CERN WA98 EXPERIMENT

WA98 Collaboration

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The WA98 experiment has studied hadron and photon production in Pb+Pb collisions at 160 A·GeV with the goal to produce hot hadronic matter over a large volume and search for signatures of a transition to a quark gluon plasma (QGP). Special emphasis of the experiment is on broad global characterization of the reaction to identify and select unusual event features or event classes. The space-time evolution of the reaction volume is studied via Bose-Einstein correlations of identified charged hadrons. The thermal history of the system is investigated by measurement of direct photons.

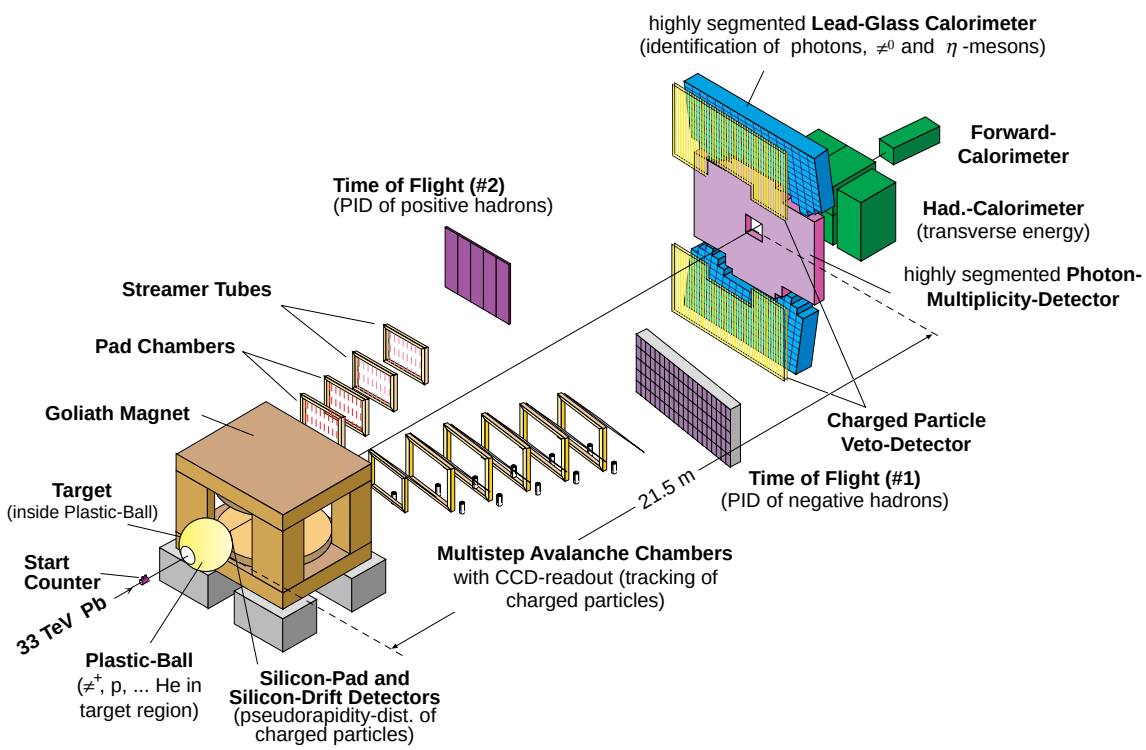

Figure 1: WA98 experimental setup.

The experimental arrangement is shown in Fig. 1. The experiment consists of a highly segmented lead-glass photon detector array (LEDA) of 10,080 modules placed at a distance of 21.5 m from the target. The momentum spectra of neutral pions and η's are reconstructed from their two-photon decay over the rapidity region of $2.3 < y < 3$. Careful determination of the photon yield from neutral pions and η's allows searching for excess direct thermal photons. The photon multiplicity measurement is extended over the range $2.8 < y < 4.1$ with a 7×4 m preshower photon multiplicity detector (PMD). Negative charged-particle tracking with time-of-flight (TOF) measurement allows momentum measurement of identified pions, kaons, and antiprotons in the range $2 < y < 3$. The tracking is achieved using a set of six 1.6×1.2 m^2 multistep avalanche counters with image-intensified CCD camera readout located downstream of the Goliath magnet. Positive charged-particle tracking was obtained with a second set of detectors consisting of two avalanche counters and two streamer tube planes, all with pad readout. Both tracking arms make use of time-of-flight measurement over a larger flight path for particle identification. Total charged-particle multiplicity is measured in the range $2.0 < y < 3.4$ in the silicon drift detector (SDD) and in the range $2.4 < y < 3.8$ in the silicon pad multiplicity detector (SPMD). Pions, protons, deuterons, and tritons emitted in the target fragmentation region are measured in the Plastic Ball detector. Finally, for centrality selection, the transverse energy and forward energy are measured in the MIRAC and Zero-Degree Calorimeters, respectively.

WA98 completed its data-taking program with the fall 1996 run with 158 A·GeV ^{208}Pb beams. Prior WA98 data-taking runs occurred in the fall of 1994 and 1995. ORNL, together with the University of Tennessee, continued to be responsible for the MIRAC calorimeter, which served as the primary trigger and event-characterization detector of WA98. ORNL was also responsible for the entire front-end electronics of the 10,080-module lead-glass calorimeter. These electronics incorporated two application-specific integrated circuits (ASIC), developed at ORNL, for pulse height, time of flight, level-one trigger delay, and level-2 high $p_\perp$ trigger formation. The experiment is now in the data analysis phase. Results have recently been published which set limits on the production of disordered chiral condensates, a signature of chiral symmetry restoration. Other published results present evidence for thermalization based on the independence of the neutral pion spectral shape with centrality. Current topics of active analysis include: studies of the scaling of the particle multiplicity and transverse energy with centrality; various studies of collective flow of pions, kaons, and protons: hydrodynamic hard-scattering descriptions of the pion spectra; various two-particle correlation analyses; and direct photon production.

Several PHENIX prototyping activities were carried out as part of the WA98 experiment effort. These included custom ASIC electronic systems designed for the lead-glass detector, for the TOF readout of the second tracking arm, and for the pad chambers. In addition, the entire lead-glass array as well as the second TOF system used in WA98 have been transported to BNL and are being installed in PHENIX.