

Parity Quality Beam (PQB) Working Group Report

OPS StayTreat

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Upcoming Parity Violation Experiments

Experiment	Energy (GeV)	Pol (%)	I (μA)	Target	A_{pv} (ppb)	Maximum Charge Asym (ppb)	Maximum Position Diff (nm)	Maximum Angle Diff (nrad)	Maximum Size Diff ($\delta\sigma/\sigma$)
PREx-II	1.0	90	70	^{208}Pb (0.5mm)	500 ± 15	100 ± 10	1 ± 1	0.3 ± 0.1	10^{-4}
C-REx	2.2	90	150	^{48}Ca (5mm)	2000 ± 42	100 ± 10	1 ± 1	0.3 ± 0.1	10^{-4}
MOLLER	11.0	90	60	^1H (150 cm)	35.6 ± 0.74	10 ± 10	0.5 ± 0.5	0.05 ± 0.05	10^{-4}

- PREx-II is tentatively scheduled for Hall A in Fall 2016
- C-REx is tentatively scheduled for Hall A in Spring 2017
- MOLLER is planned for Hall A in 2022

Issues from QWeak

1. Beam Halo: there was beam halo that could develop a large helicity-correlated charge asymmetry

Beam halo charge asymmetry was found to depend on:

- Beam loss at Injector Apertures
- Laser phase
- Machine tuning

What can we do to help?

2. BCM Resolution is not suitable for MOLLER:
 - QWeak achieved 65 ppm but MOLLER requires 10 ppm
 - BCM digital receiver bench studies found that local oscillator phase and amplitude noise being responsible for 65 ppm noise floor
 - Try new digital receivers
 - Improve phase/amplitude noise of local oscillator

Hall A 2015/2016 Beamline Plan for PQB

1. Install QWeak halo monitor in Hall A beamline
2. Equip two BCMs with new-style digital receivers
3. Install QQQ cavity triplet in Hall A beamline
4. Reinstall Hall A beam modulation system (air-core coils and associated control/drive electronics)
 - Beam modulation and accelerator Fast Feedback: is there a need to pause FFB when modulation is ON? does FFB implement a digital notch filter to attenuate modulation frequency (QWeak: 125 Hz for 20 s every 320 s) while passing all other frequencies?
 - Need software support

Beam Studies
of these
systems

Synchrotron Radiation @ 11 GeV

What are the issues? Any helicity-correlated effects?

- Synchrotron radiation causes energy spread and energy tails – clipping might be helicity-correlated (e.g., due to helicity-correlated position differences etc.)
- Emittance growth
- Effect on adiabatic damping
- Power is helicity dependent
- Is there any helicity-correlated emittance growth
- Depolarization due to spin-flip synchrotron radiation (Sokolov–Ternov effect) is very small

TASKS SUMMARY

Laser Table Tasks

Task	Sub Tasks	Date	Description
2 kHz Helicity Reversal		MOLLER	Requires 10 μ s settle time – No ringing (not required for PREX, but hoped to test at this time). No Kerr Cell.
	RTP Pockels Cell		Buy test crystals to characterize, design RTP quarter-wave system.
	KD*P re-design		Model E-field to maximize PC uniformity, buy a properly engineered, one with the correct cell-diameter-to-laser-beam-diameter aspect ratio
Pockels Cell Stewart Platform		2016	For remote optimization using e-beam. Assemble, build control software, qualify

Injector Tasks

Task	Sub Tasks	Date	Description
Reinstate Injector Parity DAQ			
Improve 2-Wien Flip Optics		PREx-II	
Injector Matching		PREx-II	Maximize damping
Helicity-correlated Beam Size Monitor		PREx-II	Looking for ideas!
Upgrade Helicity Magnet controls		PREx-II	
Locate Helicity Magnets to span (x,x') and (y,y') to minimize both position and angle		Fall 2015	
Augment helicity steering dipoles with helicity size quads		PREx-II	
Share Injector apertures' current read-back with parity DAQ		Fall 2015	
MOLLER Feedback to minimize transverse polarization			Once a shift, adjust Wien angle

Accelerator Tasks

Task	Sub Tasks	Date	Description
Study Depolarization at Higher Passes			
	Energy stability and precession to Hall		
Synchrotron Radiation		MOLLER	
	Helicity-correlated emittance growth		
	Energy spread and energy tails		Clipping might be helicity dependent
	Polarization dependence		
	Adiabatic damping		
MOLLER ($g-2$) Spin Flip			Change beam energy by 100 MeV (few reversals)

Hall A Tasks

Task	Sub Tasks	Date	Description
Reinstate Hall A Parity DAQ			
Beam Halo			
	Install QWeak halo monitors in Hall A	Fall 2015	
BCM Resolution			
	New cavities and receivers	Fall 2015	
	BCM receiver bench studies and beam studies	Fall 2015	
Beam Modulation		Fall 2015	
Beam Polarimetry			
Spin Dance			
Beam Matching and Optics			
Phase Trombone			