PHENIX reaction plane detector

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Event anisotropy is one of the most important observables in nucleus-nucleus collisions at RHIC. The large anisotropy amplitude, v_2, provides key evidence of the formation of a hot and dense partonic matter in Au+Au collisions at RHIC. Measurements of v_2 in rare observables such as electrons, photons, and high p_T particles can provide even richer information on the properties of partonic matter.

The measurements of the v_2 of these rare probes are not only limited by luminosities but also rely on accurate reaction plane measurements. In PHENIX, we use the BBC to determine the reaction plane. The statistical power of the v_2 measurement is reduced by a factor of 1/6 to 1/100 compared with the

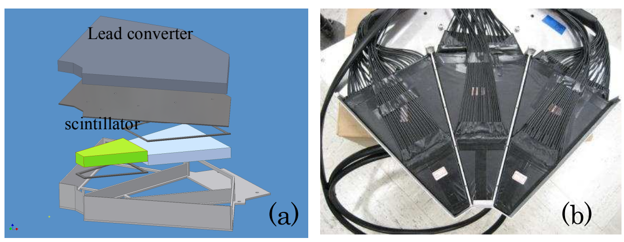

Fig.1. (a). one sector of the detector assembly; (b). one sector of real detector in the process of assembly. Converter is not installed.

ideal case in Au+Au collisions due to the poor reaction plane resolution. The situation is even worse for light ions such as Cu+Cu or at lower energy. This relatively poor reaction plane resolution of the present PHENIX detector is a major limiting factor of our v_2 measurement of rare signals. Reaction plane determination by other methods, such as central arm tracks or v1 measurement by ZDC/SMD do not provide better reaction plane resolution

We propose a new detector for reaction plane measurement in PHENIX. Comparing to the existing BBC detector, the new detector will improve the statistical power of v_2 measurements in PHENIX by about a factor of three.

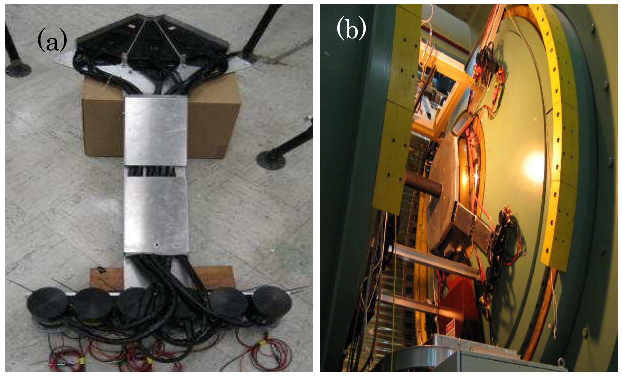

Fig.2. (a). one fully assembled sector before installation of converter.; (b) one arm of the detector in PHENIX inner center area.

The reaction plane detector will be a paddle type detector situated in front of the nosecone as shown in Fig.1. The active area will be composed of plastic scintillating material with a lead converter in front to increase the detector performance. The scintillator will have a thickness of 2cm and will be positioned at $38<|z|<40$ cm. The inner edge of the scintillator will begin at r=5 cm and extend to r=33 cm. This allows the detector to cover a pseudorapidity range of $1.0<|\eta|<2.8$. This coverage was chosen to balance the competing effects of maximum acceptance and jet induced autocorrelations with the central arm. The detector will be segmented into 12 sectors in phi to minimize the impact from dead channels. Each phi sector will be further divided into two radial sections. The inner eta segment will extend from a radius of 5cm to 18cm and the outer eta segment will continue from 18cm to a radius of 33cm. This effectively divides the detector into two rapidity regions, $1.0<\eta<1.5$ and $1.5<\eta<2.8$, which will allow the possibility to study the effect of jet induced autocorrelations on the reaction plane determination.

Embedded fiber light guides made of BCF92 will connect the plastic scintillator to the photomultiplier tubes. An adapter in which the fibers can be embedded will be used to join the fibers to the photomultiplier tube. The use of fiber light guides has several advantages for this detector design.

Most significantly, the light collection along the radial length of the scintillator is more uniform using embedded fibers than solid light guides. Additionally, the fibers allow for flexibility in the final positioning the photomultiplier tubes. This is important due to the sensitivity of the tube response to the magnetic field and will allow the tubes to be repositioned if necessary after installation.

Mesh dynode photomultiplier tubes, Hamamatsu H6155, will be used due to the strength of the magnetic field in the region where the reaction plane detector will be positioned.

A 2 cm thick lead-antimony composite converter be installed directly in front of the scintillator. The addition of 2-3% of antimony hardens the converter material and will improve the mechanical stability of converter when it is mounted. A LED calibration system will be used online to monitor the stability of the detector.

The installation of the detector has been successfully finished and we are in the process of commissioning the detector. The plan is to make it fully functional before the start of RHIC year 2007 Au+Au run and provide the improved reaction plane measurements. Beside that, the detector has the potential of serving as the PHENIX minimum-bias trigger during the low energy Au+Au run and p+p run. We are currently setting up the trigger and will also commission the trigger simultaneously.