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Insights from the STAR Fixed-Target Program[1]

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The beam energy scan (BES) program at RHIC has been designed to study the transition of QCD matter between a state of dense hadronic gas and that of a quark-gluon plasma. At top RHIC and LHC energies this is understood to be a continuous phase transition. However, many theoretical understandings suggest that, for matter-dominated (i.e. high baryon chemical potential) QCD matter, there should be a first-order phase transition and the end of the first-order boundary should be a critical point. Theory and results of BES-I suggest that the critical point may be located near or below the low-energy limit of the RHIC collider program. Therefore, STAR has developed a fixed-target program to complement the BES-II collider program. By steering a beam in RHIC to graze the upper edge of an internal gold target, the experiment and the accelerator have developed a conduct of operations to efficiently acquire Au+Au collisions at a series of nine energies ranging from $\sqrt{s_{NN}}$ = 3.0 to 7.7 GeV. At the low end of this energy range, the QCD matter is expected to remain in a hadronic gas state throughout the evolution of the reaction. The top end of the fixed-target energy range overlaps with the low end of the collider energy range, which allows a cross-check of the corrections required due to the energy-dependent fixed-target acceptance. Acquisition of these data was completed during operations in 2018, 2019, and 2020. Due to the time required for detailed offline calibrations, currently only some of the energies are available for physics analysis. This talk will address the insights acquired from the first results from this fixed-target energy scan and review the prospects as additional energies become available for physics analyses.

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