Optically-Pumped Polarized Electron, H^- and $3He^{++}$ ion sources development at BNL.

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Description of Project: New techniques for production of polarized electron, H^- ion and $^3He^{++}$ beams (based on optical pumping polarization method) will be discussed. A feasibility studies of these techniques are in progress at BNL.

I. Polarized electrons. We proposed the feasibility study of a new electron polarization technique based on the associative ionization of the alkali metal Rb vapour in the process of optical pumping by resonant light of high power laser. The experiments will be carried out at the RHIC Optically-Pumped Polarized H^- Ion Source (OPPIS). The polarization of electron beam produced in the Rb ionizer cell will be measured in the Mott polarimeter at 20-40 keV beam energy.

II. **Polarized H^- ions.** The objective of this feasibility study is a proof of principle of a very high intensity polarized H^- ion source, based on spin-transfer collisions between atomic hydrogen beam (of a 1.0-3.0) keV energy and optically–pumped alkali-metal vapor cell. Primary atomic hydrogen beam will be produced in a high-brightness source .

III. **Polarized $^3He^{++}$ ions.** A new ^3He polarization technique is based on ionization in an Electron Beam Ion Source (EBIS) of ^3He gas polarized by optical pumping. Ionization efficiency to double-charged $^3He^{++}$ state will be close to 100% and the number of ions is limited to maximum charge which can be confined in the EBIS. We propose to use the EBIS (developed at BNL for multiple-charged heavy ion beams) for feasibility study of this technique. Nuclear polarization of $^3He^{++}$ beam will be measured in a Lamb-shift polarimer. Possible depolarization effects during polarized ^3He gas injection to EBIS and multi-step ionization process will be studied. These studies are required to test feasibility of a future upgrade of the RHIC EBIS to produce $^3He^{++}$ ions of about $5 \cdot 10^{11}$ with polarization in excess of 70% for injection to eRHIC.