Polarization Optimization Studies in the RHIC Optically-Pumped Polarized Ion Source

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The performance of the RHIC Optically-Pumped Polarized H^- Ion Source (OPPIS) in the 2000-2002 runs for AGS and RHIC will be reviewed. The OPPIS met the RHIC requirements for the beam intensity with the reliable delivery of about 500 μA polarized H- ion current in 400 μs pulse duration (current can be increased to over 1.0 mA, if necessary). The beam intensity after the linac at 200 MeV was $(5\text{-}6)\cdot 10^{11}$ H^-/pulse, which is sufficient to obtain the required $2\cdot 10^{11}$ polarized protons per bunch in RHIC. A Lamb-shift type polarimeter was used for polarization measurements and optimization at a source energy of 2.6-3.0 keV (extraction voltage turned off). A proton polarization of 80% was measured in the Lamb-shift polarimeter, after OPPIS-parameter optimization. At that time the presence of a half-energy beam component coming from dissociation of H_2^+ molecular-ions was observed. The molecular ions are produced in the ECR (Electron Cyclotron Resonance) primary proton source. This component can be as high as 20%, and the polarization is significantly lower than polarization of the main beam. At the 35 keV extraction energy, this component has 33.5 keV, and is matched into the RFQ and accelerated along with the full energy ions, reducing the beam polarization. The molecular-ions can be reduced to about 5% by the ECR source-operation optimization. They can be suppressed further by optimization of the extraction optics and by use of a decelerating einzel lens in 35 keV LEBT line. As a result, the proton polarization of the accelerated beam was increased to over 80%, as measured in a 200 MeV proton-deuterium polarimeter. The polarimeter upgrade will be also discussed, which includes the high-current polarization measurements and continuous polarization monitoring (by interleaving beam pulses injected to Booster with the pulses transported to the polarimeter).