SLACPOLSOURCE TN99-07
December 2, 1999

Review of Polarized Source Requirements and Performance Expected for E158

Ray Alley and , Greg Mulhollan

The meeting was called to go over the E158 experiment requirements and make an agreement between the experimentalist and source groups that these were acceptable. Present were: Ray Alley, Jym Clendenin, Emlyn Hughes, Krishna Kumar, Greg Mulhollan, John Seemen, and Mike Woods. Ray and Greg presented a few transparencies, which will follow, that covered the key values of the experimental and source requirements. Everyone agreed that these were feasible requirements that seemed attainable. Another note brought up was that both the experimentalist and source group would be working together to make sure that these requirements are met or exceeded.

SLACPOLSOURCE TN99-07
December 2, 1999

E158 Experiment Overview

E158 is an experiment for precision measurement of the weak mixing angle in Møller scattering. Initial monies were made available in 1998 to determine the feasibility of this experiment. $200k was needed to prepare the Flash:Ti laser at CYRO for the E158 milestone tests. These test requirements were watered down versions of the final requirements to test feasibility in a short test run time. These milestones essentially passed and the project was approved. Recently a new AIP was approved to bring the source Flash:Ti laser system at CID to experimental readiness.

Gun Test Lab
Milestone Requirements

Item	Requirement
Beam Charge	$\succ 8 \cdot 10^{11}$ in 370ns pulse
Intensity Jitter	$\prec 2\%$
Position Jitter	$\prec 500 \mu m$
Spotsize Jitter	$\prec 5\%$ of spotsize
*Charge Asymmetry	$\prec 10^{-6}$
Position Asymmetry	$\prec 100 nm$
Laser Spotsize Asymmetry	$\prec 100 nm$

Notes:
1. asymmetries are cumulative averages over 24 hours
2. need to demonstrate '1/N' scaling
3. need independent measurements of charge and position asymmetries

*(experimental goal is 0.2ppm on size of charge asymmetry and 1ppb accuracy on charge asymmetry correction!)

CRYO Milestone

After various upgrades to the CRYO Flash:Ti laser system it was ready for the milestone test. These tests had special circumstances since a real test at that time would have been unrealistic. It was basically a 1 week test run and was successful at that level.

E158 Source Requirements (modified)

Gun requirements (at first BPM after cathode)

ITEM	MINIMAL REQUIREMENT	DESIRED PERFORMANCE
Beam charge	8E11 in 370ns pulse	
Polarization	75%	90%
Intensity Jitter	< 2% rms	< 1% rms
Position Jitter	< 500 microns rms	< 100 microns rms
Charge Asymmetry	<1.e-4 (no feedback)	
	< 1.e-6 (with feedback)	
Position Asymmetry	< 1 micron (no feedback)	< 100nm (no fdbk)
	< 100 nm (with feedback)	

Additional laser requirements:

Spotsize jitter	< 5% of spotsize	
Spotsize asymmetry	< 1.e-4 of spotsize	< 1.e-5 of spotsize

CID (Source Laser) Efforts

To be ready for a fully fledged E158 endstation run many upgrades to the source laser need to be performed. Starting with polarization diagnostics and control, which includes the following:

- New asymmetry control of intensity and position
- Better diagnostics for seeing laser asymmetry
- New PMON for both acquiring and controlling asymmetries

Besides polarization many optical upgrades are needed:

- The entire OTS needs modification for maximum transmission
    - Which includes the laser, main, wall, and gun benches
    - A new wall bench will be need for an optical inverter

We will need help from controls in the area of software and development of control systems.

Finally to make sure that this program achieves it's goals both the experimentalists and the source group will work together to meet and or exceed all requirements for a successful run.

