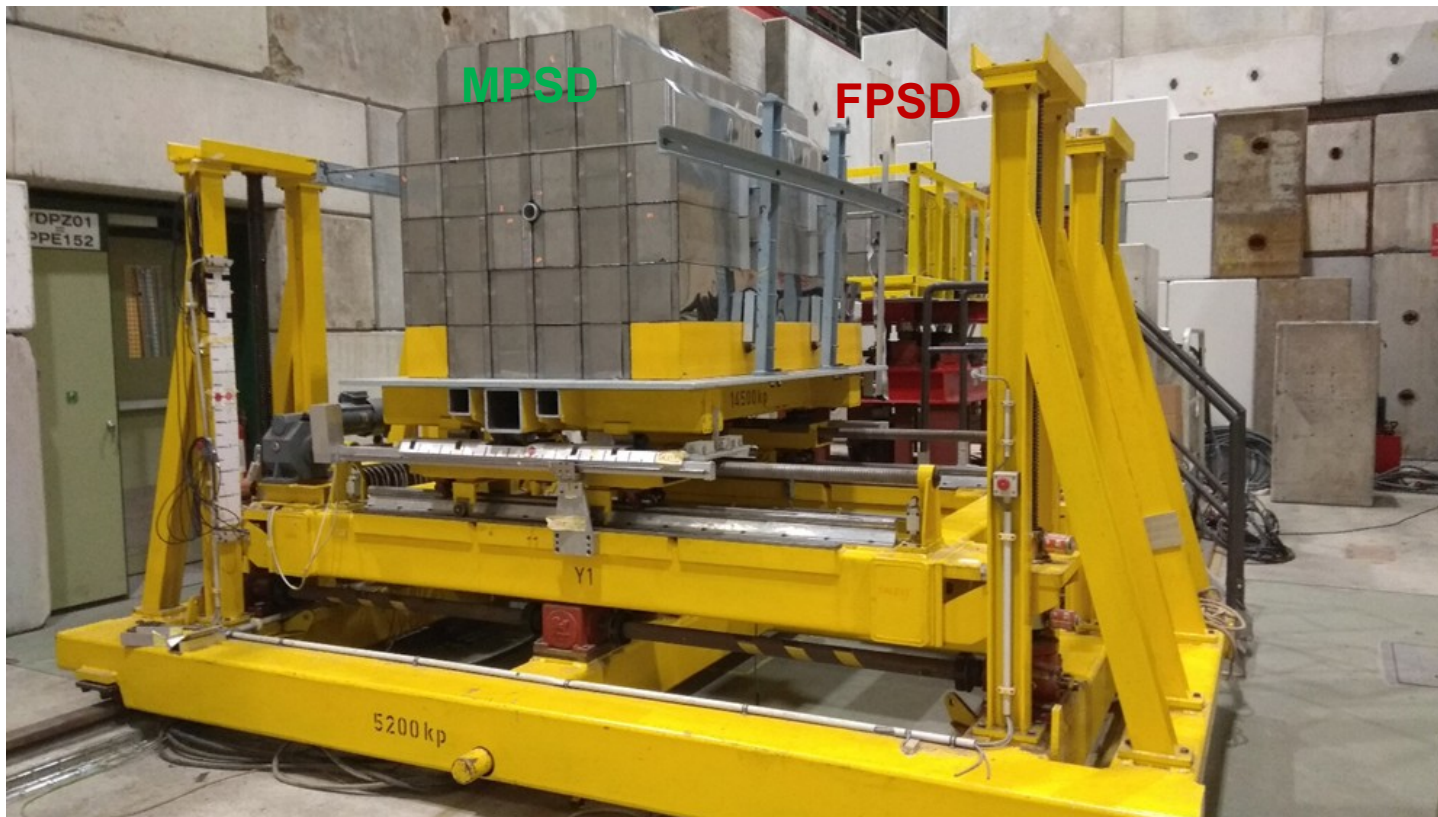
- event selection with collision centrality classes
- event plane reconstruction (with transverse granularity)

PSD upgrade motivations:

- radiation damage of central modules of PSD with expected high beam intensity
- decouple the detection of single spectators and heavy fragments
- problems with radiation alarm (PSD is now an active beam dump!)



FPSD + MPSD on NA61/SHINE beam line



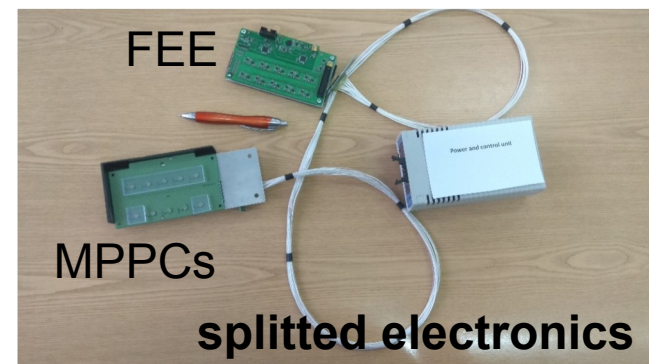
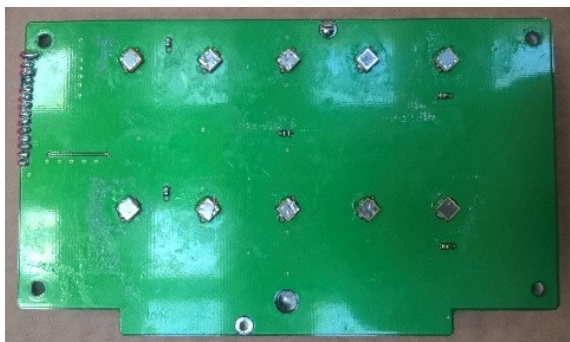
- 13 new modules in MPSD (borrowed at CBM experiment)
- 1 new (central) FPSD module with 4 cm hole in scintillators to avoid degradation of response with time due to high radiation doses

