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The Projectile Spectator Detector for measurement of geometry of heavy ion collisions at the CBM experiment at FAIR

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The Compressed Baryonic Matter (CBM) experiment at the future Facility for Antiproton and Ion Research (FAIR) is aimed to explore the QCD phase diagram in the region of high baryon densities. The Projectile Spectator Detector (PSD) is the forward hadron compensating lead/scintillator calorimeter with sampling ratio 4:1. The PSD will measure the event centrality and the reaction plane orientation in heavy-ion collisions and will operate in the range of 2-10 AGeV and beam interaction rates up to 10 MHz.

CBM@FAIR



- STS (track, vertex and momentum reconstruction)
- MuCh (muon identification)
- RICH (electron identification)
- TRD (global tracking)

PSD tasks

The PSD is used to determine such global event characteristics in nucleus-nucleus collisions as the centrality of the collision, which is related to the number of participating nucleons, and the reaction plane orientation. The schematic definition of the impact parameter and the reaction plane are presented below.







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- RPC-ToF (time-of-flight measurement)
 - ECAL (photon, electron and positron identification)
- PSD (centrality and reaction plane measurement)

The event-by-event determination of the collision centrality in heavyion interactions is used to classify the collisions, since observables like the collective flow, particle multiplicities and fluctuations vary strongly with centrality.

- segmented forward hadron calorimeter:
- 44 modules with transverse sizes 200x200mm²
- Beam hole (& 200mm) in the PSD center
- Total weight 22t

PSD modules structure



- Module transverse size 200x200mm²
- Longitudinal structure of module: 60
 Pb/scintillator tiles layers: (Pb(16mm), Scint(4mm) grouped in 10 sections.
- Total length is 5.6 λ_{int} .
- Weight of each module 500 kg.
- Light collection by WLS fibers from 6 sequentially placed scintillator tiles in one section to one optical connector at the end of module.
- Light readout: 10 MPPC (3x3mm²) per module





Sum of proton energy deposition in first n sections for 4 GeV/c (left) and 10 GeV/c (right)

The response of the PSD module with irradiated MPPCs



O D L B S B B C



The PSD supermodule tests at CERN

T9/T10 beamlines

6 GeV/c muons energy deposition in 10 sections













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