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Probing the Hadronic Spin Structure and Dynamics in High-Energy Polarized Proton-Proton Collisions at RHIC

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The Relativistic Heavy-Ion Collider (RHIC) is a unique facility. It is the world's only polarized proton + proton collider capable of delivering highly polarized protons up to a center-of-mass energy of 510 GeV. Polarized proton + proton collisions allow one to study the proton's spin structure using strong interactions by measuring single and double spin asymmetries. Using longitudinally polarized protons, the STAR experiment at RHIC can probe the proton's longitudinal spin structure, providing insights into the proton's parton helicity distributions. Employing transversely polarized proton collisions, STAR can study the transverse spin structure of the proton and properties of QCD through transverse spin effects. Presented here is a summary of recent STAR results and how they play a crucial role in understanding the proton spin structure. Moving beyond 2021, an outlook will also be presented of future measurements exploiting the STAR forward upgrade.