MPSD upgrade:

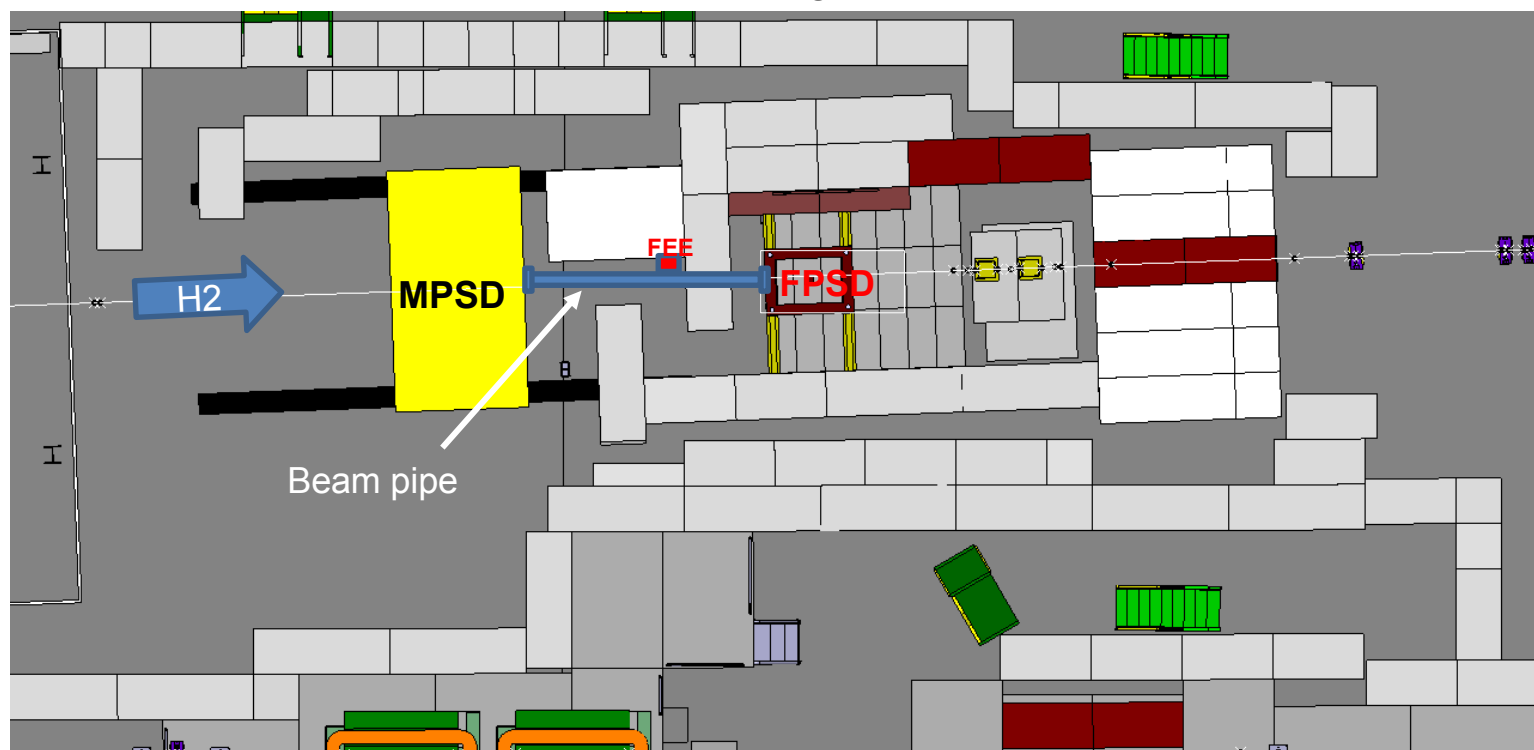
- new fast Hamamatsu MPPCs in all modules – no more saturation effect due to long pixel recovery time on old MAPD photodetectors



FEE for FPSD (based on developments for CBM experiment)

