Performance of the PHENIX EMCal in First Physics Run

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In the early summer of 2000, the PHENIX experiment for heavy-ion physics at RHIC has started, and we will start that for spin physics in 2001. In this experiment, the electromagnetic calorimeter (EMCal) plays an important role in detecting photons and electrons/positrons. In order to cover topics in both physics, e.g., thermal photon measurement in heavy-ion physics, and prompt photon, π^0 and weak boson measurement in spin physics, the EMCal needs to cover a wide energy range from a few hundred MeV to 80GeV. Spin physics also requires the energy measurement to be within 2% accuracy to measure cross sections of prompt photons and π^0 production with 10% errors, because the cross sections have steep transverse momentum (p_T) slopes. The PHENIX EMCal consists of a lead scintillator (PbSc) and lead glass (PbGl). In this paper, we will report only the performance of the PbSc.

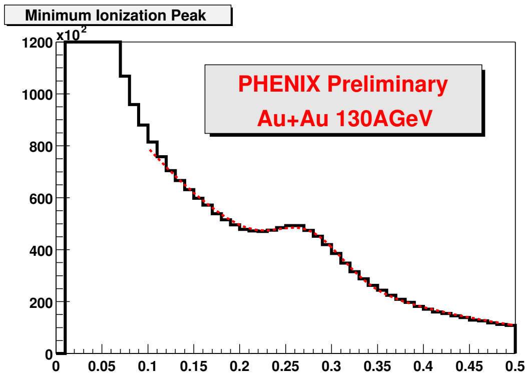

Fig. 1. Preliminary energy distribution by PHENIX Au+Au Collision at $\sqrt{s} = 130AGeV$.

To fulfill the physics requirement, several beam tests at BNL/AGS and CERN/SPS[1)2)] were performed. From the beam tests, the energy resolution for PbSc is known as $\sigma_E/E = 1.9\% \oplus 8.2\%/\sqrt{E}$ from 0.5GeV/c to 80GeV/c, where $\oplus$ represents the quadratic sum. We obtained the energy measurement with 2% accuracy from 0.5GeV to 80GeV. This result is consistent with the expected results based on the uncertainty of beam momentum, nonlinearity of photon multiplier tube[3)], readout electronics, and shower leakage effect. At 10GeV, the result shows 4% deviation, which will be corrected in the future.

Before the physics experiment of 2000, the energy scale for all towers was calibrated using a cosmic muon traversing PbSc module, whose energy deposit is 38MeV in average. Figure 1 shows the energy distribution using the PHENIX clustering algorithm at $\sqrt{s} = 130AGeV$ Au+Au collision. We observed clearly the minimum ionization peak (MIP) by charged hadron. The MIP energy was adjusted in each of the 144 towers of PbSc. After this adjustment, a 2% deviation was observed in a relative energy scale. The time dependence measured by the MIP energy was also corrected.

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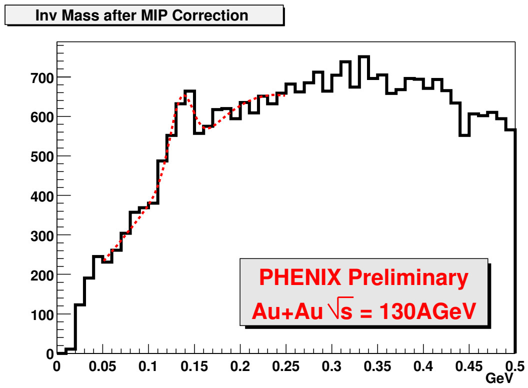

Fig. 2. Preliminary two photon invariant mass distribution in PHENIX Au+Au Collision at $\sqrt{s} = 130AGeV$.

Figure 2 shows the two-photon invariant-mass spectrum with a π^0 peak after MIP correction. The peak exhibits a nominal π^0 mass within the 2% statistical error. We can conclude that the absolute energy scale has 2% accuracy.

Table 1 shows the summary of performance. It appears to fulfill the physics requirement of 2% accuracy. However, these performance tests are dominated by energy clusters with less than 1GeV because of the 280MeV MIP energy and the steep p_T spectrum of π^0. We plan to increase the statistics in the future, and determine the performance up to more than 10GeV to satisfy the physics requirement. The physics analysis is in progress and results[4)] will soon be available.

Energy scale	
Time dependence	0.4% (after 7% correction)
Relative	2% (after < 6% correction)
Absolute	2%

Table 1. Summary of the performance of PHENIX EMCal.

References

1) Y. Goto et al.: RIKEN Accell. Prog. Rep. **32**, 47 (1999).
2) H. Torii et al.: RIKEN Accell. Prog. Rep. **33**, 168 (2000).
3) G. David et al.: IEEE Trans. Nucl. Sci. **42**:306-310(1995).
4) A. Bazilevsky et al.: RIKEN Accell. Prog. Rep. **34** (2001).