Measurement of Azimuthal Anisotropy with the New Reaction Plane Detector in the PHENIX experiment

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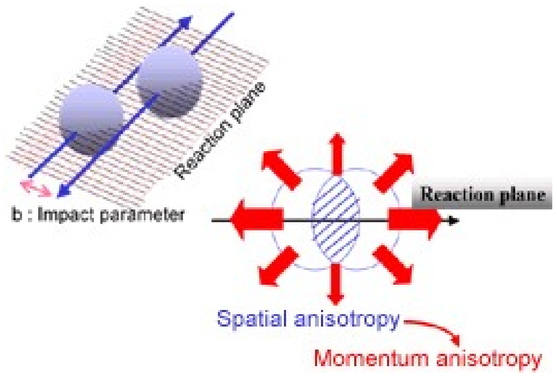
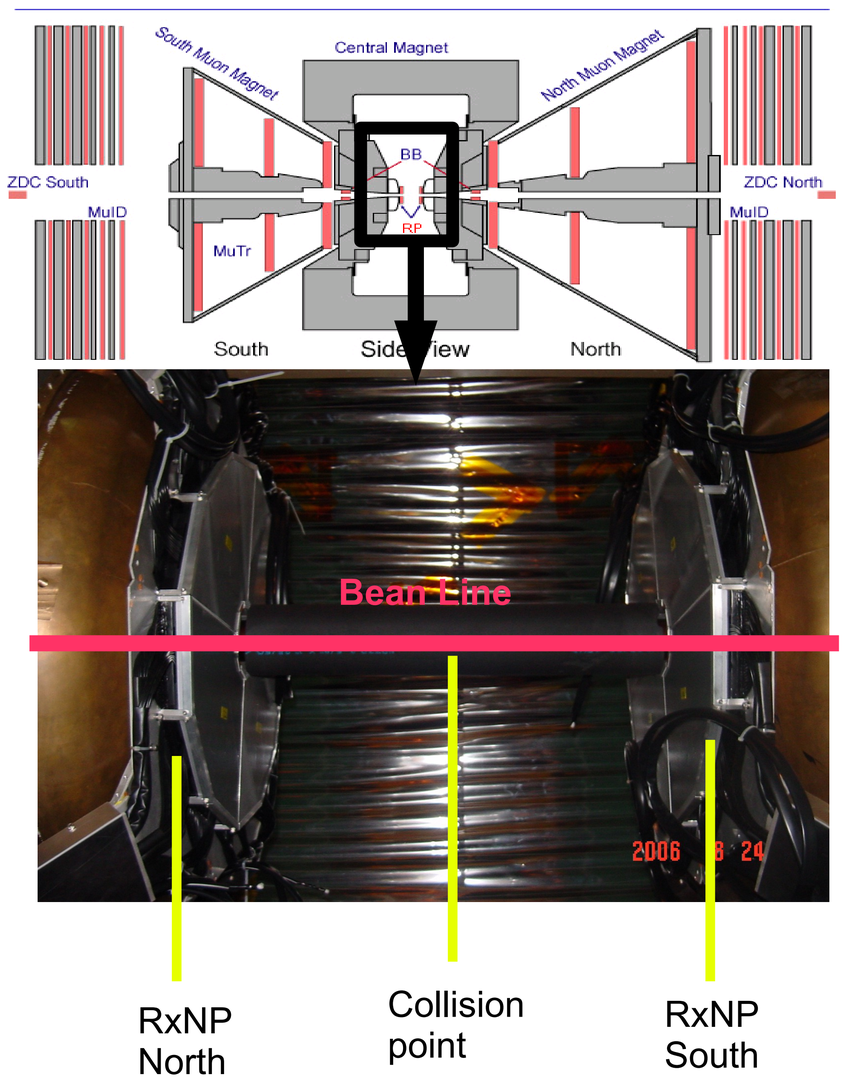


Azimuthal anisotropy of particle emission with respect to the reaction plane is one of the most important global observables in relativistic nucleus-nucleus collisions at RHIC.
The observation of a large anisotropy amplitude, v_2, which follows specific scaling relations over a broad range of particle species is considered as evidence for the probable formation of a hot and dense partonic matter in Au+Au collisions at RHIC.

$$\frac{dN}{d(\Phi-\Psi)}=N_0\{1+2v_1\cos(\Phi-\Psi)+2v_2\cos 2(\Phi-\Psi)+\ldots\}$$

