The Study of the Silicon Detector Response for p-Carbon Polarization Measurements at RHIC

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Abstract

At the Relativistic Heavy Ion Collider (RHIC) measurements of the proton beam polarization are conducted by inserting an ultra thin carbon ribbon in the beam and registering the scattered carbon ions with silicon detectors. The polarization value reported by the proton-carbon polarimeters strongly depends on the correct measurement of the energy deposited in the detectors by the recoil products. In this note we present a study of the response of the silicon detectors to α-particles employed to calibrate the detectors.

1 Motivation

The RHIC polarimetry is based on the measurement of the recoil products from elastic scattering of the proton beam on a fixed target in the Coulomb nuclear interference (CNI) energy regime. In this study we focus on the four p-Carbon polarimeters with ultra thin carbon targets which can be moved through the beam. In the current setup the polarization of each proton beam can be measured independently by two p-Carbon polarimeters installed in the "yellow" and "blue" accelerator rings.

During the 2013 run we observed significant changes in the gain in some of the silicon detectors. This change of $\lesssim 20$ % is worrisome and may cause significant systematic change in the reported polarization values due to a steep slope in the p-Carbon analyzing power within the energy range of interest.

2 Measurement and Results

The detectors produced by the BNL instrumentation group have 12 one-millimeter silicon strips operating under the nominal bias voltage of 110 V. The detector gains are normally monitored by taking calibration runs when there is no beam in the machine. Starting April 3, 2013 the calibration runs were taken automatically at the end of every RHIC store immediately after the beam dump. This approach allowed us to track the changes in detector properties at a more precise level than before. Although we primarily focus on the Run 13 data we also analyzed

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