Highlights from the 15-Year Heavy Ion Program at the PHENIX Experiment at RHIC

John C. Hill for the PHENIX Collaboration
Iowa State University

The PHENIX experiment was one of two large detectors at the Relativistic Heavy Ion Collider (RHIC) that started taking data in the year 2000. This phase of the experimental program will be completed in the summer of 2016. In this talk, after a brief introduction to the accelerator and PHENIX, a description of the initial experiments is given indicating that using collisions of 200 GeV/A Au ions a new form of hot high density matter, the Quark Gluon Plasma (QGP), was created with properties not of an expected gas but a low viscosity liquid. This was determined from measurements of flow that are consistent with relativistic thermodynamic calculations. Results of direct photon measurements are presented indicating the black body temperature of the QGP produced.

More recent measurements on the collision of Au ions with d and He-3 indicate that even in these lower mass collisions evidence for production of droplets of QGP is observed but not in p+p collisions. In all of these measurements no evidence of a phase transition was observed indicating a continuous crossover from the QGP to a hot hadronic phase. Calculations favor a first order phase transition from the QGP to hadronic matter at a high baryonic chemical potential implying the existence of a critical point. RHIC embarked on an extensive program to study low energy Au+Au collisions to narrow the location of the critical point on the QCD phase diagram. Results from the "RHIC low energy program" are presented with implications for our understanding of the QCD phase diagram. After the end of the present PHENIX program this summer the detector will be removed to make room for a new detector named sPHENIX. I will briefly describe sPHENIX and preview the physics goals for this detector.