THE Pb-GLASS DETECTOR SYSTEM IN PHENIX

PHENIX Collaboration

(For a complete list of authors, see article "PHENIX Experiment at RHIC.")

The primary role of the Electromagnetic Calorimeter (EMCal) system in PHENIX is to provide a measurement of the energies and spatial positions of photons and electrons produced in heavy-ion collisions. The EMCal covers the full central spectrometer acceptance of $70^\circ < \theta < 110^\circ$ in two walls that each subtend 90 degrees in azimuth. One wall comprises four sectors of lead-scintillator (PbSc) sampling modules; the other has two sectors of PbSc and two of lead-glass (PbGl). The PbGl array is formed from the 9,216-element system previously used in CERN experiment WA98. Small cell sizes and substantial radial distance from the interaction region keep occupancies low enough to carry out the desired measurements, even in the highest multiplicity Au+Au events at RHIC. The EMCal system allows to trigger on rare events with high p_T photons and electrons, and the signals are incorporated in Level-1 triggers for high multiplicity or large total transverse energy. The calorimeter is read out with phototubes to preserve its good intrinsic timing characteristics and allow some rejection of photon and electron backgrounds by time-of-flight measurements. EMCal energy determinations combined with momentum measurements from the tracking system are expected to provide an e/π suppression factor of about 10^{-2} at 1 GeV.

The Pb glass occupies the two lower sectors of the East Central arm of PHENIX. The time-of-flight system is located immediately in front of the Pb-glass sectors. Each PbGl sector comprises 192 super modules (SM) in an array of 16 Pb-glass super modules wide by 12 SM high. Each Pb-glass super module comprises 24 Pb-glass modules in a array of 6 Pb-glass modules wide by 4 modules high. Each Pb-glass module is 40 mm x 40 mm x 400 mm in size. The Pb-glass modules within a super module are individually wrapped and epoxied together to form a single mechanical unit with a shared calibration system. Six Pb-glass super modules, 2 SM wide by 3 SM high, or 144 Pb-glass modules, are read out with a single front-end electronics motherboard.

Each Pb-glass module is viewed by an FEU-84 photomultiplier. The high voltage for each photomultiplier is generated on-base with a Cockcroft-Walton type photomultiplier base. The high voltage for each module is individually controlled and read out with a custom VME-based control system. Each HIVOC VME control module can control up to 2048 photomultipliers.

Each Pb-glass super module has its own gain-monitoring system based on a set of 3 LEDs which are viewed commonly by all 24 Pb-glass modules within a super module. The absolute light yield of the LEDs of each super module are monitored by a photodiode which, together with preamp, is permanently attached to the super module. The photodiode-normalized LED signal observed in each Pb-glass module was calibrated in GeV-equivalent using 10-GeV electrons in the CERN X1 beam in the period of fall 1993 and spring 1994. The Pb-glass calibration has been preserved for PHENIX using the LED/photodiode system.

The Pb-glass detector system was shipped to BNL from CERN in May of 1997. The detector was shipped in the four-quadrant support structures used in WA98. The super modules were then unstacked at BNL and modified to shorten the stainless steel enclosures

of the photomultipliers and bases to accommodate the space restrictions of PHENIX. The super modules were tested and then stacked into the PHENIX sector configuration. The assembly of the Pb-glass sectors is now complete and planned for installation in PHENIX in April–May of 1999.