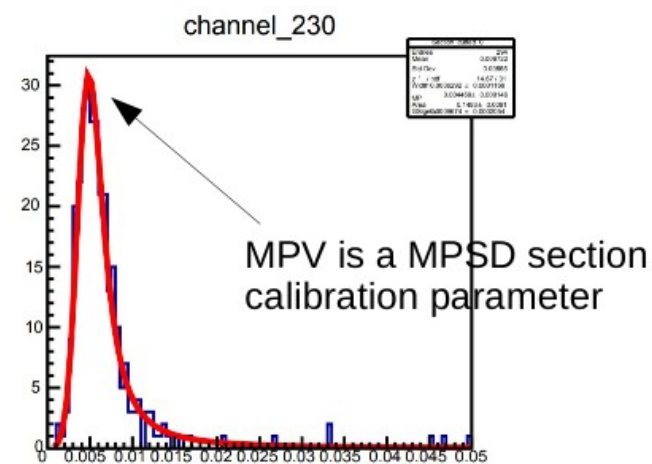
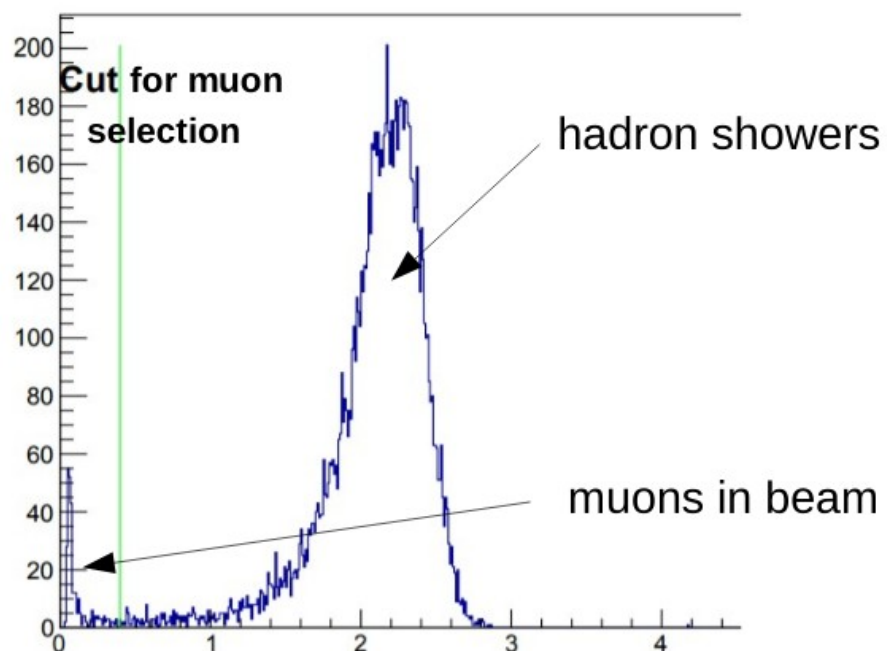
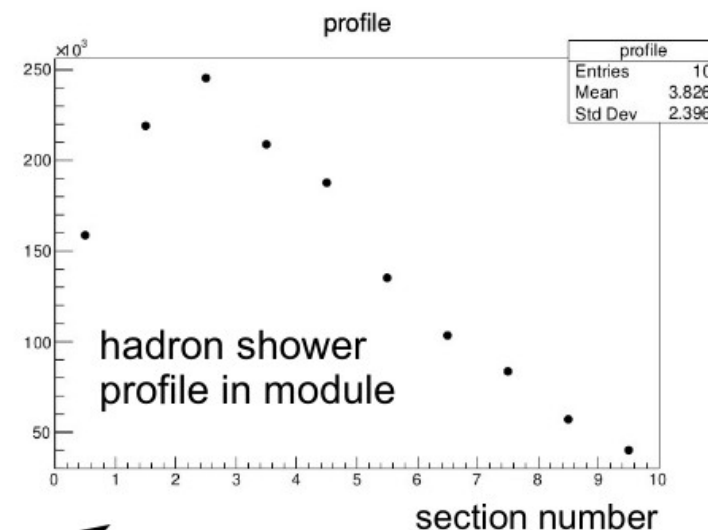
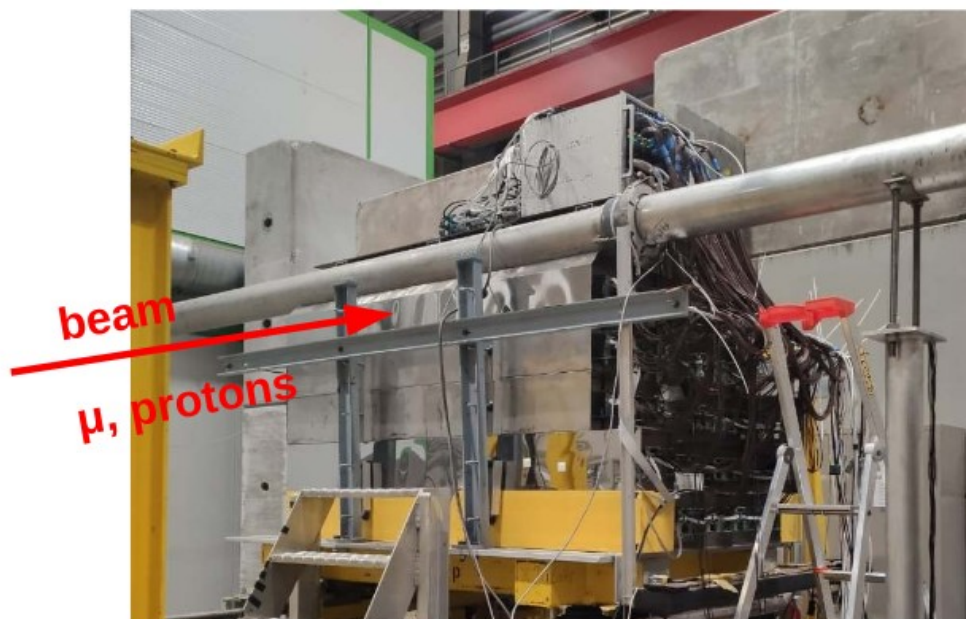


