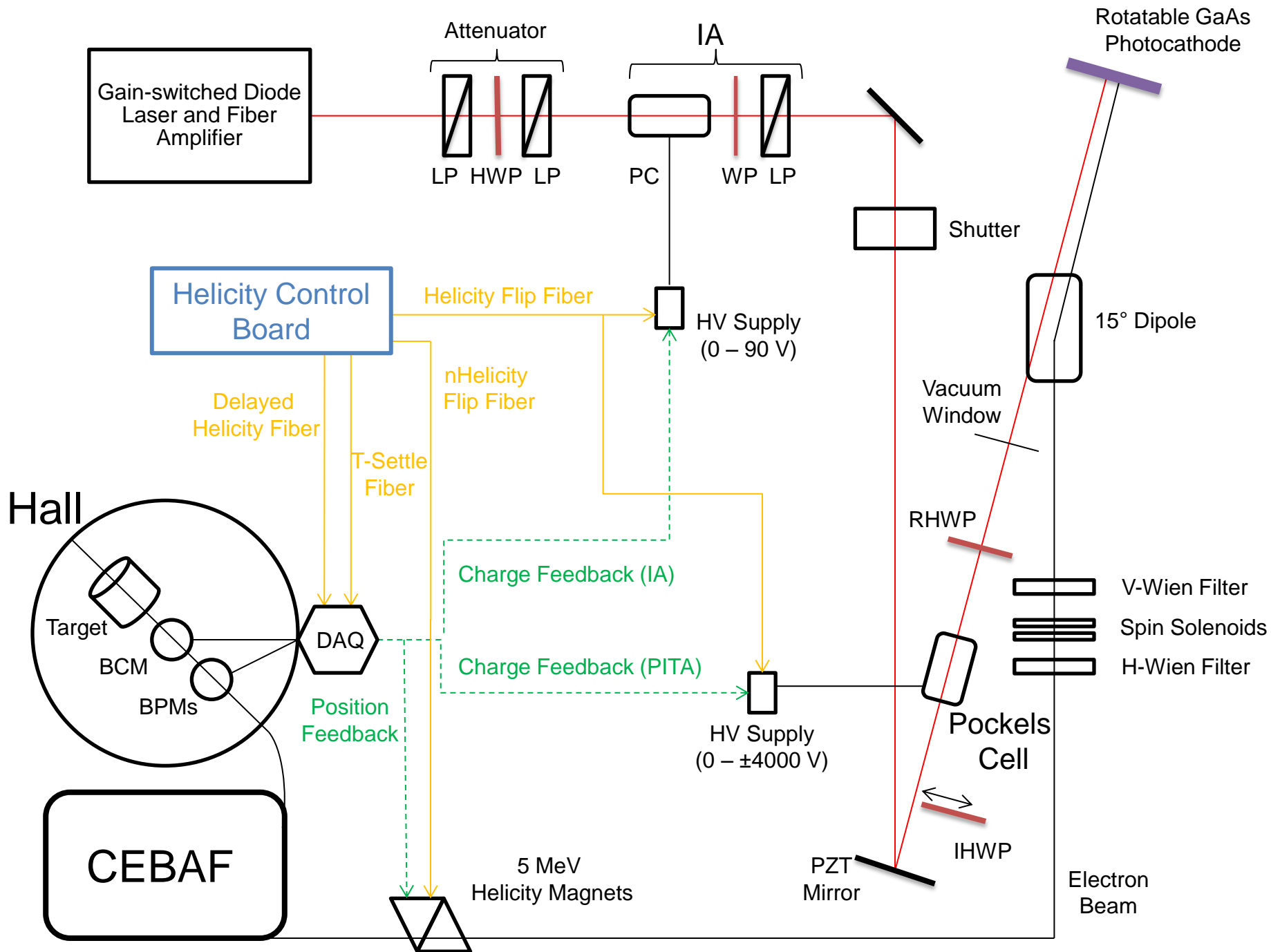


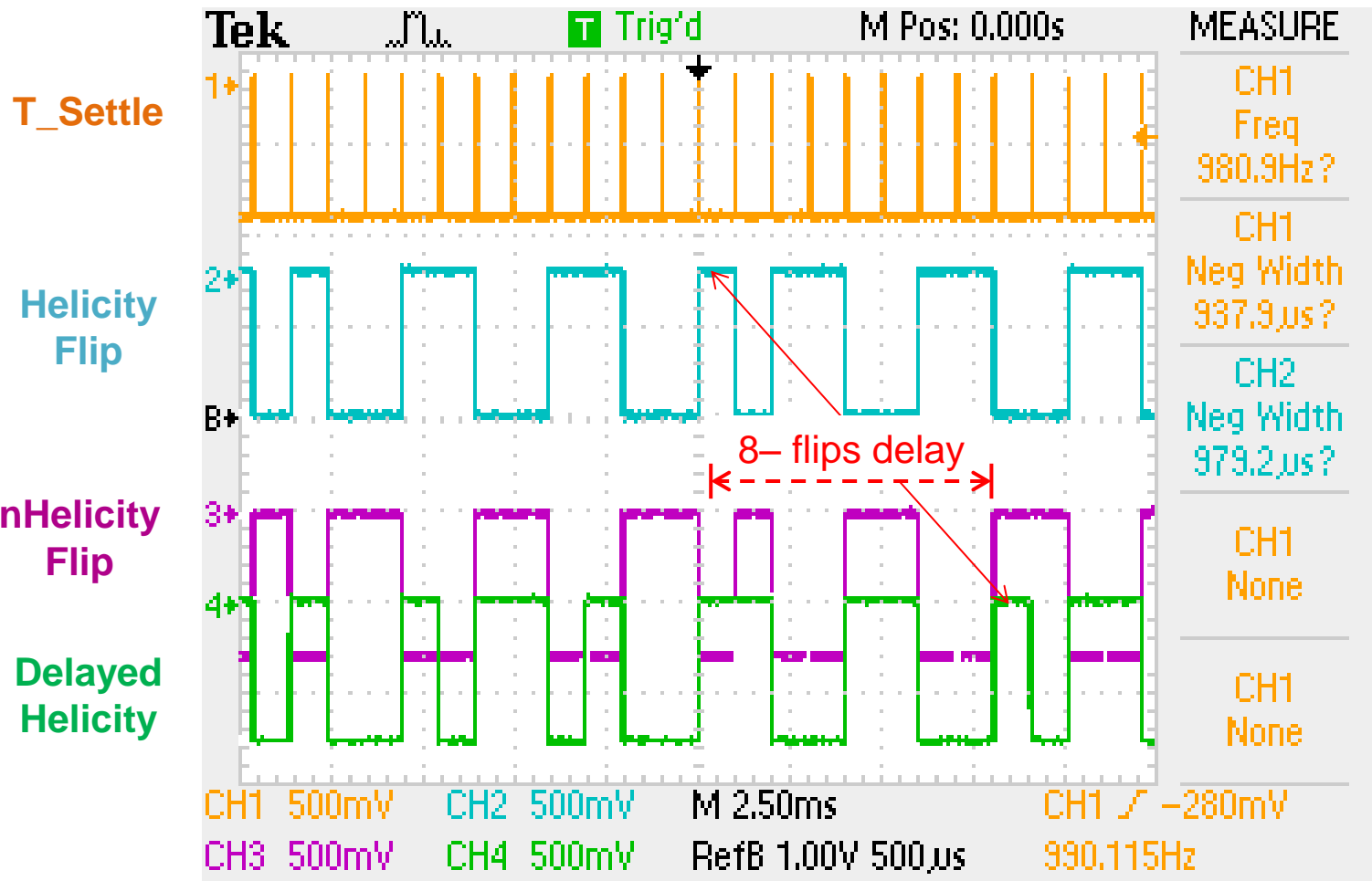
Parity Experiments and JLab Injector

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Experiment	Energy (GeV)	Pol (%)	I (μA)	Target	A_{pv} (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	^1H (15 cm)	15,050	200	12	3	
