JOHNS HOPKINS
Center for Environmental & Applied Fluid Mechanics

Weekly CEAFM Seminar: Spring 2012

Friday, March 9, 2012
11:00 a.m. – 12:00 p.m.
Gilman 50 (Marjorie M. Fisher Hall)

"RELATIVISTIC DISSIPATIVE FLUID DYNAMICS CONFRONTS EXPERIMENT"

Presented by
Dr. Paul Romatschke
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Abstract: Modern physics tells us that when the velocity of a particle becomes very large and is approaching the speed of light (or the particle is in a very strong gravitational field) ordinary concepts such as the particle's momentum and kinetic energy must be replaced by their analogues in Einstein's special (general) theory of relativity. For the same reason, ordinary fluid dynamics (described by the Navier-Stokes equation) must be replaced by its relativistic analogue.

While much more complicated than ordinary fluid dynamics at first glance, the relativistic version of fluid dynamics can be understood (and formulated) simply as the conservation of energy and momentum, which maybe are the most basic building blocks of physics. Contrary to ordinary fluid dynamics, the relativistic version of the Navier-Stokes equation has been recognized as inadequate, violating basic principles such as causality. Motivated by experimental results from high-energy particle colliders, there has been a flurry of activity in the past decade to formulate a viable version of fluid dynamics including dissipative effects from first principles, with a minimal set of assumptions. Current state-of-the art results from relativistic fluid dynamics confronting experimental data from colliders provide evidence for the existence of the least viscous fluid ever created in the laboratory. I will review some of the key developments and point out the truly fascinating connections uncovered in the process, which link together experimental nuclear physics, string theory, kinetic theory and cold atomic gases.