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The High Intensity Polarized Proton Source

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The High Intensity Polarized Proton Source and Siberian Snakes enabled RHIC's high-luminosity polarized proton beams to study proton spin structure, conduct fundamental tests of QCD, and conduct electroweak interactions. For 25 years, the polarized proton source based on OPPIS (Optically Pumped Polarized H- Ion Source) reliably delivered the high-intensity polarized proton beam for the RHIC spin physics program. The first OPPIS system, based on the ECR (Electron Cyclotron Resonance) primary proton source, operated successfully in the Runs 2000–2012. In 2012 it was then replaced by an OPPIS system based on the Fast Atomic Ion Source (FABS) with a hydrogen atomic beam injector and a helium ionizer [1]. FABS produces a significantly brighter primary proton beam, resulting in increased beam intensity and polarization. Since 2012 FABS-based OPPIS has been operating successfully for RHIC. Since its implementation FABS has undergone numerous upgrades to optimize beam parameters, ensuring high polarization and intensity while effectively suppressing unpolarized beam components and maintaining small beam emittance. As a result, we have achieved a peak polarization of over 86%, an intensity exceeding 1000 µA, and a beam pulse duration of over 400 µs out of the Linac. The average volume of polarization is approximately 80% and an intensity of 350 µA. After the successful operation in Runs-2013-24, OPPIS is in good shape to deliver up to 1012 polarized H- ions/linac pulse with 82-85% polarization for future Electron Ion Collider (EIC) operation [2].

1. A. Zelenski et al., "The RHIC polarized source upgrade"19th International Spin Physics Symposium (SPIN2010)

2. D. Raparia* et al., "Polarized ion sources at BNL", 25th International Spin Physics Symposium (SPIN 2023) 24-29 September 2023 Durham, NC, USA

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