

# STAR Heavy Ion and Cold QCD programs for 2021+ runs

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## Abstract

The STAR Collaboration has performed several detector upgrades in the last few years, including the replacement of the inner chambers of the Time Projection Chamber (iTPC, with pseudorapidity  $0 < |\eta| < 1.5$ ), the Event Plane Detector (EPD,  $2.1 < |\eta| < 5.1$ ) and the Endcap Time of Flight (eTOF,  $-1.5 < \eta < -1.0$ ) that are commissioned and fully operational since 2019. A full suite of forward detectors, including a tracking system consisting of a silicon and small Thin Gap Chamber (sTGC) coupled with both electromagnetic and hadronic calorimetry will be installed covering the forward pseudorapidity region of  $2.5 < \eta < 4$  before 2022. These upgrades will substantially extend STAR's kinematic reach and further enhance its particle identification capabilities.

The primary scientific goal for the STAR Collaboration in 2021 is to complete the second phase Beam Energy Scan (BES-II) program. We will also explore the origin of small system collectivity via O+O collisions in 2021. In 2023 and 2025, with the anticipated Au+Au runs, we will be able to map out the 3-dimensional initial state of heavy ion collisions at RHIC energies. Beginning in 2022, STAR will be in a unique position to provide the essential exploration of the spin and flavor structure of nucleons with the installation of the full suite forward detectors. This enables studies of the universality and factorization in transverse spin phenomena, nuclear PDFs and fragmentation functions over a wide range of momentum fractions,  $x$ . To carry out these measurements, the STAR collaboration is planning to collect data from transversely polarized p+p collisions at 500 and 200 GeV and p+Au collisions at 200 GeV in 2024.

In this talk, we will outline prospects for key measurements envisioned to be carried out in the next few years, as well as report on the progress of the STAR forward upgrade preparations.