Spring 2023 Colloquium

Department of Physics & Astronomy
Texas A&M University-Commerce
April 27, Thursday, 4-5 PM in Science Building 127
(coffee and cookies will be served at 3:50 PM)
Astro-Physics

Relativistic Fluid Dynamics: From Particle Colliders to Neutron Star Mergers

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Professor Jorge Noronha received his bachelor's degree in Physics from the Federal University of Rio de Janeiro (UFRJ), Brazil, in 2003. After completing his M.Sc. in 2004 at the Brazilian Center for Physical Research (CBPF), he went on to obtain his Ph.D. in Physics from the Goethe University Frankfurt, Germany, in 2007. His Ph.D. thesis helped determine the properties of the ultradense matter present in the core of neutron stars in the presence of strong magnetic fields. Because of his PhD work, he was awarded the Gernot and Frank Carin Prize in Frankfurt in 2008. Jorge was a postdoctoral research scientist at Columbia University in New York from 2008-2011 where he focused on the applications of string theory techniques (holographic correspondence) to investigate the dynamical properties of the quark-gluon plasma formed in ultrarelativistic heavy ion collisions. From 2011-2019 Jorge was a faculty member at the University of Sao Paulo in Brazil, where he developed novel techniques to describe out-of-equilibrium phenomena in relativistic systems under extreme conditions. He became an Affiliated Member of the Brazilian Academy of Sciences in 2015. Jorge joined the Physics Department at UIUC in August 2019. His research establishes connections between string theory, relativistic fluid dynamics, and kinetic theory to tackle outstanding problems in high energy nuclear theory that are beyond the reach of current first principles techniques. Since 2020 he has served as the Associate Director of the Illinois Center for Advanced Studies of the Universe (ICASU). More information can be found at https://physics.illinois.edu/people/directory/profile/jn0508

Abstract

Heavy-ion collision experiments have provided overwhelming evidence that quarks and gluons, the elementary particles within protons and neutrons, can flow as a nearly frictionless, strongly interacting relativistic liquid over distance scales not much larger than the size of a proton. On the other hand, with the dawn of the multi-messenger astronomy era marked by the detection of a binary neutron star merger, it became imperative to understand how extremely dense fluids behave under very strong gravitational fields. Therefore, cutting-edge experimental apparatus in modern science, such as the Relativistic Heavy Ion Collider (RHIC), the Large Hadron Collider (LHC), and the Laser Interferometer Gravitational-Wave Observatory (LIGO) are now taking data whose description requires pushing the boundaries of our current understanding of fluid dynamics. In this talk I will discuss the new developments that have contributed to redefine the onset of relativistic fluid dynamics and its extension towards the far-from-equilibrium regime. New results involving viscous fluids and their coupling to general relativity will also be presented. These developments pave the way for the inclusion of viscous effects in neutron star merger simulations.