FPSD shielding structure



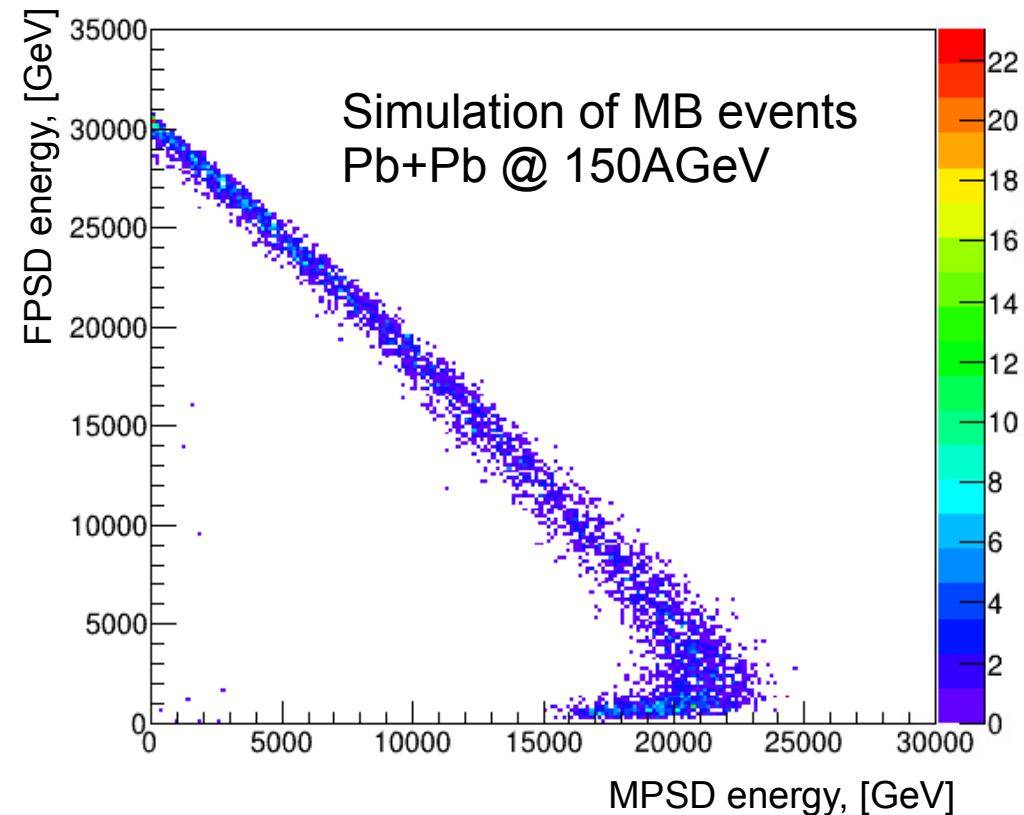
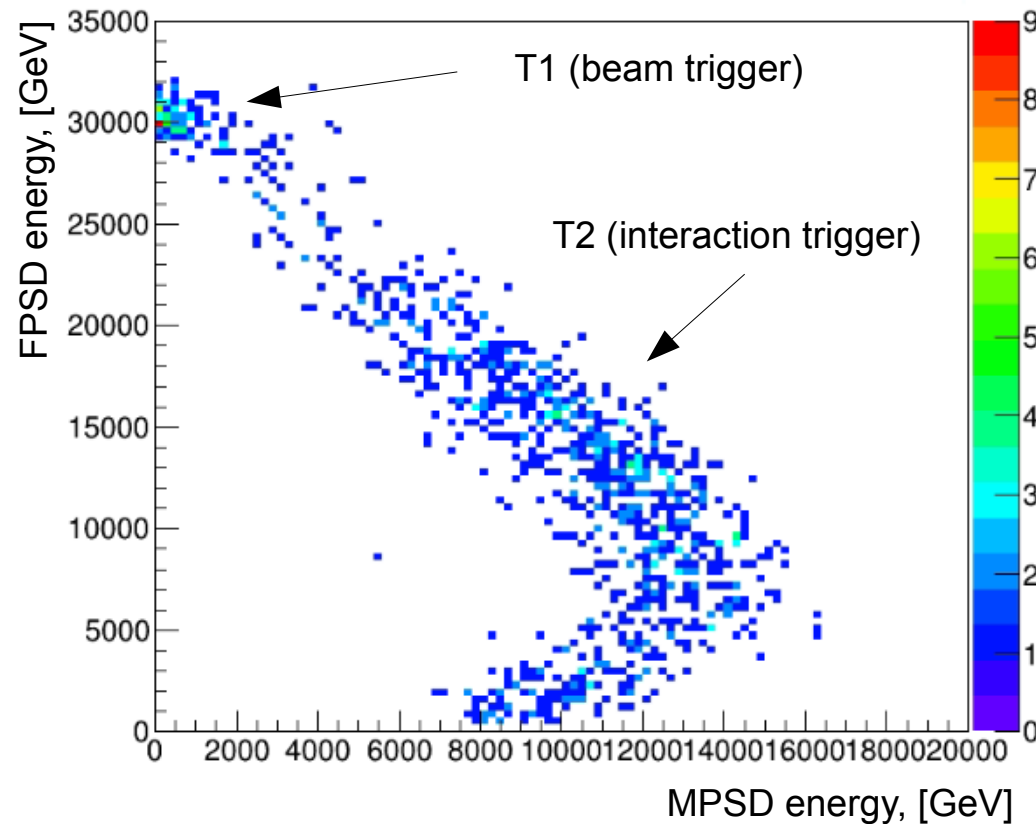
FPSD + MPSD on NA61/SHINE beam line