N : Numbe of particles
Φ : Particle emittion
Ψ : Reactionplane

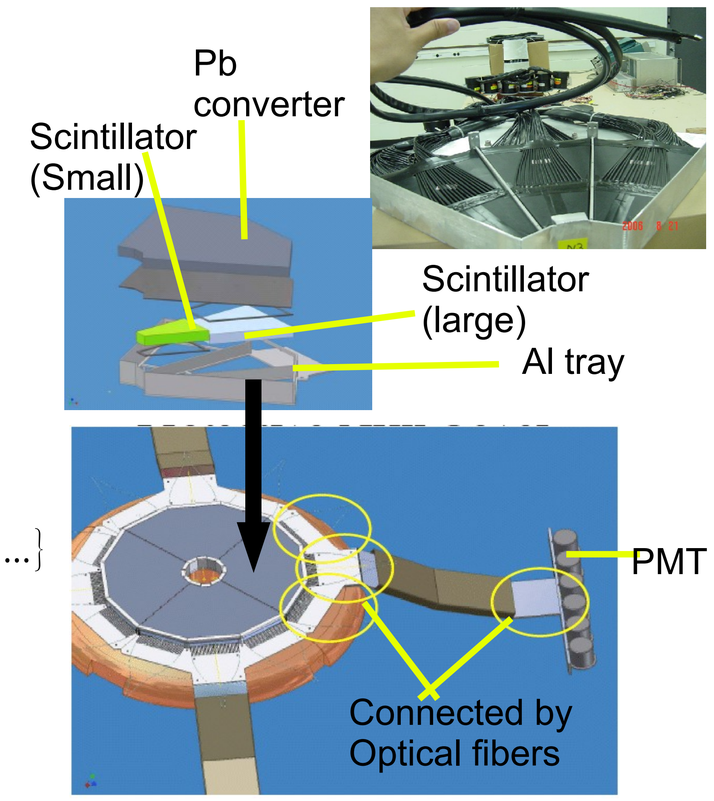


The accurate measurement of the reaction plane is a key factor in the study of azimuthal anisotropy.
Measurements of the v_2 are limited not only by statistics of the signal itself but reaction plane resolution becouse event anisotropy is measured relative to the reaction plane.
Therefore, the finite resolution in reaction plane angle ψ smears the v_2 signal, and the observed strength $v_{2observe}$ is reduced.

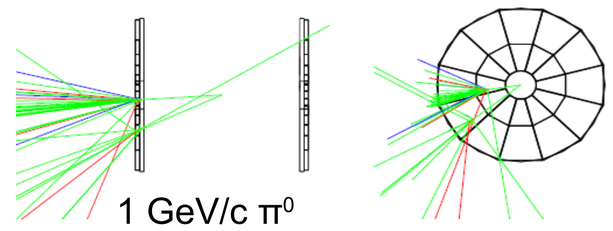
$$v_{2\,observe}=v_{2\,real}\times\langle\cos 2(\Psi_{real}-\Psi_{observe})\rangle$$

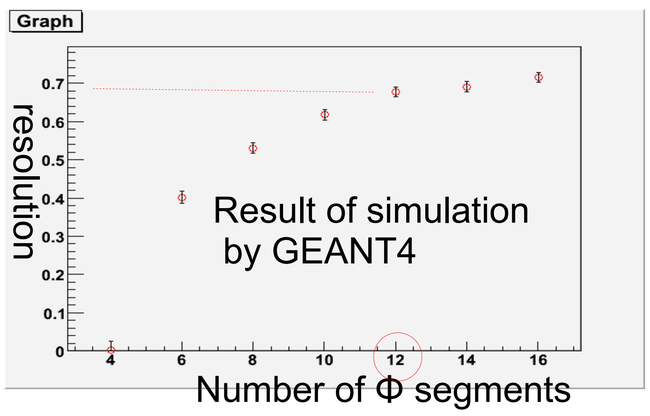
$$\delta v_2\sim\frac{1}{\langle\cos 2(\Psi_{real}-\Psi_{observe})\rangle}\times\frac{1}{\sqrt{N}}$$

<cos2Δψ> is called reaction plane resolution (for v_2)
The error in the v_2 is amplified by a factor of it.

