Performance for anisotropic flow measurements of the future CBM experiment at FAIR

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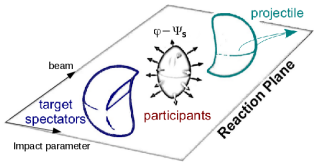
Abstract

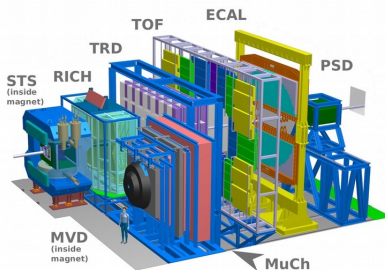
The Compressed Baryonic Matter experiment (CBM) at FAIR aims to study the area of the QCD phase diagram at high net baryon densities and moderate temperatures.
The CBM performance for anisotropic flow measurements is studied with Monte-Carlo simulations using gold ions at SIS-100 energies at lab momentum of 10AGeV/c employing UrQMD event generator. Various combinations of CBM detector subsystems are used to investigate the possible systematic biases in flow measurement and to study effects of detector azimuthal non-uniformity.

Anisotropic flow

Anisotropic flow is quantified by v_n coefficients in the Fourier decomposition of the particle's azimuthal distribution wrt. the reaction plane: $dN/d\phi \sim 1 + 2\sum_{n=1}^{\infty} v_n \cos[n(\phi - \Psi_n)]$
$\Delta\phi$ - particle's azimuthal angle, Ψ_n - collision symmetry plane. We study performance relative to spectator plane using CBM forward calorimeter PSD. The detector anisotropy in ϕ is corrected with Qn-Correction Framework [1, 2].

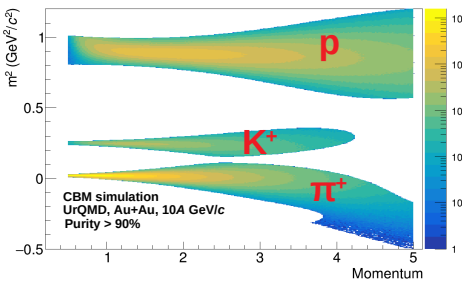


CBM experiment and simulaton setup



A sample of 5M Au+Au collisions with beam momentum of 10A GeV/c simulated with UrQMD [3] event generator was used. Charge particles tracks are reconstructed in Silicon Tracking System (STS) and Micro-Vertex Detector (MVD). The Projectile Spectator Detector (PSD) modules were grouped for analysis into PSD1, PSD2 and PSD3 starting from most central part.

Particle identification and tracking efficiency

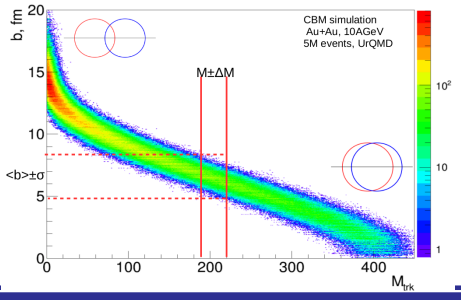


Bayesian approach utilizing information from the TOF detector.

p_T and rapidity dependent correction for tracking efficiency.

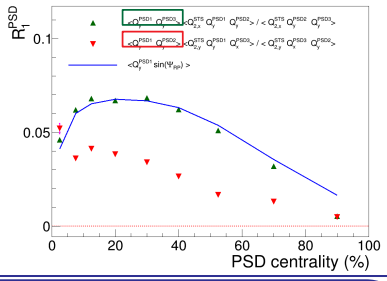
Centrality selection

Centrality determination is performed following the procedure described in Ref. [4]. Impact parameter resolution with the STS estimated to be 5-7%.

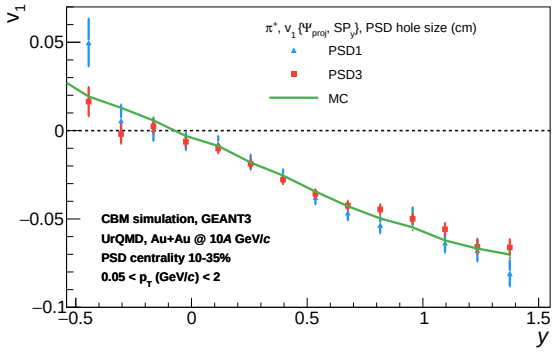


Resolution correction

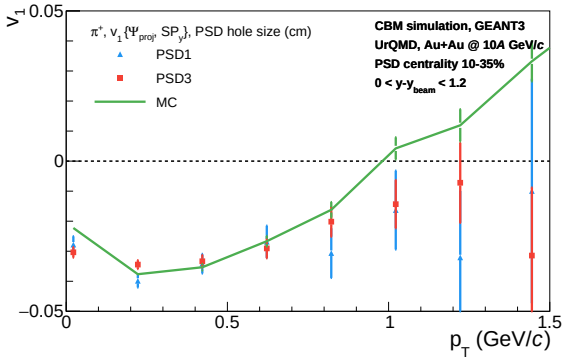
Second harmonic in equation for resolution correction factor allows to reduce non-flow correlations (e. g. contribution due to total momentum conservation) and reproduce MC-true resolution.



Results



Directed flow for positively charged pions with the event plane estimates from PSD is shown. Results are in agreement with those calculated using MC-true reaction plane angle.



Summary

Performance for directed flow measurement for charged pions relative to the projectile spectator symmetry plane are presented as a function of transverse momentum and rapidity. Corrections are applied to account for effects of the detector azimuthal non-uniformity and detection inefficiency. Good agreement between reconstructed and input values of directed flow is shown. Future plans include study of performance for higher order anisotropic flow.

References

[1] I. Selyuzhenkov and S. Voloshin, Phys. Rev. C **77**, 034904 (2008)
[2] V. Gonzalez, J. Onderwaater, and I. Selyuzhenkov, Detector non-uniformity corrections for collision symmetry plane estimates, GSI Scientific Report 2015
[3] M. Bleicher et al., J.Phys. G25, 1859 (1999).
[4] V. Klochkov *et al.* [CBM Collaboration], J. Phys. Conf. Ser. **798**, no. 1, 012059 (2017).