Design studies and preliminary test beam results for a new electromagnetic calorimeter for the sPHENIX experiment at RHIC

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The PHENIX Experiment at RHIC is planning a series of major upgrades that will enable a comprehensive measurement of jets in relativistic heavy ion collisions, provide enhanced physics capabilities for studying nucleon-nucleus and polarized proton collisions, and eventually allow a detailed study of electron-nucleus collisions at the Electron Ion Collider at Brookhaven. The first of these upgrades, sPHENIX, will be based on the former BaBar magnet and will include a hadronic calorimeter and new electromagnetic calorimeter that will cover ±1.1 units in pseudorapidity and 2πi in phi in the central region, resulting in a factor of 6 increase in acceptance over the present PHENIX detector. This talk will focus on the electromagnetic calorimeter, which will be a tungsten plate and scintillating fiber design. The plates and fibers will be oriented approximately along the incoming particle direction, and either be tilted at a small angle with respect to the incoming particles or have an accordion structure to prevent channeling of particles along the scintillator. The fibers will be grouped into towers and read out using silicon photomultipliers and waveform digitizing electronics. The calorimeter will have a Moliere radius ~ 2 cm, a radiation length of ~ 7 mm, and a total depth of ~ 17 radiation lengths. The energy resolution is expected to be ~ 15%/√E. Detailed design studies and Monte Carlo simulations for the calorimeter have been carried out and a small prototype detector, shown in Figure 1, has been constructed. This prototype will be tested in a test beam at Fermilab in February 2014. This talk will discuss the overall design of the sPHENIX electromagnetic calorimeter and the R&D work that has gone into developing it, the construction of the prototype detector, and present preliminary results from the test beam measurement. A similar description of the sPHENIX hadronic calorimeter will be presented in a separate contribution to this conference.

Figure 1: sPHENIX prototype tungsten-scintillating fiber electromagnetic calorimeter

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