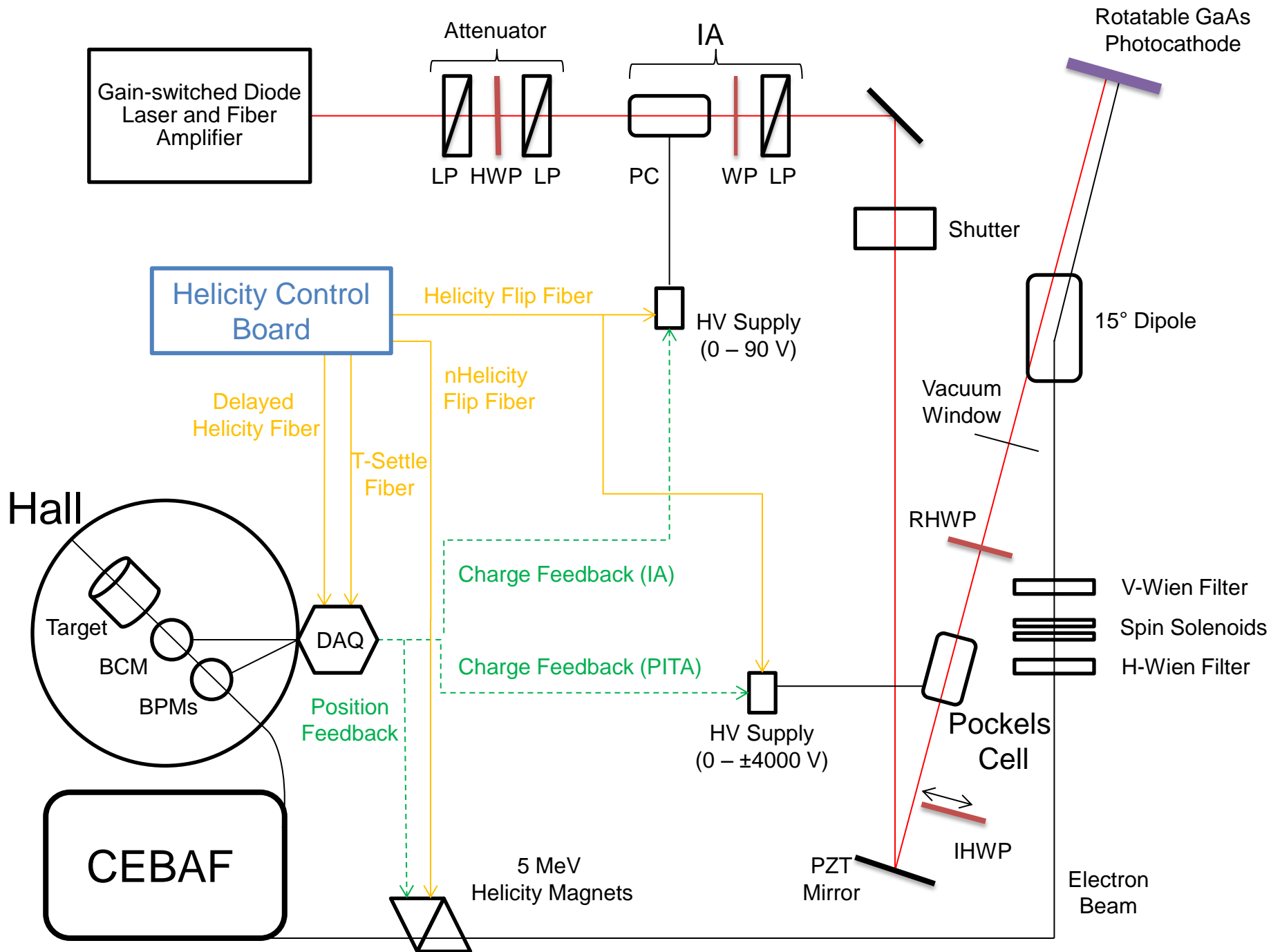


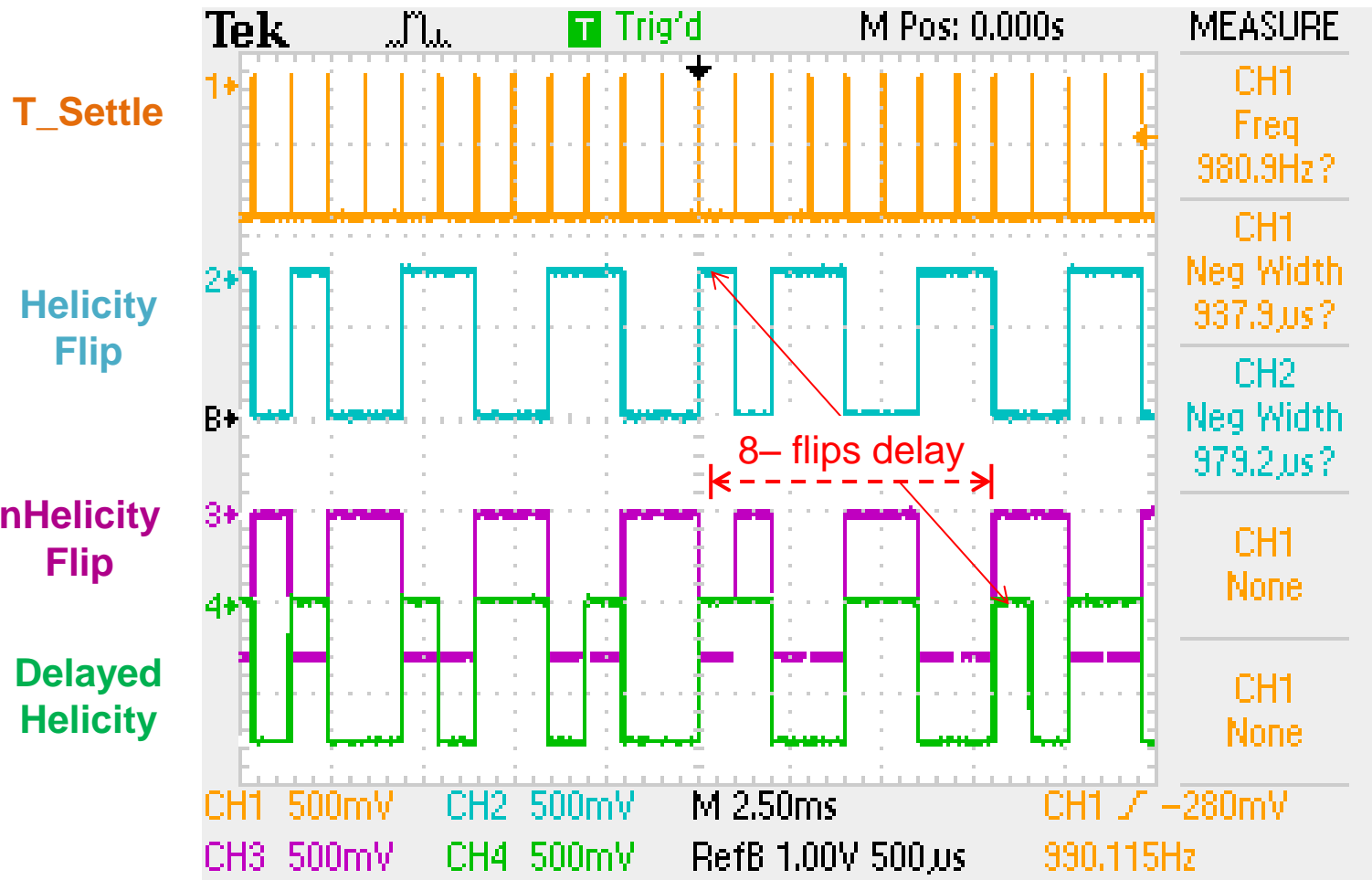
# Parity Experiments and JLab Injector

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Experiment	Energy (GeV)	Pol (%)	I ( $\mu\text{A}$ )	Target	$A_{\text{pv}}$ (ppb)	Charge Asym (ppb)	