G0-Forward (Achieved)	3.0	73.7	40	^1H (20 cm)	3,000- 40,000	300 ± 300	7 ± 4	3 ± 1	
HAPPEX-II (Achieved)	3.0	87.1	55	^1H (20 cm)	1,580	400	2	0.2	
HAPPEX-III (Achieved)	3.484	89.4	100	^1H (25 cm)	23,800	200 ± 10	3	0.5 ± 0.1	10^{-3}
PREx-I (Achieved)	1.056	89.2	70	^{208}Pb (0.5 mm)	657 ± 60	85 ± 1	4	1	10^{-4}
QWeak-I (Achieved)	1.155	89.0	180	^1H (35 cm)	281 ± 46	8 ± 15	5 ± 1	0.1 ± 0.02	10^{-4}
QWeak	1.162	90	180	^1H (35 cm)	234 ± 5	$<100\pm 10$	$<2\pm 1$	$<30\pm 3$	$<10^{-4}$
PREx-II	1.0	90	70	^{208}Pb (0.5mm)	500 ± 15	$<100\pm 10$	$<1\pm 1$	$<0.3\pm 0.1$	$<10^{-4}$
MOLLER	11.0	90	85	^1H (150 cm)	35.6 ± 0.74	$<10\pm 10$	$<0.5\pm 0.5$	$<0.05\pm 0.05$	$<10^{-4}$



