Fall 2019
Beam Helicity control

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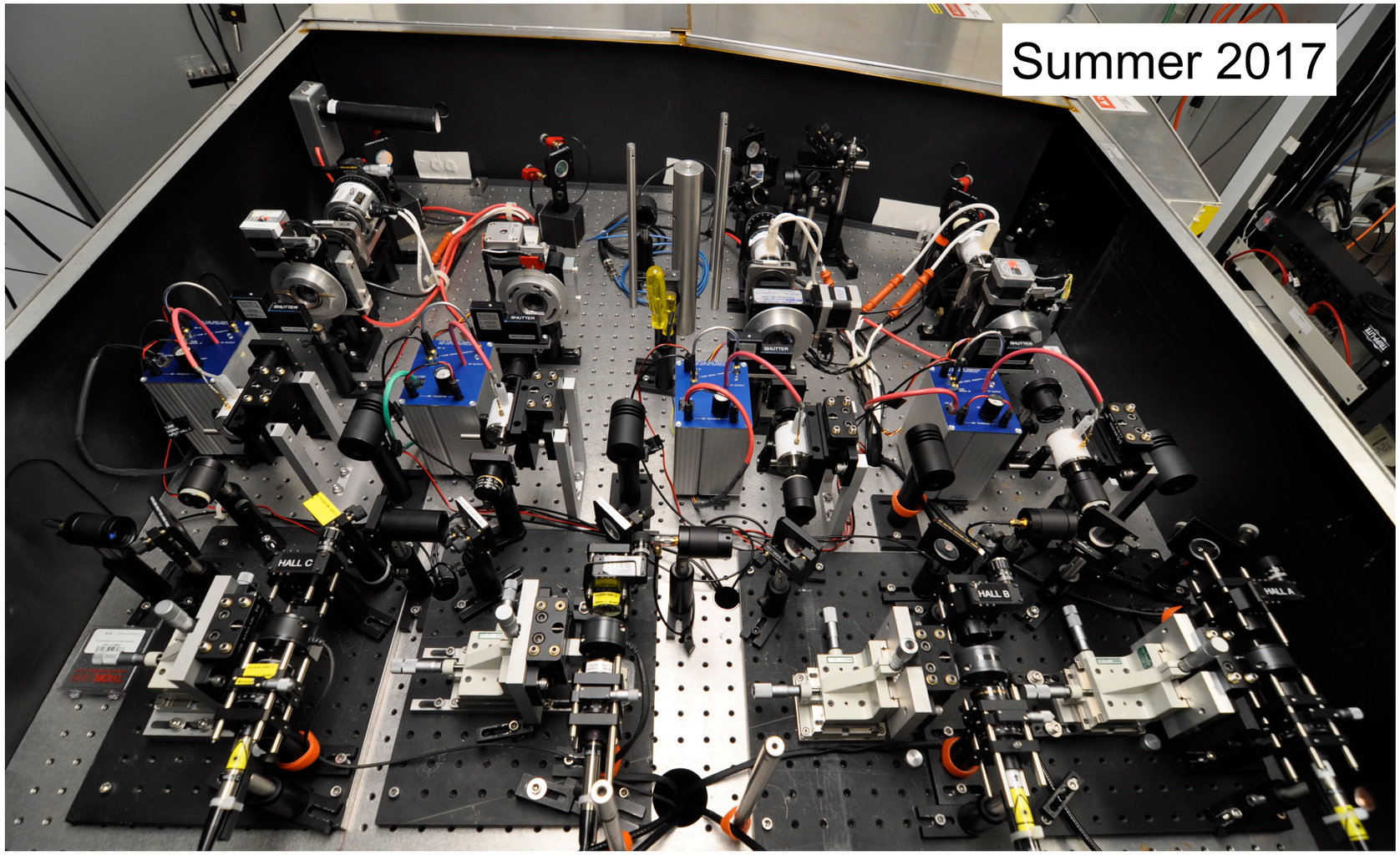
CREX is similar in requirements to HAPPEX2