The muon spectrum in one MPSP section with Landau+Gauss convoluted fit

First data from FPSD + MPSD on beam of Pb+Pb 150 AGeV, November 2022



Conclusions:

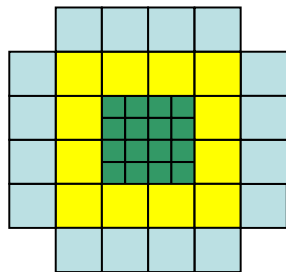
- NA61/SHINE PSD detector has been updated with new MPSD+FPSD calorimeter system for high intensity beam conditions
- first experimental data for Pb+Pb @ 150 AGeV have been taken with upgraded PSD in November 2022

Thank you for your attention!

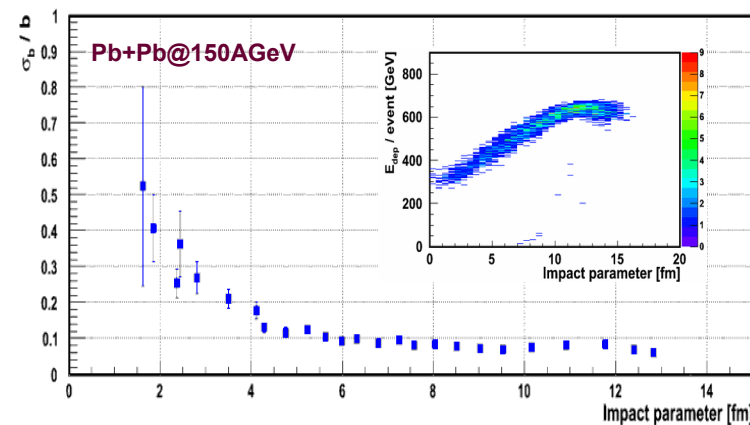
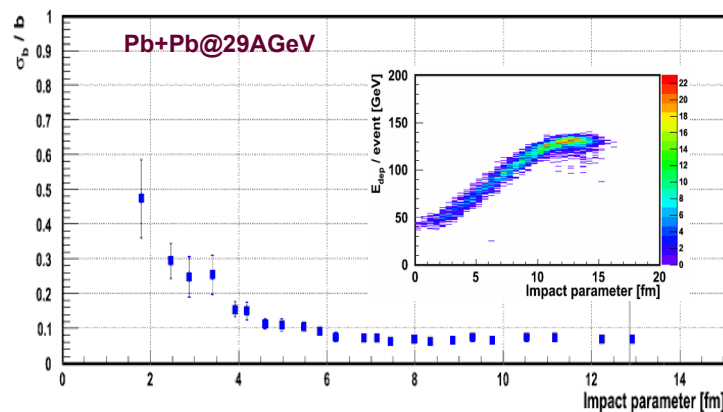
Backup slides

Centrality determination with PSD schematics:

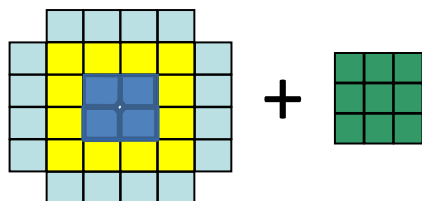
old NA61/SHINE PSD



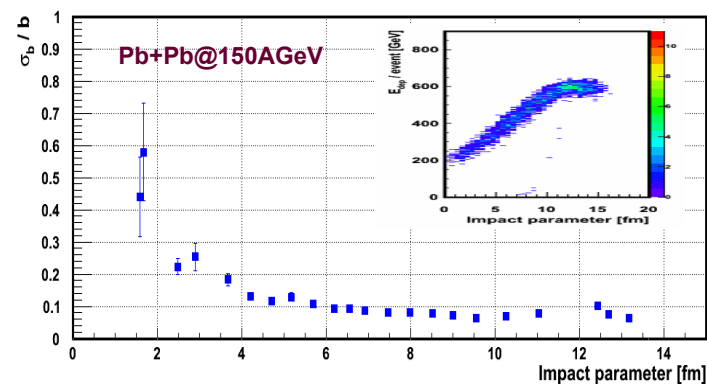
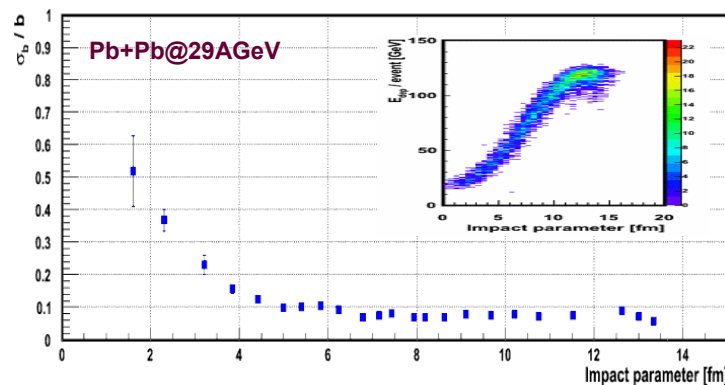
simulated impact parameter resolution