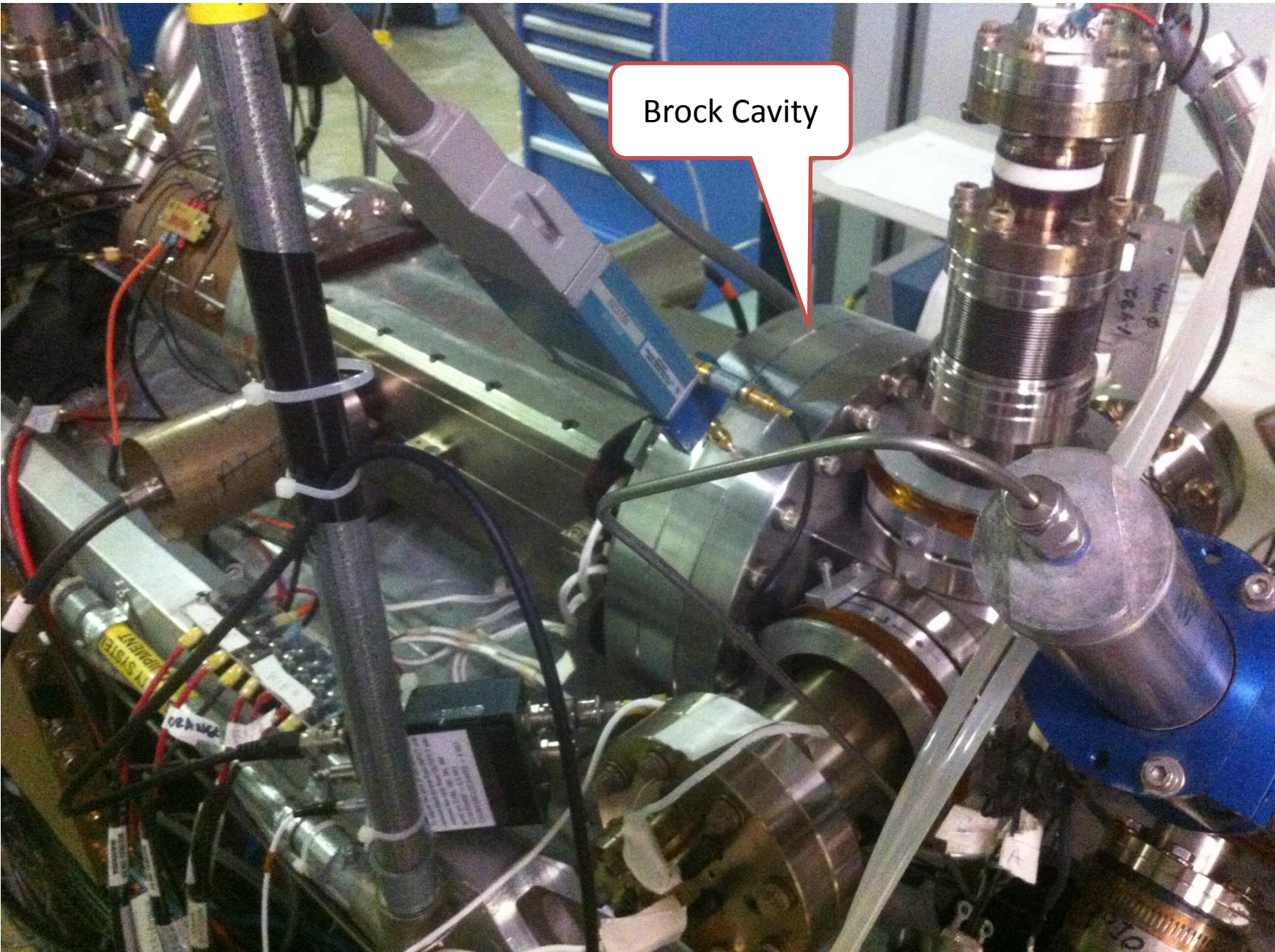


- How to carry out a parity violation experiment:
 - Scatter longitudinally polarized electrons off un-polarized target (i.e., Hydrogen, Deuterium, Helium, Lead)
 - Reverse the beam helicity (\pm) with Pockels Cell, measure detected signals (S^\pm) and currents (I^\pm), calculate physics asymmetry (A_{physics}):

