

Beam parameters for the Hall-B RG-B run during November 2019 and February 2020

October 18, 2019

Hall-B Run Group B is scheduled to run from November 25, 2019, to February 2, 2020. The run will use 10.6 GeV (5-pass) longitudinally polarized ($> 80\%$) electron beam with currents up to 200 nA impinging on a liquid deuterium target (LD_2)¹. The Hall B CLAS12 detector will be used in its standard configuration. The CLAS12 detector system is based on two superconducting magnets, a toroid for the forward detector and a solenoid for the central detector. The system includes Cherenkov Counters, Drift Chambers, Scintillator Counters, Silicon-strip detectors, Micro-mega gas detectors, and Calorimeters.

As a target, the CLAS12/Saclay cryotarget located inside the central detector in the center of the 5 T solenoid magnet will be used with and without LD_2 in it. The target cell is a 20 mm diameter, 5 cm long Kapton tube installed inside the beam vacuum, in a foam scattering chamber. The target cell has 30 μm thick Aluminum windows along the beam. The Aluminum windows are 10 mm in diameter. Outside of the 10 mm diameter range, material around the beam is much thicker, especially in the upstream end where the target cell supports and the cryogenic supply pipes are located. The beam vacuum has discontinuity between the upstream and downstream beamlines with ~ 40 cm of air between the exit window of the target scattering chamber and the entrance window of the downstream beam pipe. Both windows are 50 μm thick aluminum.

The production running with LD_2 target will be done with ~ 50 nA beam current (this corresponds to luminosity of $\sim 0.75 \cdot 10^{35} \text{ cm}^{-2}\text{s}^{-1}$). Data

¹A short run with low energy beam, 2 pass, is expected for backward neutron detector calibration.

also will be taken with empty target cell with up to ~ 200 nA beam. During running with beam currents above 15 nA (~ 160 W), the Hall B beam stopper (a 30 cm long, water cooled-copper absorber) will be positioned before the Faraday cup to prevent overheating. For the beam tune and Möller runs, the beam will be directed into the beam dump in the Hall B Tagger dipole yoke. Quality of the beam will be assessed using the Hall-B halo counters and wire harps. The nA cavities (2C21, 2C24, and 2H01) will be used as beam position and current monitors, and as well as in the orbit locks. The delivery procedures from the last CLAS12 run must be revised and will be used for RG-B run.

Below are requirements for beam parameters RG-B run.

Parameter	Requirement	Comments
Energy (GeV)	10.5 (~ 4.4)	A short run with 4.4 GeV, 2-pass beam is needed for BAND calibration
$\delta p/p$	$\sim 2 \times 10^{-4}$	
Current (nA)	≤ 200	The production running will be at ~ 50 nA
σ_{xy} (μm)	< 300	As measured by 2H01A harp
Position stability (μm)	< 100	On 2H01 and 2H00 ($> 30\text{nA}$) BPMs with feedback
Divergence (μrad)	< 100	
Beam Halo ($> \pm 5\sigma$)	$< 10^{-5}$	As measured by 2H01A harp
Beam Polarization	$> 80\%$	As measured by Hall-B Moller polarimeter
Charge asymmetry	$< 0.1\%$	Measured with SLM and halo rates, and controlled by hall
Long term current stability	$< 5 \%$	For > 30 nA, integrated over minutes
Short term beam intensity stability (60 Hz harmonics)	$< 10\%$	of the total power, measured with SLM and halo rates
Bunch charge fluctuations	$< 10 \%$	Measured with DAQ

Table 1: Required beam parameters.

