New State of Nuclear Matter in Heavy Ion Collisions at RHIC: Physics and Detectors

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Measurements made in heavy-ion collisions at the Relativistic Heavy Ion Collider (RHIC) have led to a broad and deep understanding of the properties of hot QCD matter. It has been determined that the quark-gluon plasma (QGP) created in Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV is a strongly coupled liquid with the lowest value of specific viscosity ever measured. These findings are supported by major empirical observations from both soft and hard probe sectors at RHIC and LHC energies.

In this talk, I present the findings obtained by major experimental observations via measurements of the bulk properties of particle production, particle ratios and chemical freeze-out conditions, and elliptic flow. I then discuss hard probe measurements: high-$p_{_{\rm T}}$ hadron suppression, dijet fragment azimuthal correlations, and heavy flavor probes. These measurements are presented for particles of different species as a function of system sizes, collision centrality, and energy carried out in RHIC experiments. I also present in detail my extensive experience with detector design, construction, assembly, signal processing and operation with regards to the silicon multiplicity/vertex detectors and the silicon vertex tracker used in the PHOBOS and PHENIX experiments at RHIC, respectively.