Recreating conditions of the early Universe

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Helen Caines focuses on understanding the behavior of nuclear matter under extremes of temperature and density.

Caines is an American Physical Society (APS) Fellow and a Fellow of the Institute of Physics, UK. In January of 2012, she was named APS Committee on the Status of Women in Physics Woman Physicist of the Month. She was also awarded the Engineering and Physical Sciences Research Council Advanced Research Fellowship, UK. Caines was the co-spokesperson of the STAR collaboration from 2017 to 2023.

Caines is an advocate for diversity, equity, and inclusion in STEM. Among the courses she has taught at Yale is "Being Human in STEM" and she is co-chair of the Yale APS Inclusion, Diversity, and Equity Alliance (APS-IDEA) team.

Relativistic Heavy Ion Group (RHIG)

RHIG, co-led by Helen Caines, Laura Havener, and John Harris, uses experiments that accelerate and then collide particles to recreate a primordial state of matter, the quark-gluon plasma (QGP). The QGP is a hot, dense, soup-like state of the fundamental particles of nature—predicted by the Standard Model of particle physics to have existed ten millionths of a second after the Big Bang—and is one of nature's most extreme fluids. The group's research focuses on measuring jets—the spray of high momentum particles from high energy particle collisions—and jet substructure to further understanding of the the properties and evolution of the QGP. RHIG is involved in the ALICE, STAR and ePIC collaborations.
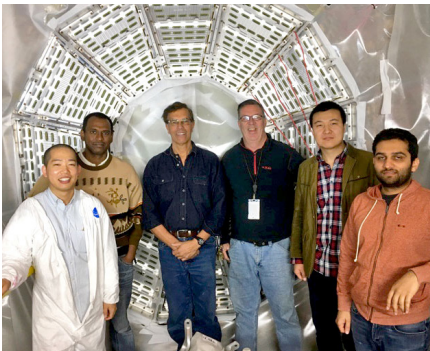
Solenoidal Tracker at RHIC (STAR)

The STAR experiment is at the Relativistic Heavy Ion Collider at Brookhaven National Laboratory (BNL) in New York. Members of RHIG play a critical role in preparations and data-taking, including trigger coordination, shift leadership, and on-call detector expertise. As the co-spokesperson of STAR from 2017 to 2023, Caines led the successful completion of a multi-year data program called Beam Energy Scan II and the installation of a suite of forward-rapidity detectors. RHIG contributes to a diverse range of analyses, taking advantage of STAR's large variety of datasets.

A Large Ion Collider Experiment (ALICE)

ALICE is a detector at the Large Hadron Collider at the European Organization for Nuclear Research (CERN) in Switzerland. Members of RHIG contributed to the construction and commissioning of an upgraded detector Time Projection Chamber using gas electron multipliers (GEMs). This upgrade allows ALICE to now produce data at a staggering rate of 3.5 terabytes per second, which is two orders of magnitude higher than before. RHIG members have contributed to various aspects of ALICE preparations and data-taking, and this expanded data set will be a primary focus of the RHIG ALICE program in the next few years.
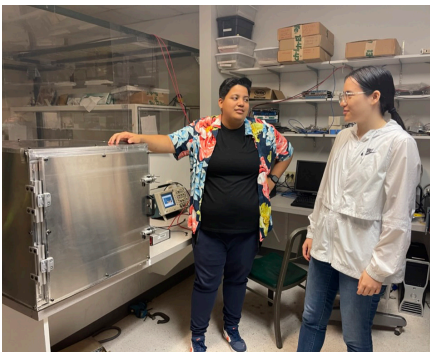
Electron-Ion Collider (EIC)/Electron-Proton Ion Collider (ePIC)

RHIG has substantially increased its involvement in preparations for the future EIC, which will be built at BNL. The group has multiple ongoing research and development (R&D) projects, including calorimetry and tracking. Members of RHIG are working on charactirizing silicon photomultipliers (SiPMs) at Wright Lab and participating in test beam studies at CERN for the forward calorimeter of the ePIC detector. The group is also involved in R&D for gaseous tracking detectors.