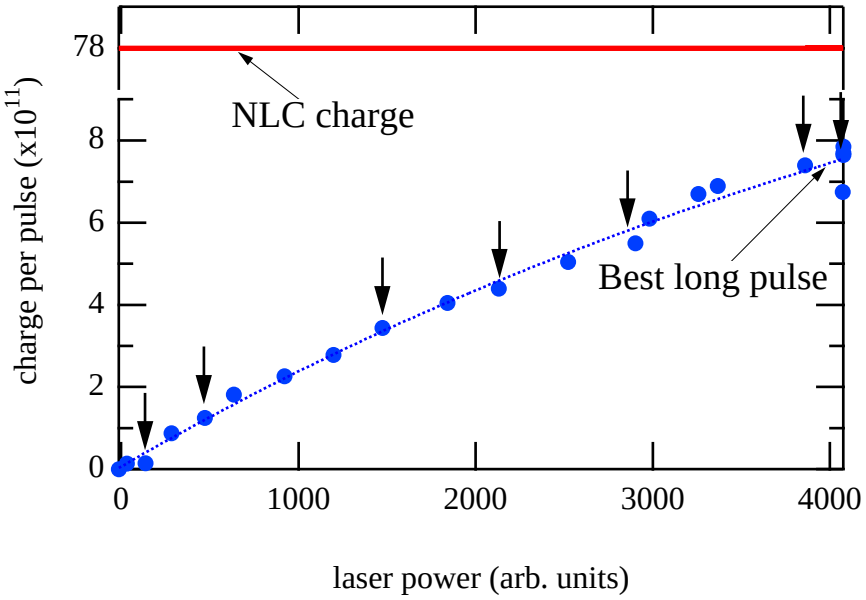
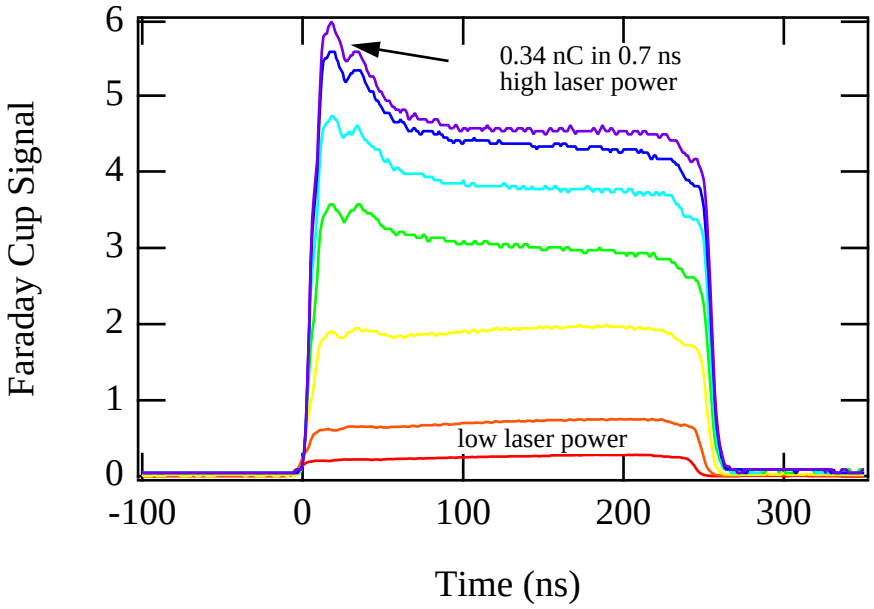
E158 Requirements on Photocathode and Gun

Minimum Operating Parameters

Beam voltage	121 kV
Polarization	75 %
Charge at gun	8×10^{11} e- in 370 ns pulse

GTL Benchmarks

Beam voltage	121 kV
Polarization	75 %
Best charge in 250 ns	7.5×10^{11} e-
Best charge in 370 ns (scaled)	11×10^{11} e-
QE at high field (80 kV) and polarization peak	~ 0.15 %
Laser energy if no charge limit for 8×10^{11} e-	125 microJ
Attenuation factor due to charge limit	7/9
Laser energy with charge limit for 8×10^{11} e-	161 microJ
Transmission to FARC (2 cm diameter cathode)	78 %
Cesiation period	4 days
Cathode type	single strained layer

Charge output of $5x10^{18}/cm^3$ doped 100 nm strained GaAs

FARC signals correspond to marked points