Experiment	Energy (GeV)	Pol (%)	I (μA)	Target	A_{PV} Expected (ppb)	Charge Asym (ppb)	Position Diff (nm)	Angle Diff (nrad)	Size Diff ($\delta\sigma/\sigma$)
HAPPEx-I (Achieved)	3.3	38.8 68.8	100 40	^{1}H (15 cm)	15,050	200	12	3	
G0-Forward (Achieved)	3	73.7	40	^{1}H (20 cm)	3,000-40,000	300±300	7±4	3±1	
HAPPEx-II (Achieved)	3	87.1	55	^{1}H (20 cm)	1,580	400	2	0.2	
HAPPEx-III (Achieved)	3.484	89.4	100	^{1}H (25 cm)	23,800	200±10	3	0.5±0.1	
PREx-I (Achieved)	1.056	89.2	70	^{208}Pb (0.5 mm)	657±60	85±1	4	1	
QWeak-I (Achieved)	1.155	89	180	^{1}H (35 cm)	281±46	8±15	5±1	0.1±0.02	
QWeak (Analysis In Progress)	1.162	90	180	^{1}H (35 cm)	234±5	<100±10	<2±1	<30±3	$<10^{-4}$
PREx-II/CREx (To Be Scheduled, FY18+?)	1	90	70	^{208}Pb (0.5mm)	500±15	<100±10	<1±1	<0.3±0.1	$<10^{-4}$
MOLLER (To Be Scheduled, FY21+?)	11	90	85	^{1}H (150 cm)	35.6±0.74	<10±10	<0.5±0.5	<0.05±0.05	$<10^{-4}$