Position Diff (nm)	Angle Diff (nrad)	Size Diff ( $\delta\sigma/\sigma$ )
<b>HAPPEX-I (Achieved)</b>	3.3	38.8 68.8	100 40	$^1\text{H}$ (15 cm)	15,050	200	12	3	
<b>G0-Forward (Achieved)</b>	3.0	73.7	40	$^1\text{H}$ (20 cm)	3,000- 40,000	$300\pm 300$	$7\pm 4$	$3\pm 1$	
<b>HAPPEX-II (Achieved)</b>	3.0	87.1	55	$^1\text{H}$ (20 cm)	1,580	400	2	0.2	
<b>HAPPEX-III (Achieved)</b>	3.484	89.4	100	$^1\text{H}$ (25 cm)	23,800	$200\pm 10$	3	$0.5\pm 0.1$	$10^{-3}$
<b>PREx-I (Achieved)</b>	1.056	89.2	70	$^{208}\text{Pb}$ (0.5 mm)	$657\pm 60$	$85\pm 1$	4	1	$10^{-4}$
<b>QWeak-I (Achieved)</b>	1.155	89.0	180	$^1\text{H}$ (35 cm)	$281\pm 46$	$8\pm 15$	$5\pm 1$	$0.1\pm 0.02$	$10^{-4}$
<b>QWeak</b>	1.162	90	180	$^1\text{H}$ (35 cm)	$234\pm 5$	$<100\pm 10$	$<2\pm 1$	$<30\pm 3$	$<10^{-4}$
<b>PREx-II</b>	1.0	90	70	$^{208}\text{Pb}$ (0.5mm)	$500\pm 15$	$<100\pm 10$	$<1\pm 1$	$<0.3\pm 0.1$	$<10^{-4}$
