

**Phenomenology and Experiment of Particle Physics – Basics of
heavy-ion physics**

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A Journey through the Past

While riding east on the LIE (I was going to visit a relative in Mattituck, where my father's cousin has a small vineyard) I turned on the radio in my car (a new Chevy just rented from National at the Newark Airport). The weather was quite nice.

After switching between the local channels I finally settled with WXXP where someone was interviewing a local scientist. The scientist (apparently a physicist) was claiming that his and his colleagues' findings pointed to the possibility that the matter formed in the universe shortly after the Big Bang resembled an almost perfect liquid.

After listening for a while I switched to another local channel where Neil Young was singing "Living with War".

I didn't think more of it.

Litterature:

The First Few Microseconds / Michael Riordan and William A. Zajc. Scientific American, May 2006

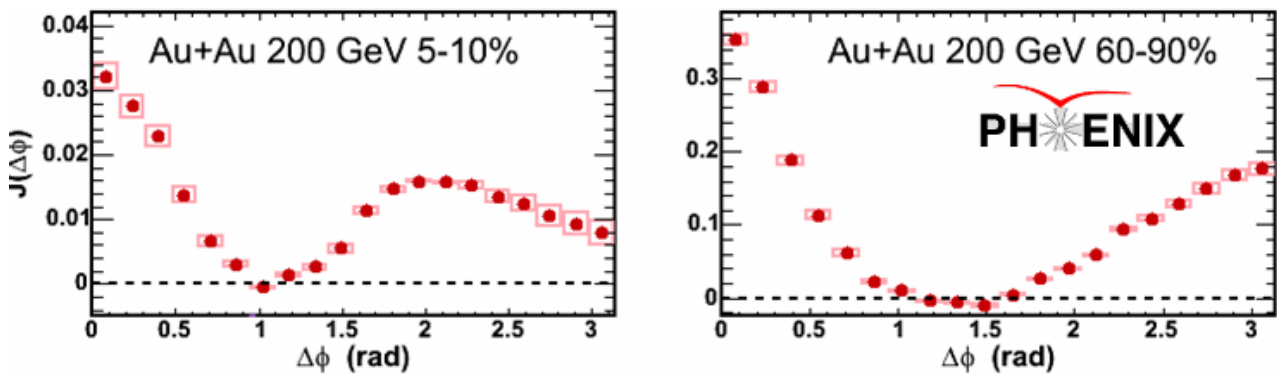
White papers from the 4 experiments: BRAHMS, <http://arxiv.org/abs/nucl-ex/0410020>; PHENIX, <http://arxiv.org/abs/nucl-ex/0410003>; PHOBOS, <http://arxiv.org/abs/nucl-ex/0410022>; and STAR, <http://arxiv.org/abs/nucl-ex/0501009>

Recent results in relativistic heavy ion collisions: from 'a new state of matter' to 'the perfect fluid' / M J Tannenbaum. Rep. Prog. Phys. **69**(2006)2001-2059.

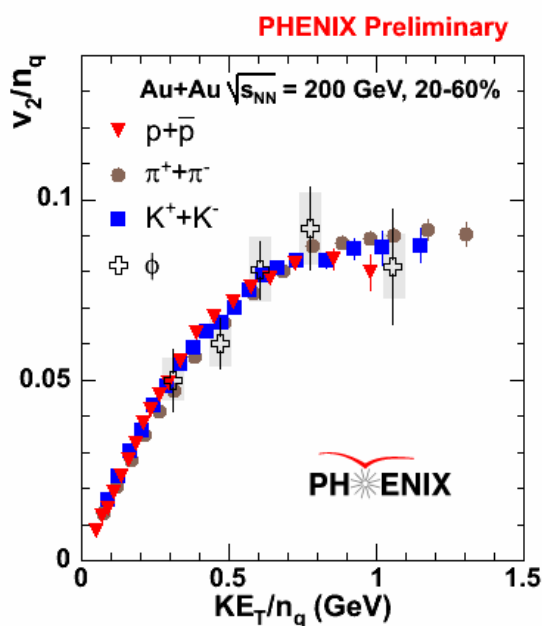
Quark Matter '06, <http://www.sinap.ac.cn/qm2006/scientific.html>

Aims:

The aims of this cycle is to give the students a general knowledge of the present state of the field of ultra-relativistic heavy-ion collisions, especially of the new results implying that the state of matter produced in the collisions behaves like an almost perfect liquid. Waiting for the LHC at CERN, experiments are presently performed at the Relativistic Heavy Ion Collider (RHIC) at the Brookhaven National Laboratory on Long Island outside New York. For different experiments have been taking data for the last six years.



The figure above shows how the 'away jet' (around $\Delta\phi = \pi$) disappears in the most central collisions (left) as compared to the case in peripheral collisions (right). This indicates that the jet going through the medium is strongly modified.



The figure to the left shows the particle flow, parameterized by the v_2 parameter (the second coefficient of the Fourier-expansion of the azimuthal distribution with respect to the reaction plane) as a function of the transverse kinetic energy ($m_T - m_0$). When the quantities are calculated per valence quark, all particles show essentially the same behaviour. This indicates that it is the quarks that are flowing and that the final state particles are formed when quarks recombine.

The two figures show some of the key results that have lead to the conclusion of an almost perfect fluid.

Regarding the scenario LIE stands for Long Island Expressway and the car trip referred to is supposed to take place not far from the Brookhaven National Laboratory.