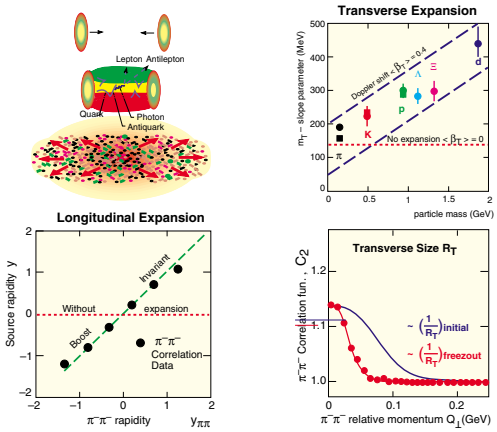
Heavy Ion Physics

High-energy Heavy Ion Physics studies strongly interacting matter at extreme energy densities. QCD predicts that at such densities hadronic matter turns into a plasma of deconfined quarks and gluons, the QGP.

The study of the phase diagram of matter is a new approach to investigate QCD on its natural scale, Λ_{QCD}, and to address the fundamental questions of confinement and chiral-symmetry breaking.

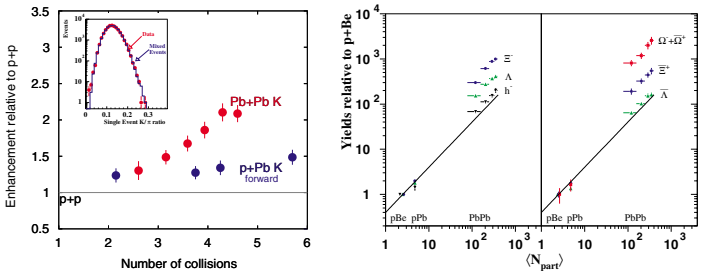
Results from the SPS heavy ion program, obtained with S and Pb beams, reveal that very dense matter and high energy densities are produced in these reactions, leading to new phenomena, beyond extrapolations of p-A results.

Longitudinal and Transverse Expansion



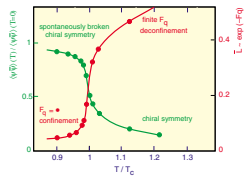
Lorentz contracted Pb nuclei collide, creating a system of high energy density. A very high pressure leads to a strong transverse expansion, visible through particle spectra and correlations.

Strangeness Enhancement

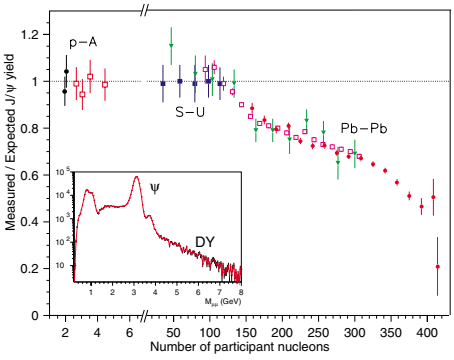


Production of strange quarks is enhanced in Heavy Ion collisions relative to pp and p-A. Fast strangeness production is expected for a deconfined phase of quarks and gluons.

Results from Lattice QCD

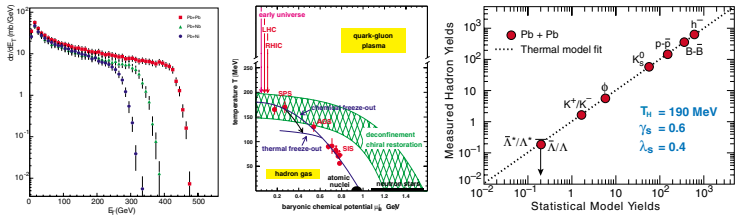


J/ψ Suppression



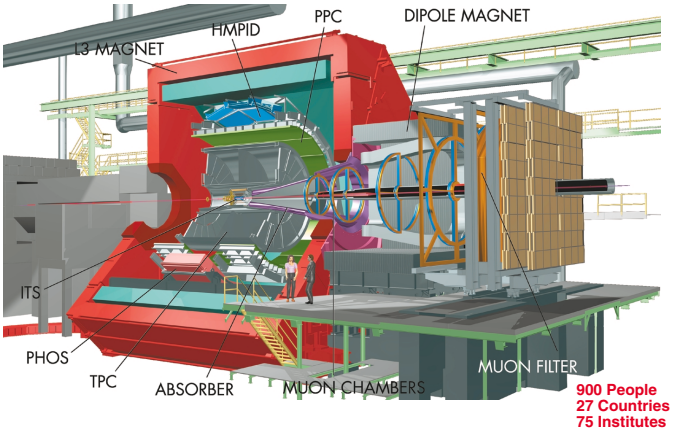
J/ψ production is strongly suppressed in Pb-Pb collisions. This should occur if a deconfined state of matter is produced.

Energy Deposition and Particle Yields



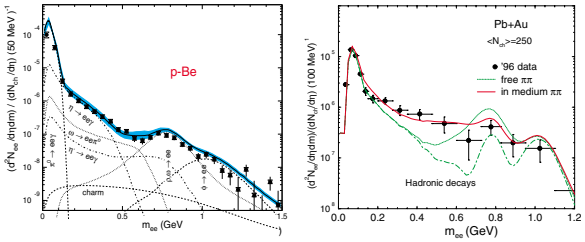
Expansion, energy deposition, particle abundances and momentum distributions, reveal a state of matter close to the critical conditions predicted for a phase transition.

The LHC Experiment devoted to Heavy Ions : ALICE

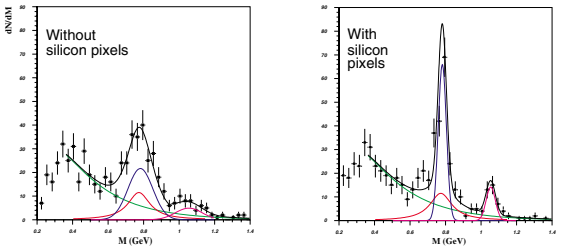


ALICE will allow a comprehensive study of hadrons, electrons, muons and photons produced in Pb-Pb collisions. It will also study collisions at smaller energy densities by using lower-mass ions.

Low Mass Dilepton Enhancement



The mass and width of light vector mesons, observable through their leptonic decays, are expected to change in dense matter if chiral symmetry is restored. This could explain the enhancement observed in the low mass dilepton spectrum.
The addition of silicon pixel detectors has been shown to vastly improve the detection of dileptons, opening interesting perpectives for the near future.



SPS and LHC