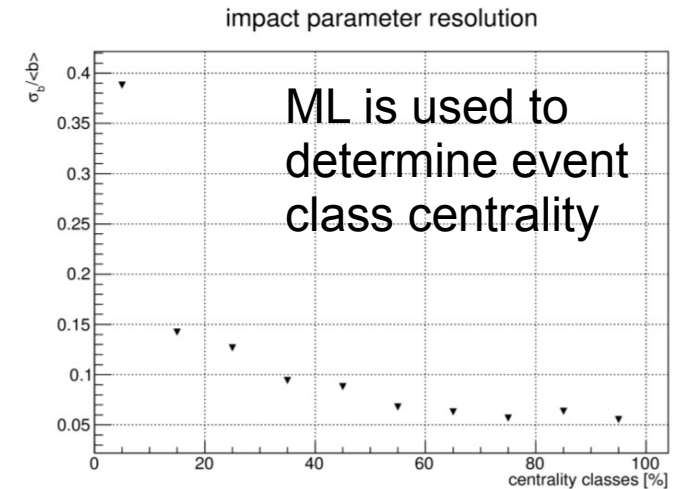
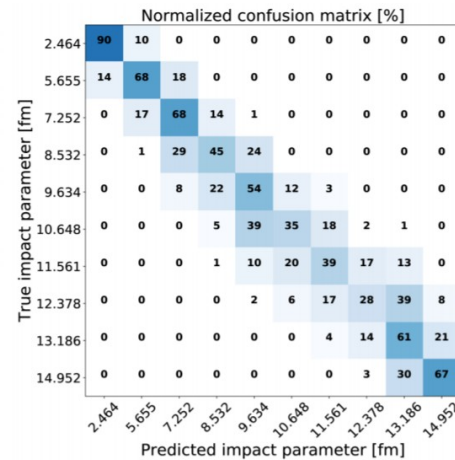
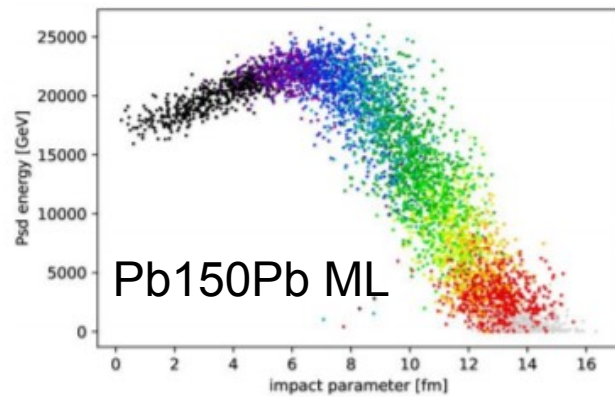
New MPSPD+FPSD



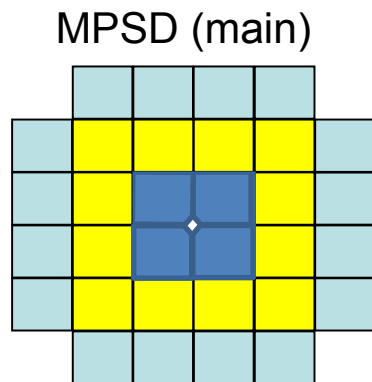
simulated impact parameter resolution



New approach with Machine Learning technique for event selection with MPSPD only



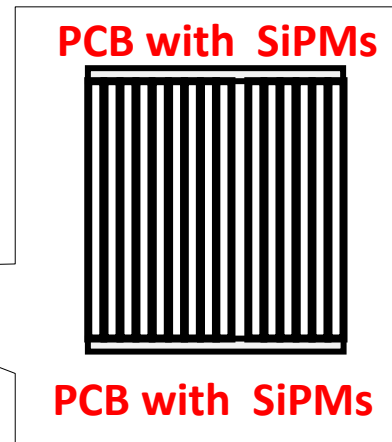
..and an alternative to the FPSD to help with event centrality estimation



