NEW HOT PAPERS - 2009

March 2009

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Paul Romatschke talks with *ScienceWatch.com* and answers a few questions about this month's New Hot Paper in the field of Physics.

Article Title: Viscosity information from relativistic nuclear collisions: How perfect is the fluid observed at RHIC?
Authors: Romatschke, P;Romatschke, U
Journal: PHYS REV LETT
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Year: no.-172301 OCT 26 2007
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SW: Why do you think your paper is highly cited?

The value of the viscosity of hot nuclear matter has been widely discussed in the high energy physics community. Our article showed how to extract information about this quantity from experimental data and provided estimates for the value of the viscosity.

SW: Does it describe a new discovery, methodology, or synthesis of knowledge?

It describes a new method (viscous hydrodynamic simulations with fluid velocities very close to the speed of light) and applies this method to constrain an unknown quantity using a synthesis of existing knowledge.

"The value of the viscosity of hot nuclear matter has been widely discussed in the high energy physics community."

SW: Would you summarize the significance of your paper in layman's terms?

Loosely speaking, a smaller value of viscosity means that a fluid flows more like water than honey, and our results suggest that hot nuclear matter has the smallest viscosity of any known fluid studied in the laboratory. It is less viscous than even superfluids!

SW: How did you become involved in this research, and were there any problems along the way?

Fluid dynamics is a fascinating theoretical tool: it is comparatively simple and universal in describing very different physical systems, ranging from the weather on our planet to the behavior of hot nuclear matter.

The theory of viscous fluids with velocities close to the speed of light was not sufficiently developed when we started our work, which was a problem we could overcome by drawing on recent advances in high energy physics. However, the biggest problem was psychological: colleagues were warning us about all the numerical challenges we would face, recommending we should tackle simpler problems. Luckily, we

ignored those warnings.

SW: Where do you see your research leading in the future?

Further refinements of our method and/or new ideas are needed to extract the viscosity of nuclear matter, including its error bar. Our article was only the first step in this direction.

SW: Do you foresee any social or political implications for your research?

No. However, implications from basic science are often unpredictable. For example, on December 8, 1864, James Clerk Maxwell outlined the theory of electromagnetism in a presentation to the Royal Society—without which there would be no cell phones today—in his paper: "A Dynamical Theory of the Electromagnetic Field," *Philosophical Transactions of the Royal Society of London* 155: 459-512, 1865.

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KEYWORDS: HEAVY-ION COLLISIONS; CAUSAL VISCOUS HYDRODYNAMICS; ELLIPTIC FLOW; THERMODYNAMICS; SPECTRA; NONSTATIONARY.

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