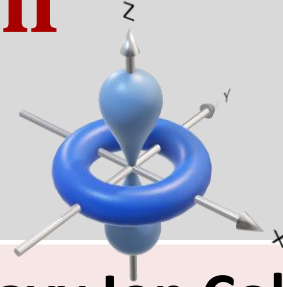




Department of Physics Colloquium

May 1st, 2023



3:00 PM

Golden Age of Jet Tomography in Heavy Ion Collisions: The Evolution of Jets as Probes of the Quark Gluon Plasma

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The nuclear strong force, known as quantum chromodynamics (QCD), is one of the least understood of the four fundamental forces of nature as it cannot be fully quantified via a perturbative expansion. The collision of heavy-ions accelerated to ultra-relativistic speeds creates a droplet of matter with a temperature so high that the constituent protons and neutrons melt into quarks and gluons, which are collectively called partons. This medium, called the quark gluon plasma (QGP), has an extremely low viscosity over entropy ratio, making it a nearly perfect liquid. It is well established that the degrees of freedom of the plasma are partonic, rather than hadronic. How this emergent property of QCD occurs is one of the fundamental questions of the field of high-energy nuclear physics. An understanding of the structure of the QGP is required, namely whether quasi-particles exist and if so, what is their extent. To answer these fundamental questions, a probe with an extremely small spatial resolution is required. One such probe is to use the particle jets created in high momentum transfer parton-parton collisions. These collisions occur early in the heavy-ion collision dynamics, so that the high momentum partons created in these scatterings traverse the newly formed medium, and thus can probe the entire evolution of the system. Understanding how these partons interact with the QGP provides critical insight into QCD. In this talk, I will provide a general overview of the status and interpretation, as well as future prospects for measuring jets in ultra-relativistic heavy ion collisions. The existing measurements have reached new levels of precision and systematic control in recent years, with a wealth of new observables based on the jet structure, emission location and parton flavor. I will discuss what these measurements reveal about the nature of the QGP at both RHIC and the LHC, and give some insight on future prospects.

**This colloquium will be held in-person, at SERC 116
unless announced otherwise.**