<b>MOLLER</b>	11.0	90	85	$^1\text{H}$ (150 cm)	$35.6\pm 0.74$	$<10\pm 10$	$<0.5\pm 0.5$	$<0.05\pm 0.05$	$<10^{-4}$



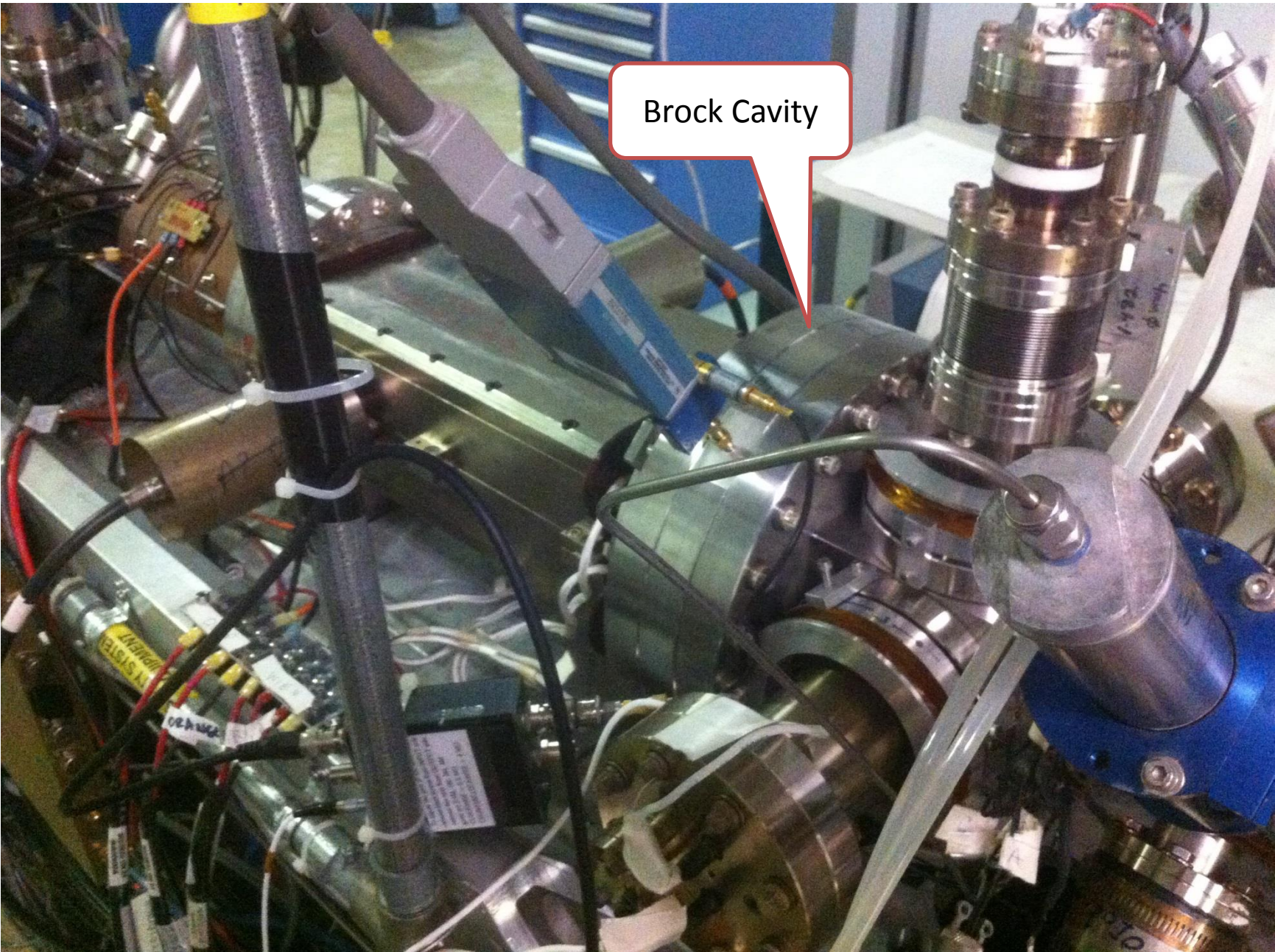


- How to carry out a parity violation experiment:
  - Scatter longitudinally polarized electrons off un-polarized target (i.e., Hydrogen, Deuterium, Helium, Lead)
  - Reverse the beam helicity ( $\pm$ ) with Pockels Cell, measure detected signals ( $S^\pm$ ) and currents ( $I^\pm$ ), calculate physics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

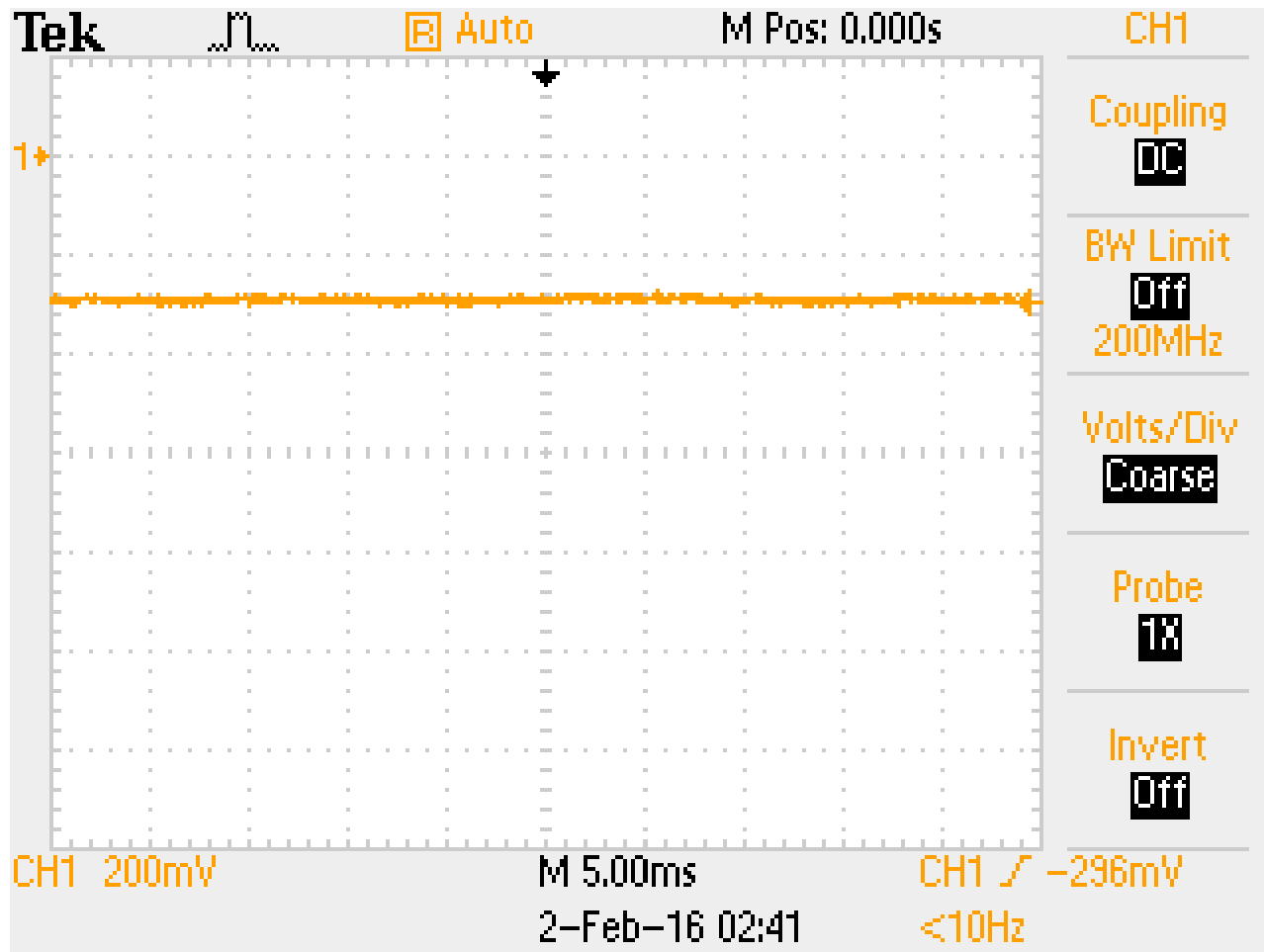
$$A_{\text{physics}} = \frac{\frac{S^+}{I^+} - \frac{S^-}{I^-}}{\frac{S^+}{I^-} + \frac{S^-}{I^+}} \approx \frac{\textit{Weak}}{\textit{EM}}$$

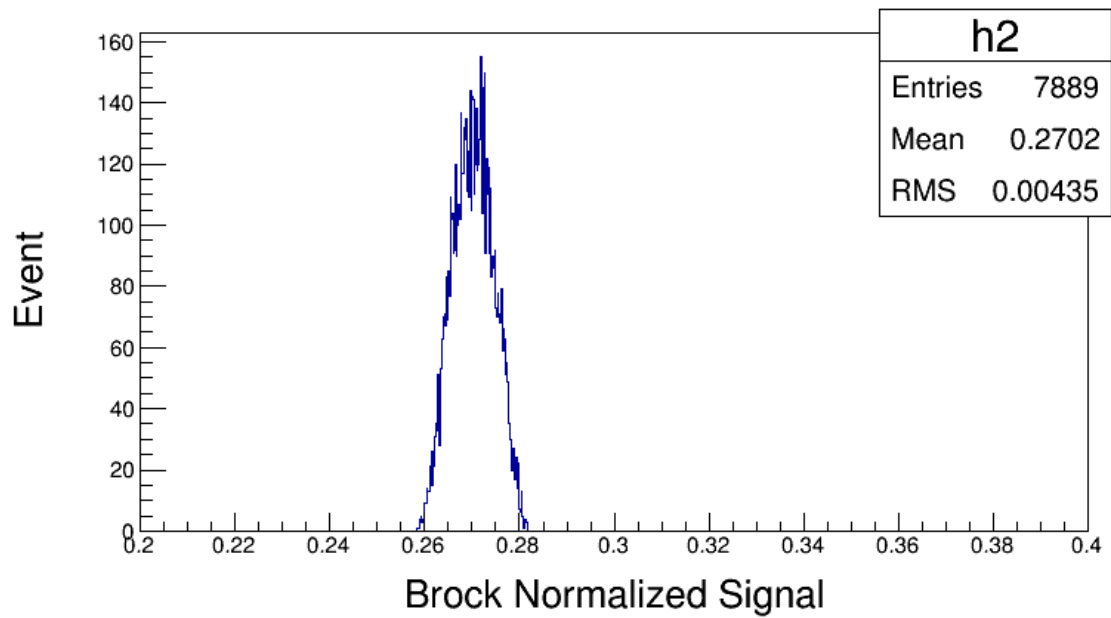
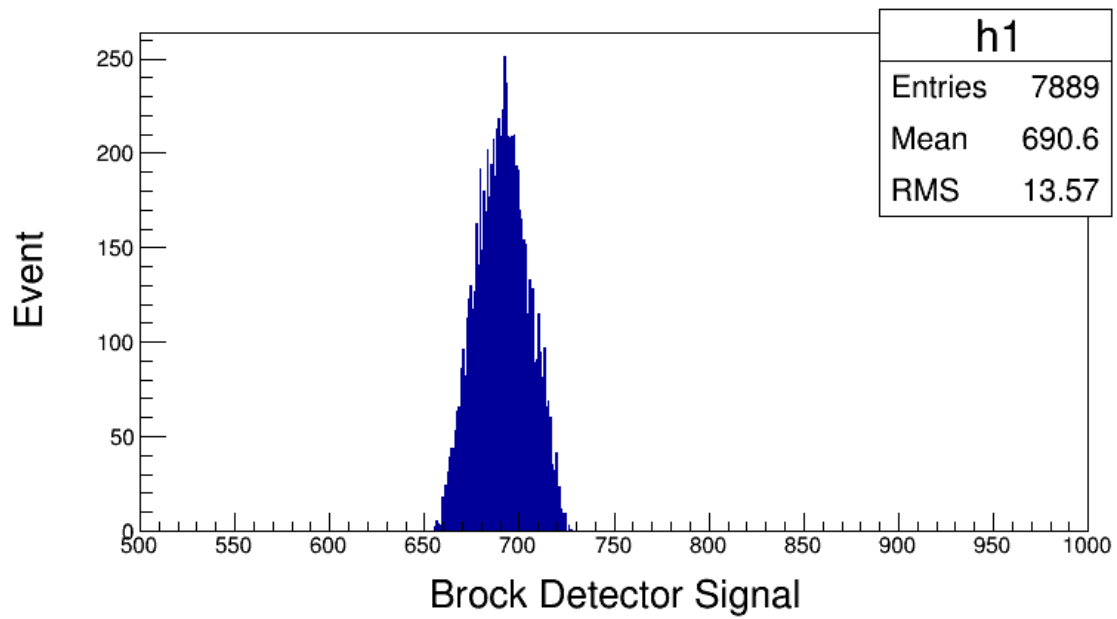
