

The Department of Physics and Astronomy
presents
2022 William H. Nelson Lecture:



CREATING LITTLE BIG BANGS IN THE LAB

Prof. Helen Caines, Yale University,

Tuesday, 15 November 2022, 3:00pm, 25 Park Place, Room 223

(refreshments start at 2:30 pm)

Abstract: Quantum Chromodynamics (QCD) predicts that the phase diagram of nuclear matter has a rich structure, including that of a deconfined state of quarks and gluons at extreme temperatures and/or pressure. We have shown that we create such a state, termed the Quark-Gluon Plasma or QGP, in the fireball generated when heavy nuclei are collided at ultra-relativistic velocities. Although we call this medium the Quark Gluon Plasma that's a misnomer, it's actually one of Nature's most extreme fluids. It has a specific viscosity that is smaller than that of any known substance, including that of superfluid liquid helium, and a vorticity that surpasses that of super-cell tornado cores and Jupiter's Great Red Spot. In addition, the Quark Gluon Plasma has quark and gluon degrees of freedom and an initial temperature of 10^{12} Kelvin, conditions that last existed only a few microseconds after the Big Bang. Understanding the properties of the QGP and locating key features, such as the predicted first order phase transition boundary and the corresponding critical point in the QCD phase diagram, will enhance our knowledge of the universe's evolution and the structure of all visible matters.

In this talk I will first briefly explain how we have determined these incredible properties of the Quark Gluon Plasma. I will then discuss how we are experimentally probing different regions of the QCD phase diagram by varying the energy of the colliding beams and the intriguing hints of a first order phase transition that these studies have revealed.



Helen Caines is a Professor of Physics at Yale University. She obtained her Ph.D. from Birmingham University in the UK, before moving to the Ohio State University as a postdoc. She has lived in the US ever since. She is an experimental nuclear physicist and currently the elected co-spokesperson of the STAR experiment at the Relativistic Heavy Ion Collider (RHIC), at Brookhaven National Laboratory, NY. She is a Fellow of the American Physical Society and is currently serving on their Committee for Minorities in Physics. She currently lives in Connecticut with her family and their bunny Cloud.

The William H. Nelson Physics & Astronomy Research Endowment was set up to honor the memory of Dr. William H. Nelson by the Nelson family. Dr. Nelson worked at GSU from 1974 until his sudden death in 2010.



Dr. Nelson began as an assistant professor in 1974, became tenured in 1981, a full professor in 1988, and served as the acting chair of Physics & Astronomy from 1992-1994. He became full chair in 1994. In 2004, Dr. Nelson became Associate Dean of Research and Graduate Studies for the College of Arts & Sciences. In 2009, he served as interim chair of the Math Department.