****(A. Freyberg Aug 2016 ECT'16)**

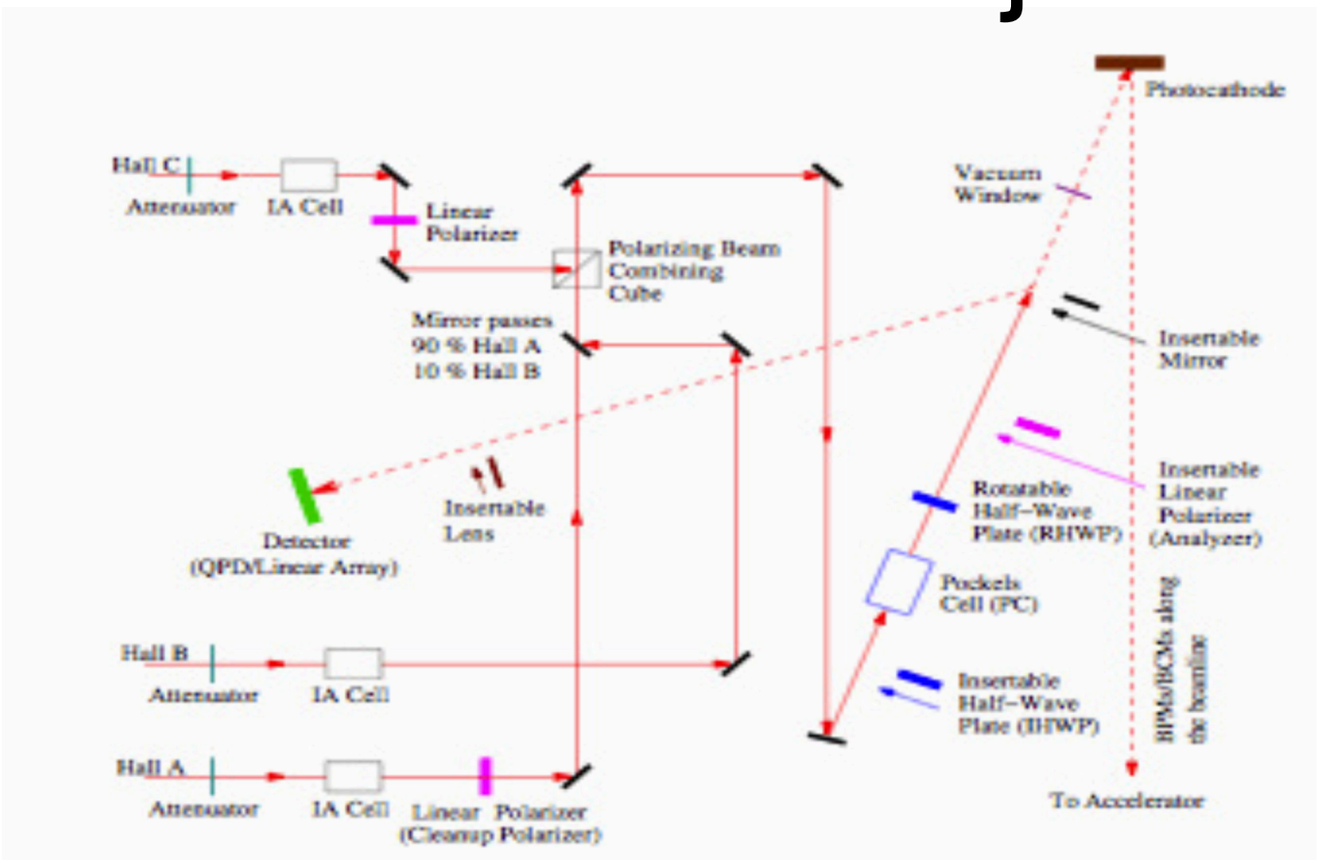
- The accelerator capability to be able to run PREX/CREX have been achieved in previous parity runs (Qweak, HAPPEX3)
- CREX will have >2x HAPPEX2 asymmetry while the rate will be similar, making it an easier experiment than PREX2
- CREX will need monitor and minimize the charge and position asymmetry
  - This will require careful setup and continuous measurements of these quantities
- Additionally we will perform beam modulation (similar to previous experiments) to understand the detector responses and correct Helicity Correlated Beam Asymmetries