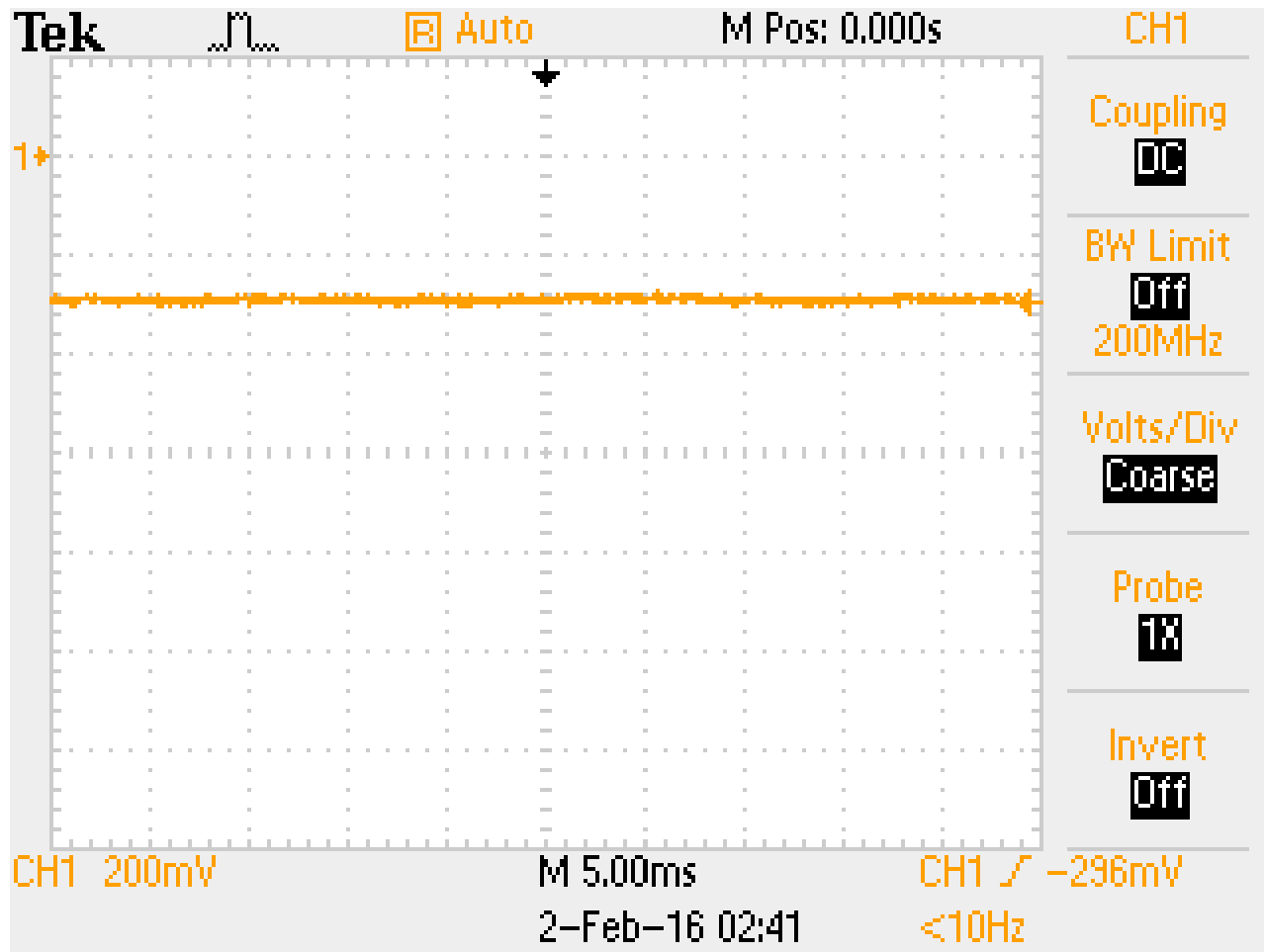
$$A_{\text{physics}} = \frac{\frac{S^+}{I^+} - \frac{S^-}{I^-}}{\frac{S^+}{I^-} + \frac{S^-}{I^+}} \approx \frac{\text{Weak}}{\text{EM}}$$