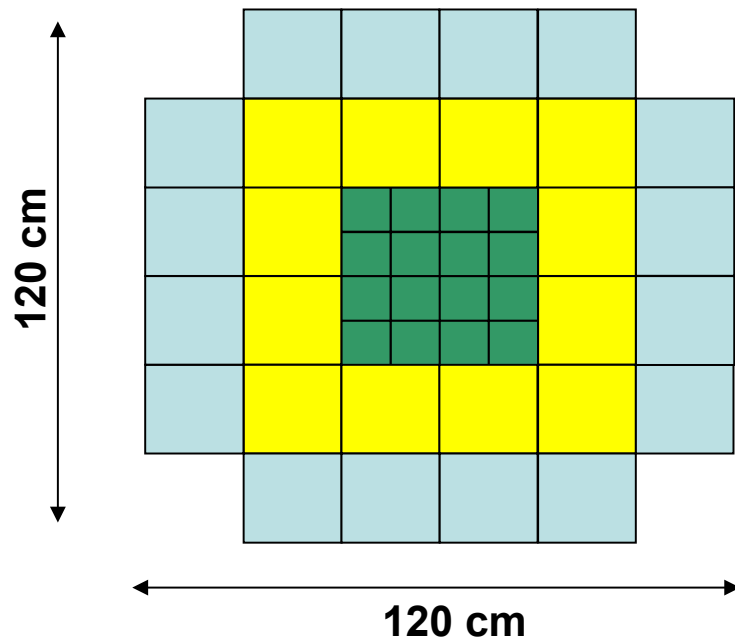
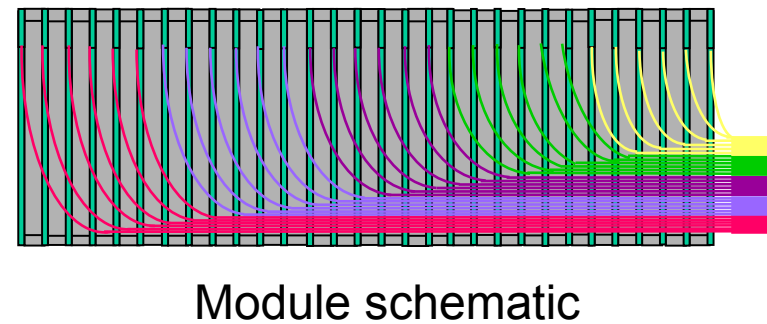
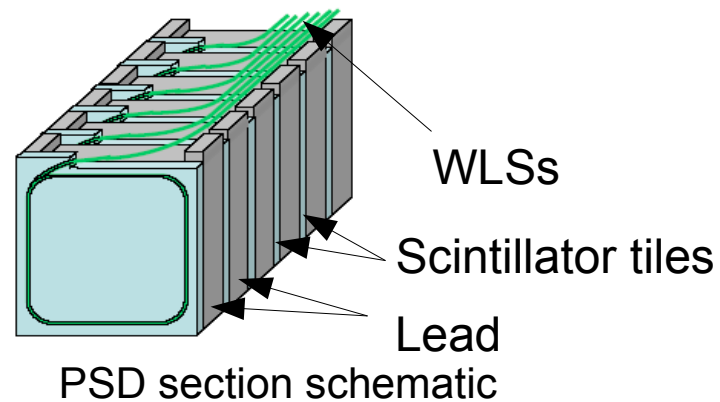
+



quartz forward hodoscope



Quartz forward hodoscope is under development at INR (planned to be used with BM@N and CBM calorimeters)



44 modules + 1:

