Predictions for sPHENIX

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To complete the RHIC mission, sPHENIX was specifically designed to measure jet and heavy-flavor observables with an exceptional level of precision not previously achievable at RHIC. This will enhance our understanding of the quark-gluon plasma (QGP) properties and their temperature dependence beyond what is possible with existing and planned data obtained from the LHC and other RHIC experiments.

A major goal of the sPHENIX program is to address questions regarding the approach to thermalization of the quark-gluon plasma and its transport properties using hard probes, such as jets and heavy-flavor particles. The current three-year run plan includes Au + Au, p + Au, and $p + p$ collisions at 200 GeV.[1)] The Au + Au dataset provides a large QGP system to study the QGP properties. The p + Au dataset will allow for additional studies regarding the intriguing behavior other RHIC experiments observed in flow measurements, as well as transport properties of cold QCD matter and proton/nuclear structure. The $p + p$ collisions provide a necessary reference for Au + Au and p + Au collisions and allow for additional studies of proton structure. The upgraded sPHENIX data acquisition system will enable data collection at a high rate to achieve the statistical precision needed for measurements with rare probes. Anticipated measurements include, but are not limited to, jet substructure observables, photon and heavy-flavor tagged jets and comparisons of the production mechanisms of the different upsilon states in all three collision systems.

To maximize the rich physics sPHENIX is capable of accessing, a workshop was hosted July 20–22, 2022 at Brookhaven National Lab (BNL). The goal of the workshop was to enhance the discussions between the experimentalists extracting the measurements and the theorists whose models will be tested and constrained by the new data. Because sPHENIX will start collecting data in Spring of 2023, this workshop was timely for theorists wishing to make final predictions regarding the anticipated observables before data collection commences. In addition, it provided an opportunity for theorists and experimentalists to propose and discuss new observables.

The workshop was very successful and attracted 106 registered participants. The format of the workshop was hybrid with slightly less than half of the participants attending in person at BNL and the others joining remotely via Zoom. The full agenda is available on Indico at `https://indico.bnl.gov/event/15482/` . The 30 talks included both experimentalists and theorists, resulting in productive discussions. The experimental talks covered current results obtained from experiments at RHIC and LHC, as well as the capabilities and planned measurements for sPHENIX. The theory talks represented various theoretical approaches and topics. An important outcome of this workshop was the decision to write a paper collecting the latest theoretical predictions from the presenters. The goal is to submit the paper for publication before sPHENIX starts collecting its first physics data. This collection of theoretical predictions for sPHENIX will be an extremely useful resource and particularly helpful for citing the theories in future sPHENIX publications.

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Reference

1) sPHENIX Beam Use Proposal 2022, sPH-TRG-2022-001, `https://indico.bnl.gov/event/15148/attachments/40846/68568/sPHENIX_Beam_Use_Proposal_2022.pdf` .