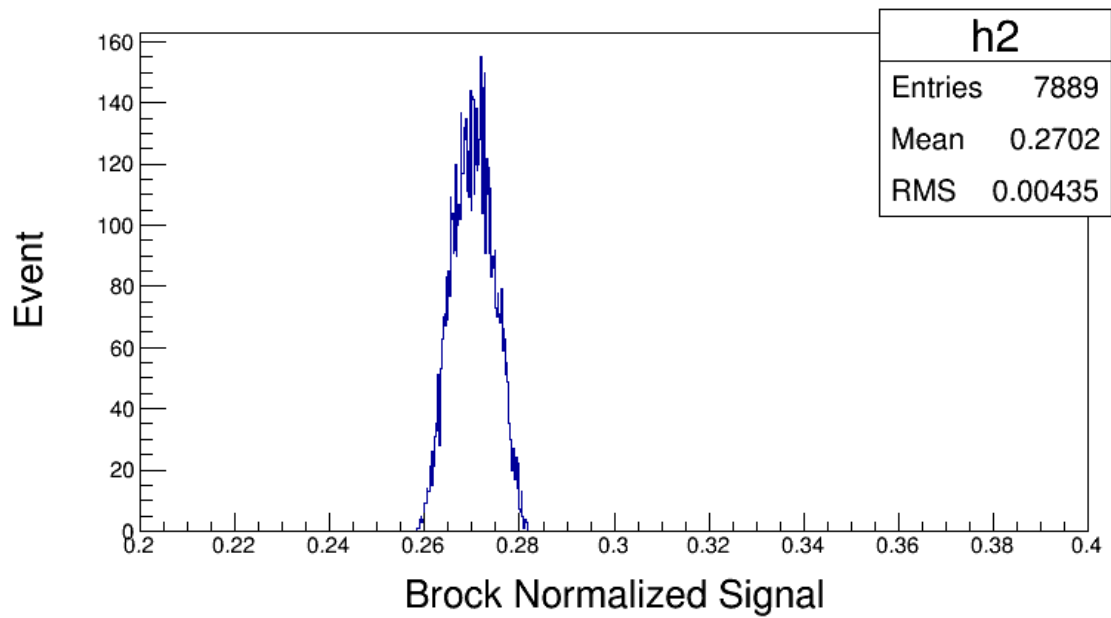
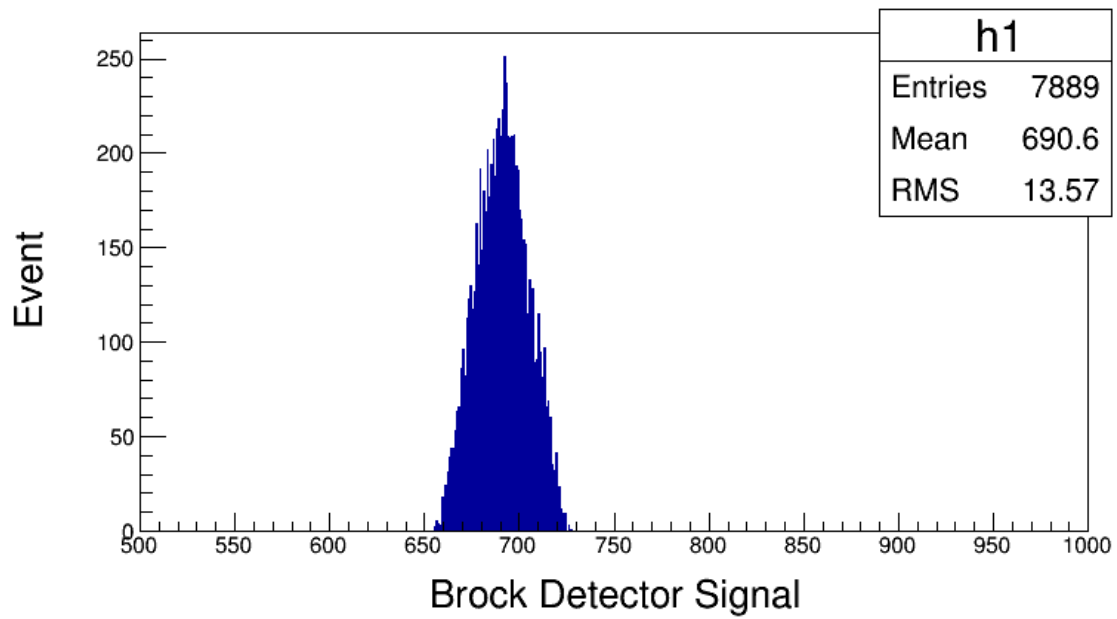
} 1/15th of a second