16 small: 10cm x 10cm size

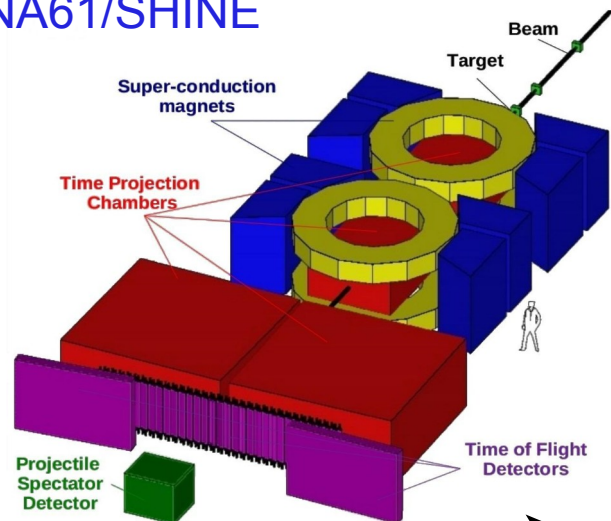
28 large: 20cm x 20 cm size

(10 sections in 1 module) => ~5.6 int. length

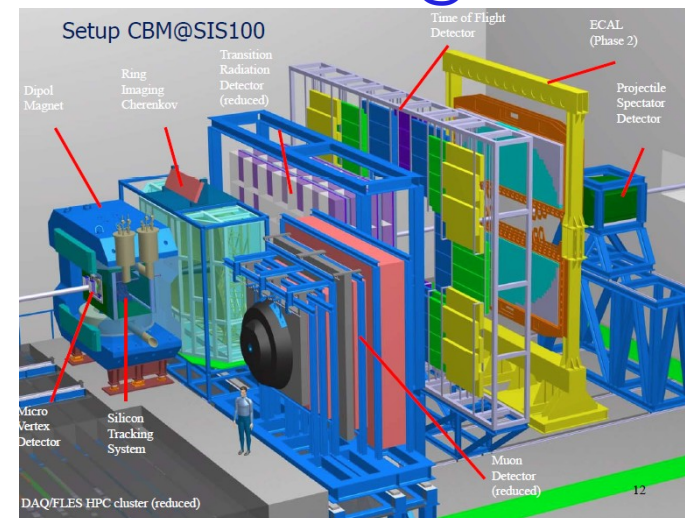
1 short module of 2 sections

450 channels to read-out

NA61/SHINE

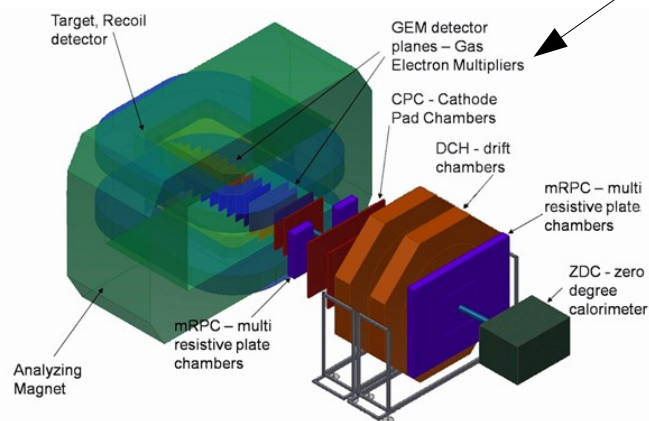


CBM @ FAIR

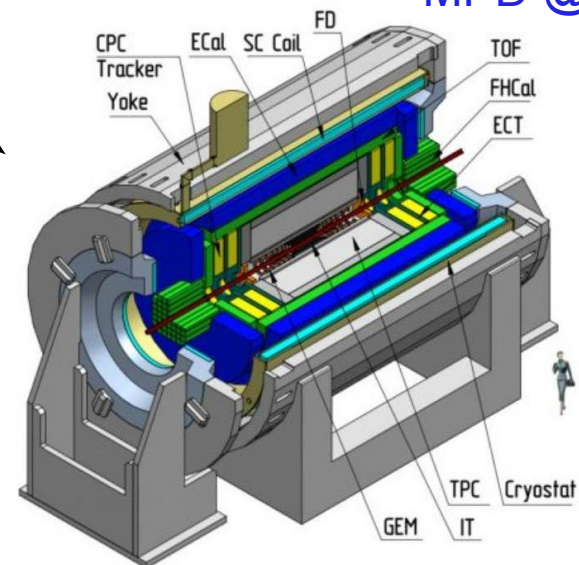


Forward Hadron Calorimeters

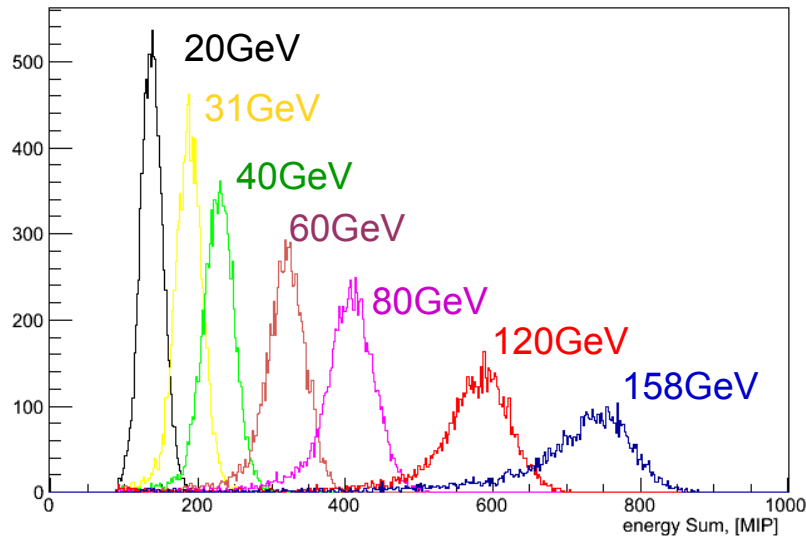
BM @ Nuclotron



MPD @ NICA

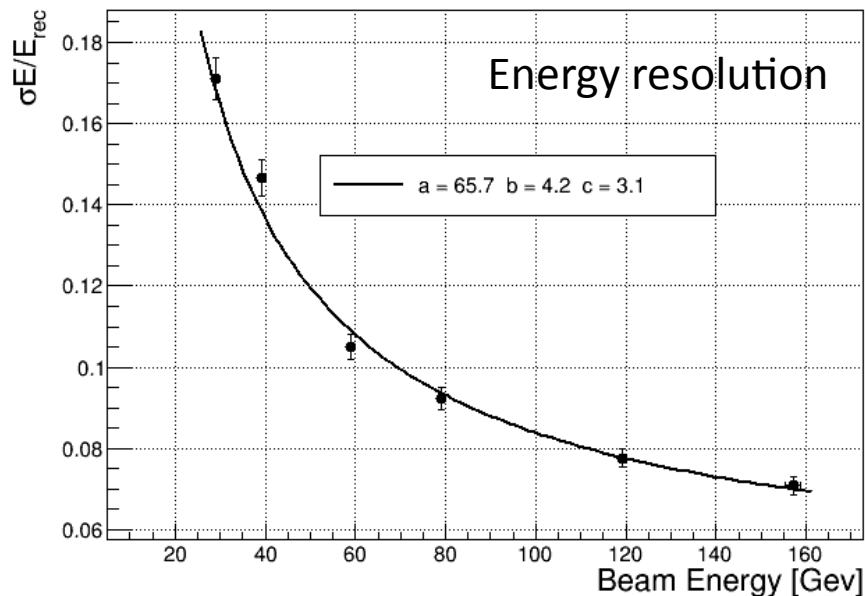


PSD energy in MIPs



Forward hadron calorimeter at NA61/SHINE
(calibration and performance):

- good linearity with slight longitudinal shower leakage effect starting from 120GeV
- good energy resolution with about 65% stochastic term



NA61 PSD Calibrations