Injector setup



- After the 12 GeV upgrade the injector laser setup has been updated as well

Injector setup

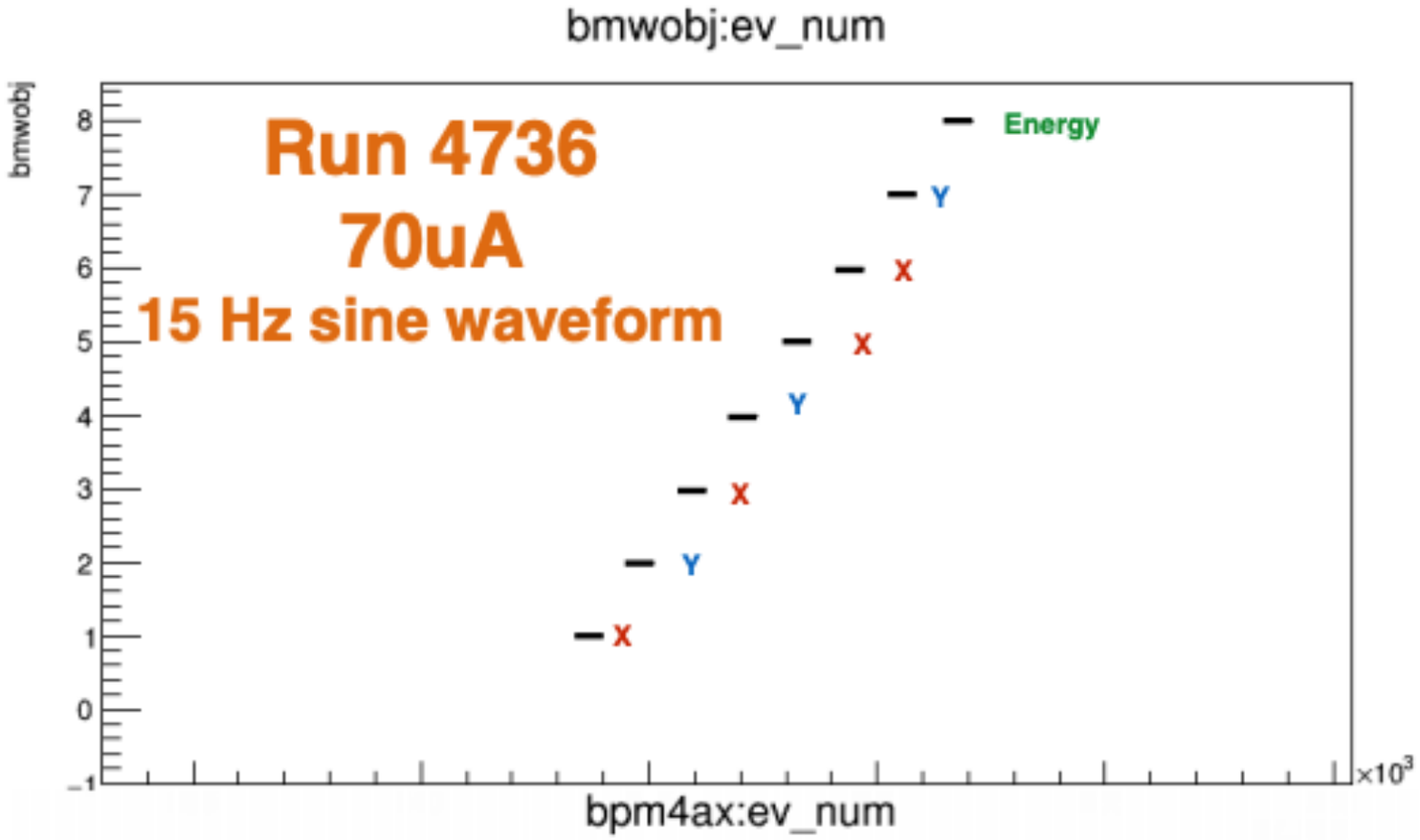


Basic schematic is similar to 6 GeV era laser

For parity experiments Aq from one high power hall has been observed to influence Aq of the other hall. CREX will need to control Hall C Aq.

- During CREX we will turn off the IA Cell for hall A (to be able to control the beam charge asymmetry using the PITA voltages on the Pockels Cell)
- Control of the Hall C charge asymmetry will be done through your IA Cell
  - The laser polarization is opposite in Hall A and Hall C (due to how the beams are combined) so a change in the PITA that will minimize Hall A Aq will move the Hall C Aq in the opposite direction
- **To be able to monitor and correct the Hall C charge asymmetry we will need a copy of the V2F BCM signal**
  - what level of charge asymmetry is acceptable for A1n?

Beam modulation



- During CREX we will perform periodic beam modulations where fast feedback will need to be turned off
  - Feedforward will continue to work (main task is to suppress 60Hz noise - which we don't expect a lot of)
- Hall A will employ a set of 8 air core coils that we activate and which perform excursions in position, angle and energy
  - this will run automatically and continuously (for example during PREX1 it was on 86 s every 9m and 36 s giving us about a 10% duty cycle)
- since Hall A will have the energy lock it means that about 2% of the total experimental time we will have energy feedback off
- **We will provide signals to Hall C to let you know when beam modulation is on and when the energy lock is off**

Plan

- We are developing monitoring and feedback tools during the Spring 2019 run
  - Plan is to monitor Hall B charge asymmetry
    - If possible to get the Hall C signal soon it would make things easier for us integrate it as we are developing the system
  - For A1n the benefit is that this system will have already been tested and fully commissioned during the summer when we will run PREX2