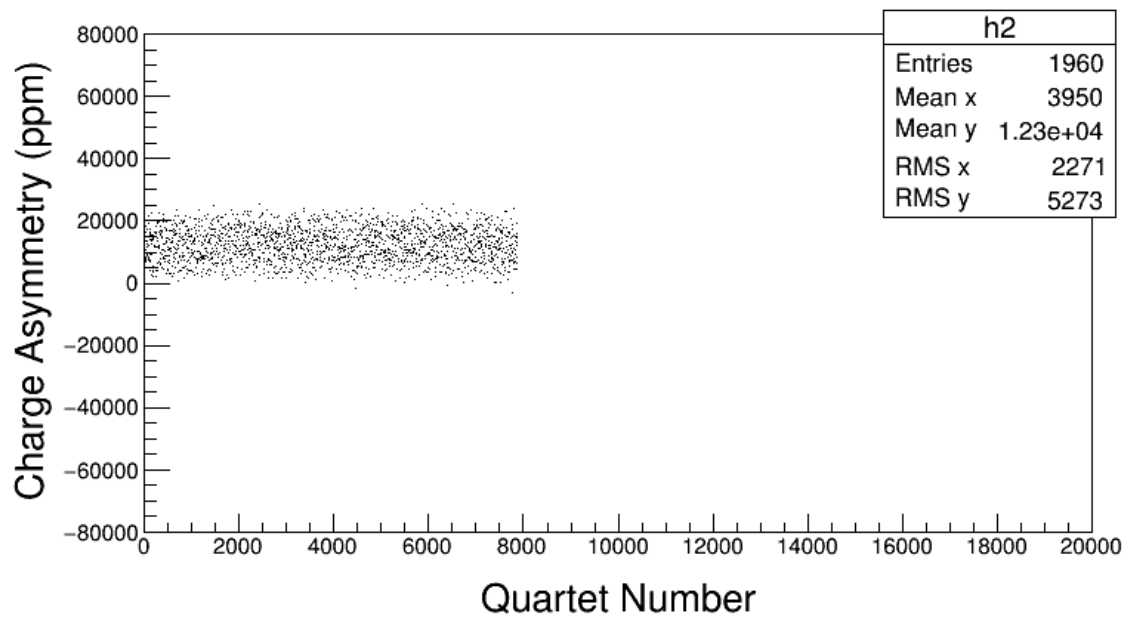
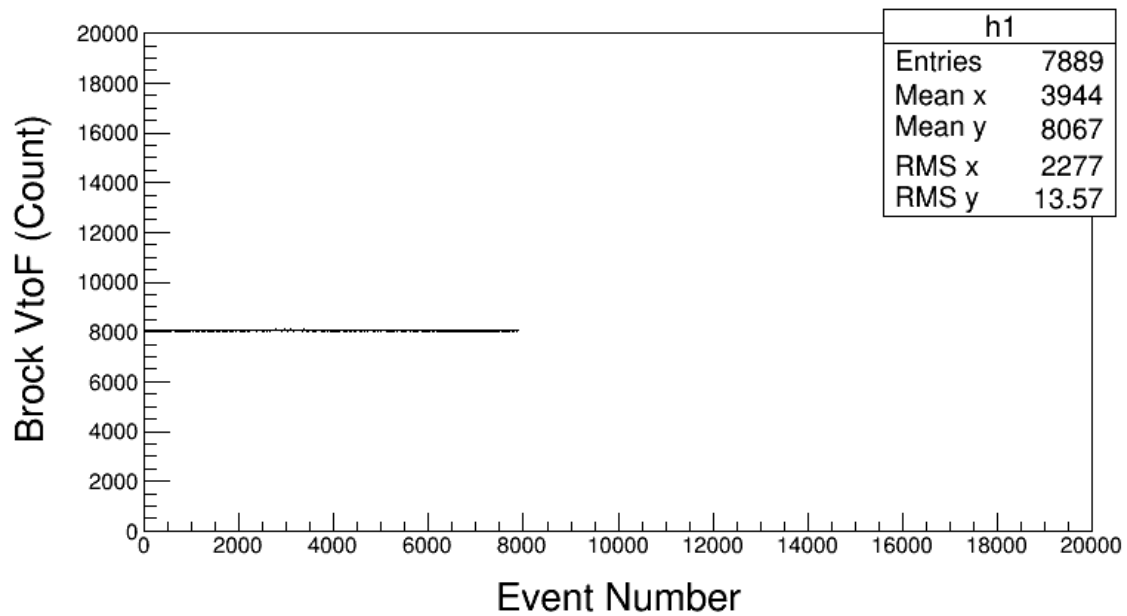
- Repeat the whole experiment: Millions of measurements
- Statistical distribution of these measurements is Gaussian: Mean is average asymmetry and error is width of Gaussian divided by square root of number of asymmetry measurements
- Average asymmetry is very small (1-50 ppm)

