

Exploration of Quark Matter with Nuclear Collisions at the Large Hadron Collider

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Quark Matter is a new state of matter which existed in the early universe until about 10 microseconds after the big bang. In this state the hadrons are all dissolved and the quarks and gluons are deconfined. We review how this state of matter is formed over a large space-time volume in a fireball in Pb-Pb collisions at the CERN Large Hadron Collider LHC. The initially very hot and dense fireball expands collectively and its properties can be diagnosed with tomographic and hydrodynamic concepts. Particle production at the phase boundary between quark matter and hadronic matter (baryons and mesons) leads to a thermodynamic state which can be compared with predictions from Quantum Chromodynamics. Analysis of hadron spectra and multiplicities (including quarkonia and hadrons containing heavy quarks) provides information on the quark matter phase boundary and on the degree of deconfinement reached. Future opportunities with the full energy and high luminosity collisions at the LHC will be discussed.