} 1/15<sup>th</sup> of a second

- 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)

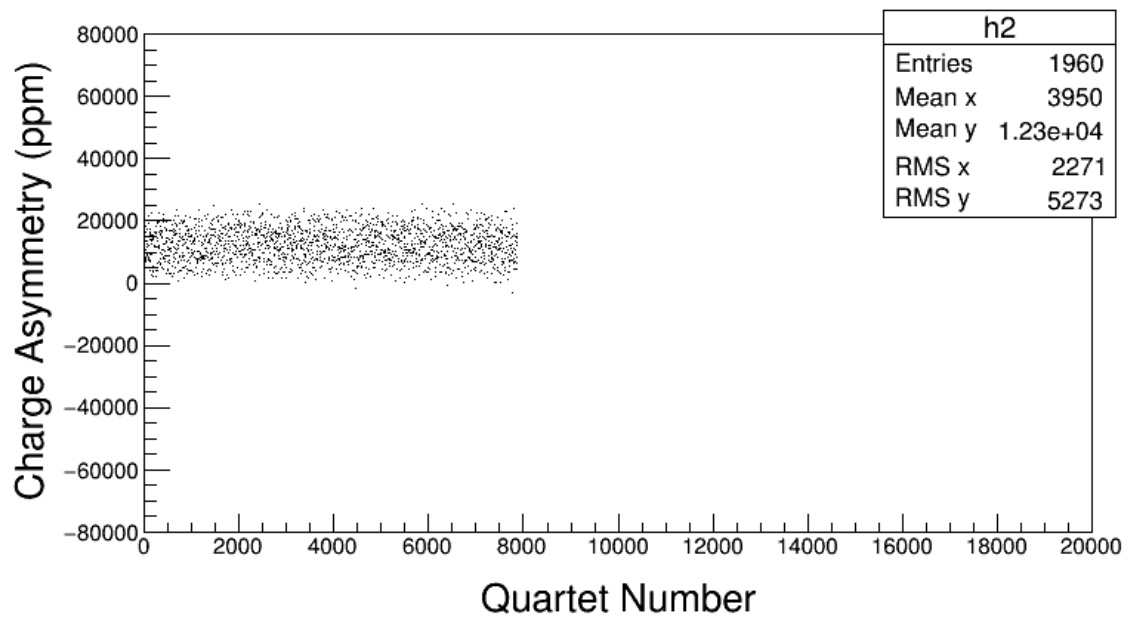
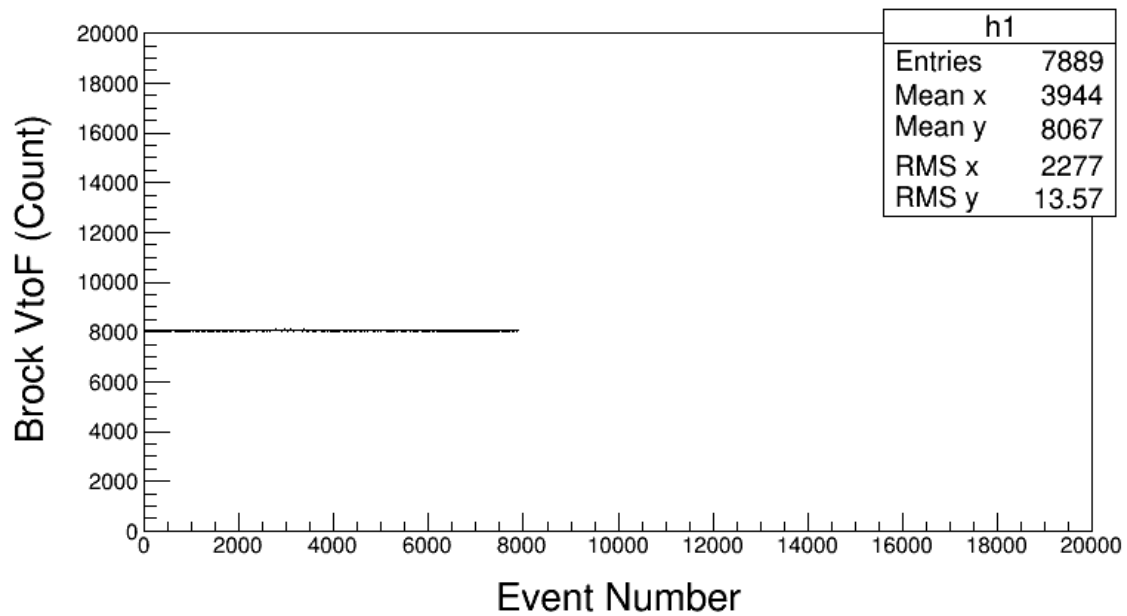


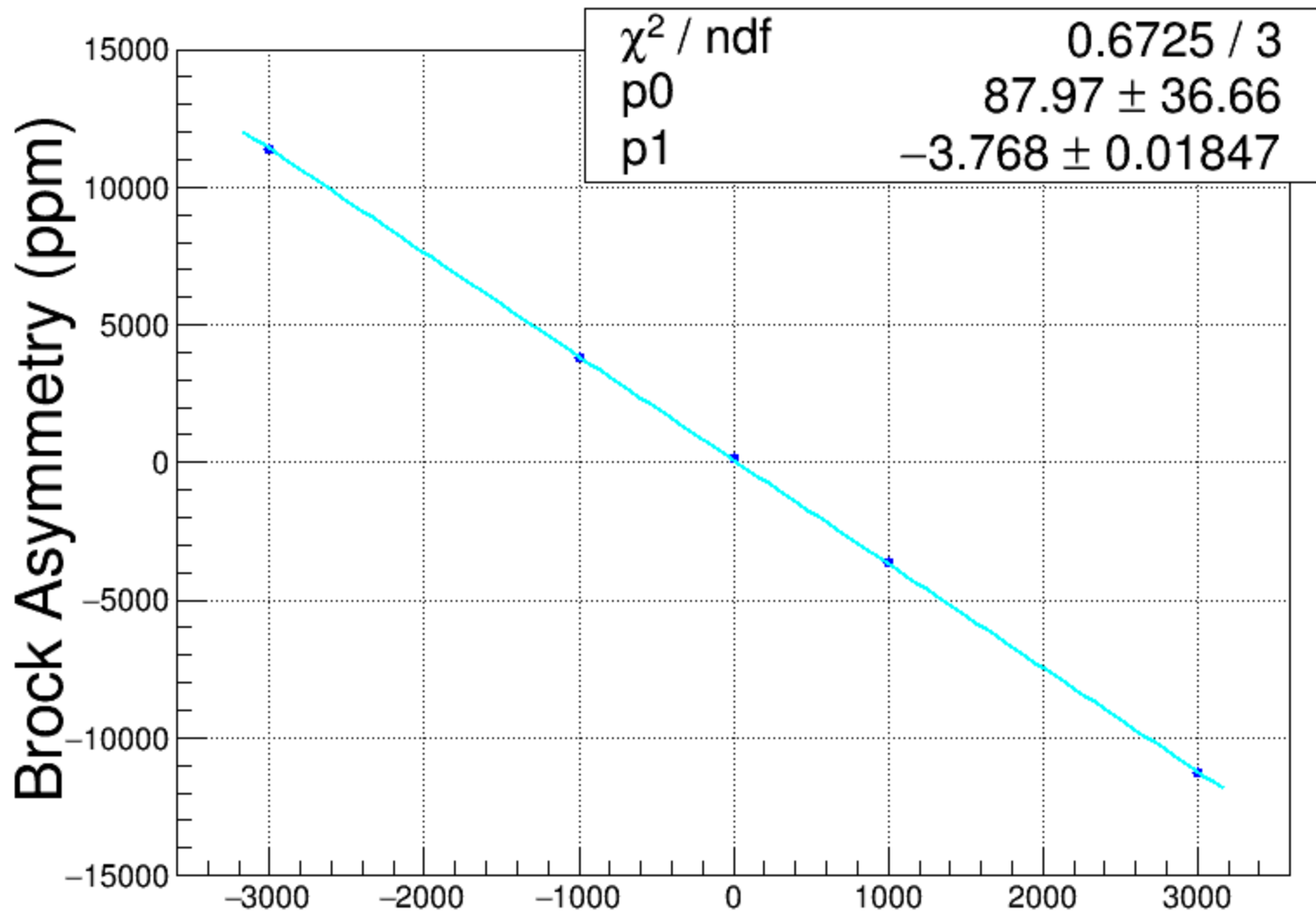
Brock Cavity











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?**