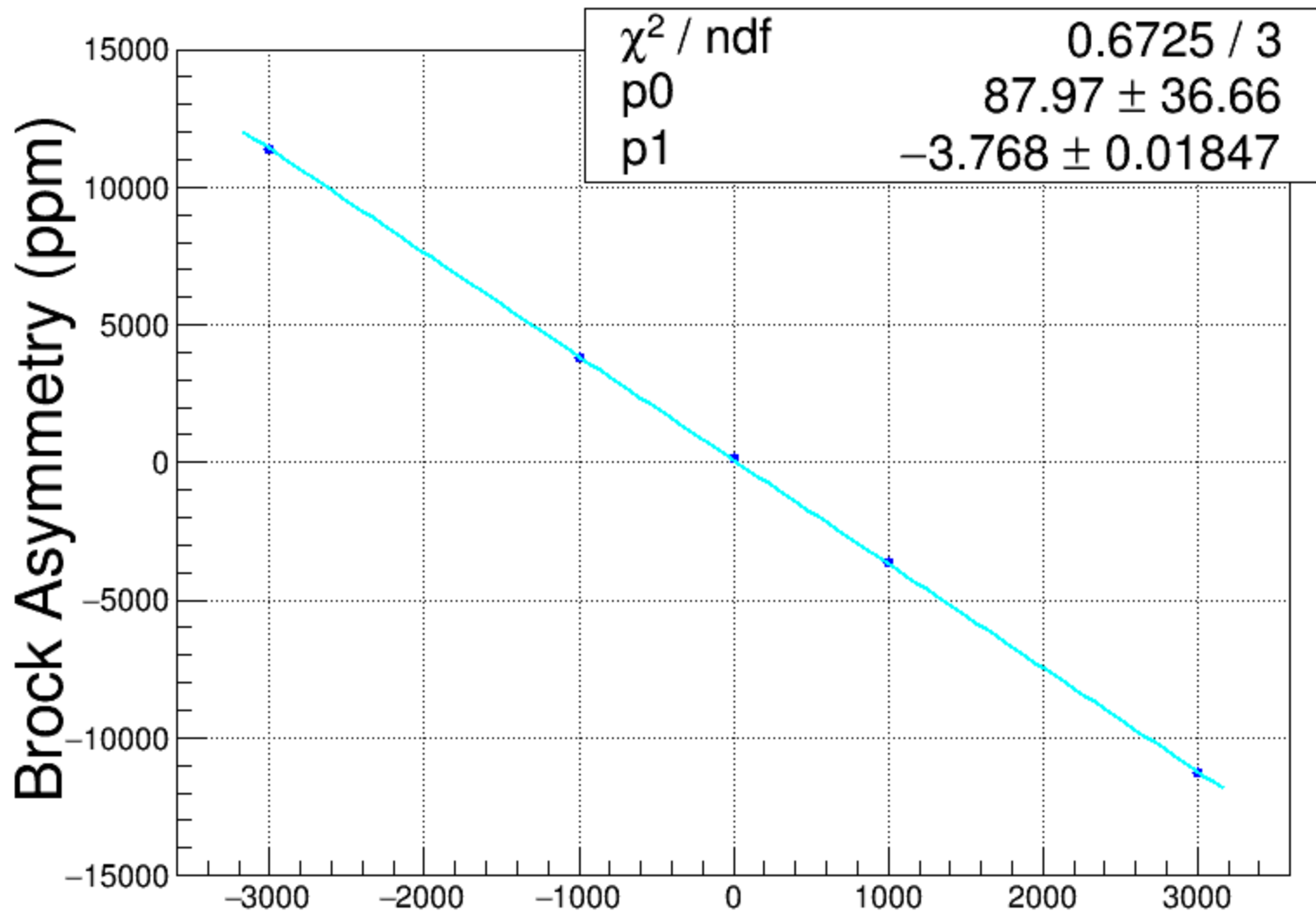


Brock Cavity









Pockels Cell PITA

For any polarimeter:

Polarization

$$\text{Signal} = \text{Constant} (1 + A_y \cdot P)$$

Proportional to
beam current

Analyzing Power

**Question: What
is A_y for RF
polarimeter?**