The Quark-Gluon Plasma at RHIC

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The first two years of running at the Relativistic Heavy Ion Collider (RHIC) have produced a wealth of data. I will start by giving a theory-guided overview of the experimental situation and then concentrate on two key observations which go qualitatively beyond what was seen at lower energy accelerators: the strong "elliptic flow" measured in non-central Au+Au collisions, and the observation of "jet quenching". The elliptic flow requires fast thermalization of the hot matter produced in the collision within less than 1 fm/c, followed by almost ideal hydrodynamic expansion. This has dramatic implications for the kinetic theory of hot and dense quark-gluon systems. The initial energy density of the thermalized state is more than a factor 10 above the critical value for color deconfinement, and the thermalized quark-gluon plasma (QGP) lives for about 5-7 fm/c before beginning to form conventional hadrons. The bulk of the radial and almost all of the elliptic flow is generated by the quark-gluon plasma. As predicted, the QGP also seems to efficiently suppress jets from hard-scattered partons: recent observations appear to be consistent with emission of hard partons only from a thin surface layer of the hot fireball, while anything that has to travel through the interior gets stuck and becomes part of the thermalized plasma.