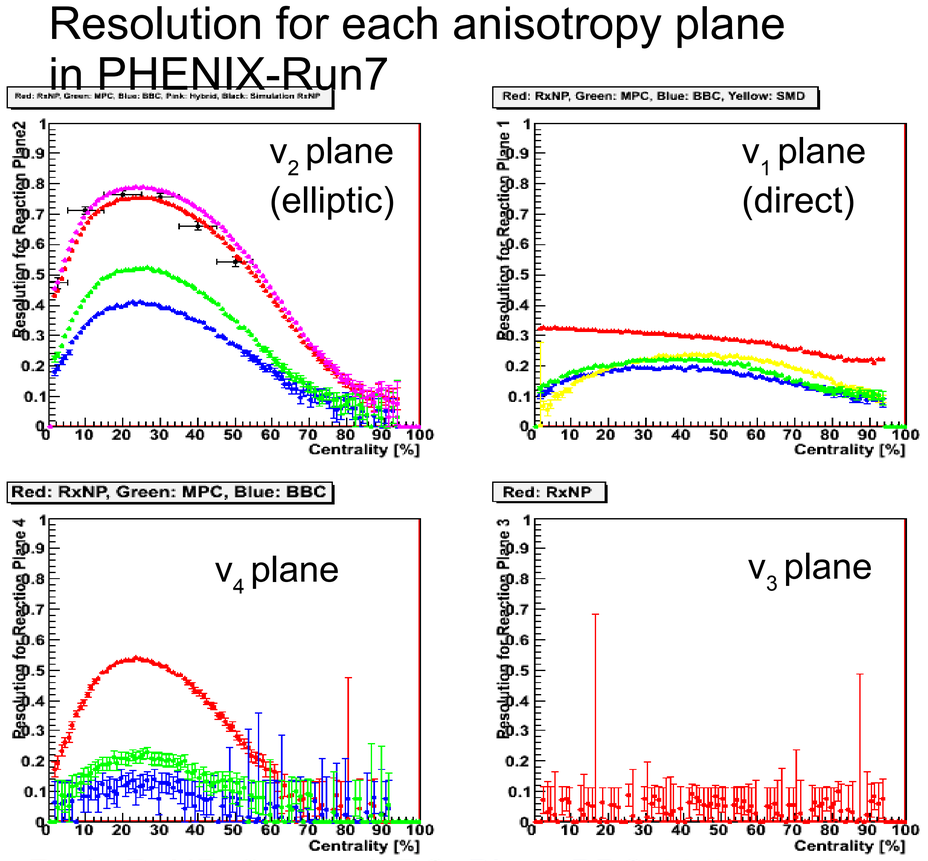


GEANT4 simulation





Resolution for each anisotropy plane in PHENIX-Run7



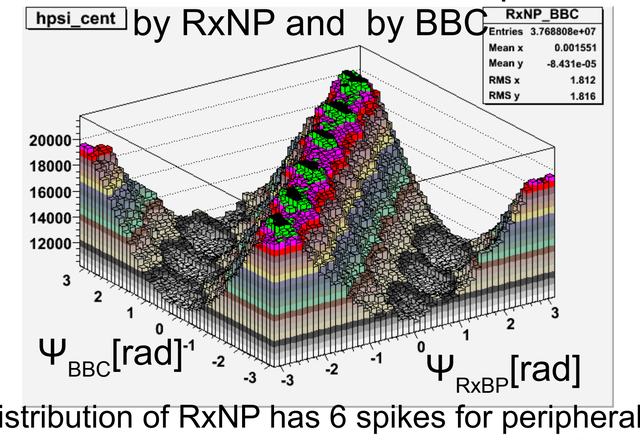
Red : RxNP, Green : MPC, Blue : BBC, Yellow : SMD,
Magenda : Hybrid of all detectors

RxNP has double performance of the BBC for elliptic (v_2) plane. It lets v_2 error reduce to half.
In addition, RxNP can observe more detailed anisotropy (v_4)

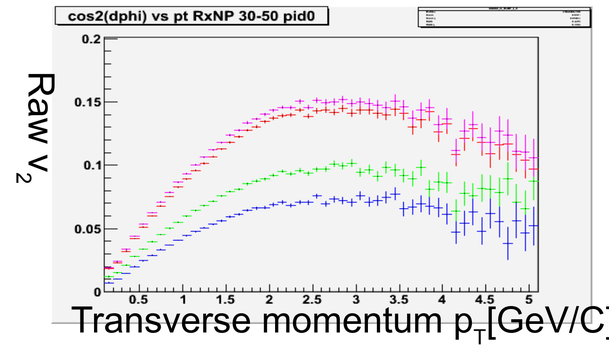
The new detector(RxNP) was installed in the position of north and south 38cm from the collision point, and 5cm inside diameter, 33cm outside diameter, the thickness 4cm.
RxNP have the particle statistics more than 2 times of BBC which observed reaction plane in PHENIX.
Scintillator is divided for Φ into 12 and for η into 2.
It have 2cm Pb converter to increase the number of the particles.
These values were provided from a result of simulation for 200GeV AuAu collision.
Resolution of RxNP was calculated 0.75 (maximum) in simulation and actually became so in PHENIX-RUN7.

As a result of the upgrade, the reaction plane resolution was improved by a factor of two.
This allows us to improve the precision of the measurements of azimuthal anisotropy for particles with high transverse momentum p_T>4GeV/c and to perform a more detailed study of rare particles.

Correlation of reaction plane by RxNP and by BBC



Distribution of RxNP has 6 spikes for peripheral events becouse RxNP was divided φ into12.



These are raw v_2 used by reaction plane from each detector.
These values should become same after revision by each Reaction Plane resolutions.