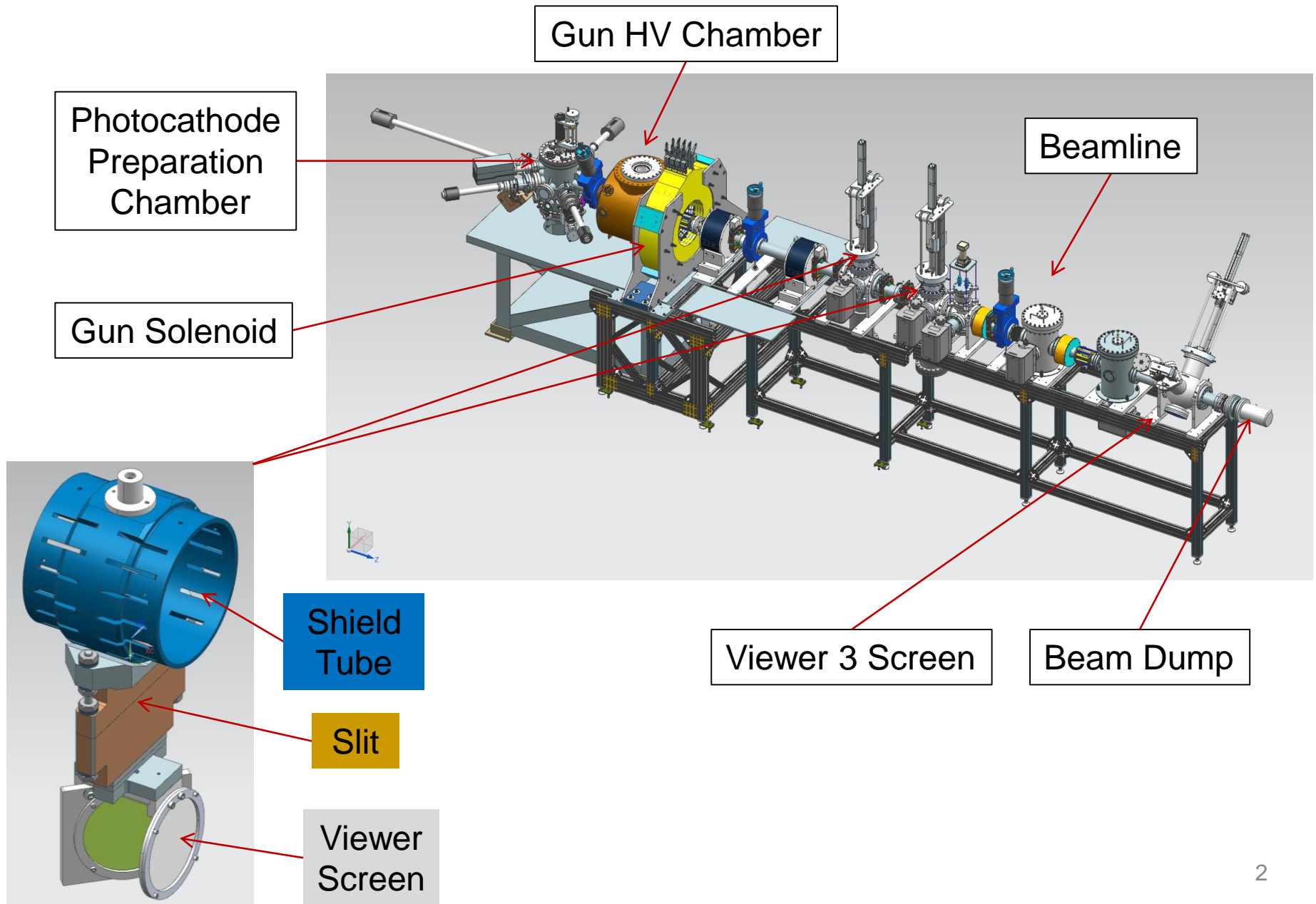


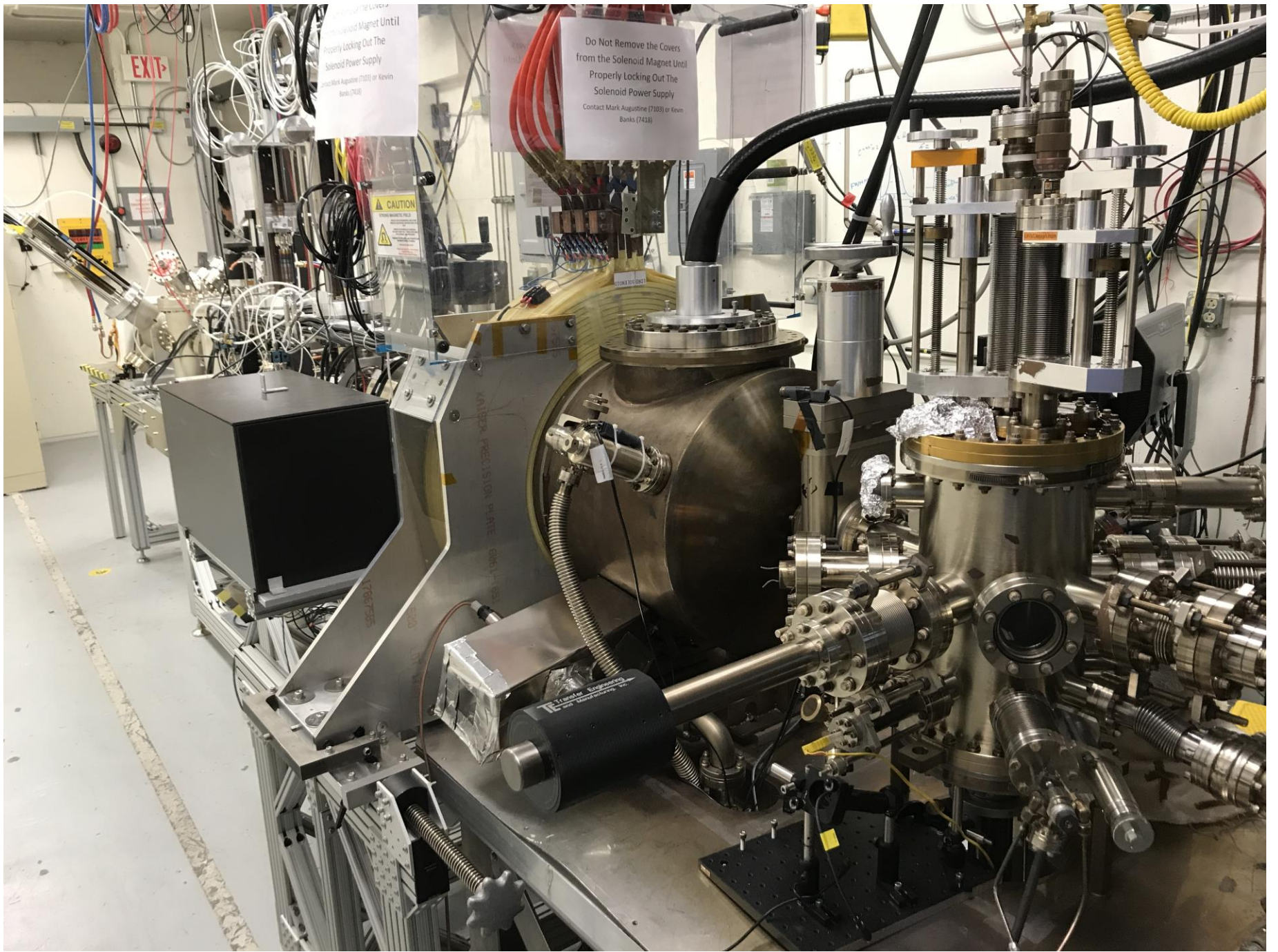
**Cooler e-source**

**Magnetized Beam LDRD Progress  
Report**

June 1, 2017

# Magnetized Electron Source at GTS





Do Not Remove the Covers from the Solenoid Magnet Until Properly Locking Out The Solenoid Power Supply  
Contact Mark Augustine (7103) or Kevin Banks (7418)

Do Not Remove the Covers from the Solenoid Magnet Until Properly Locking Out The Solenoid Power Supply  
Contact Mark Augustine (7103) or Kevin Banks (7418)

CAUTION  
STRONG MAGNETIC FIELD

EXIT

1/2" Linear Engineering  
10000 Main Street  
Cincinnati, OH 45241

ALBERT PRECISION STATE COMPANY

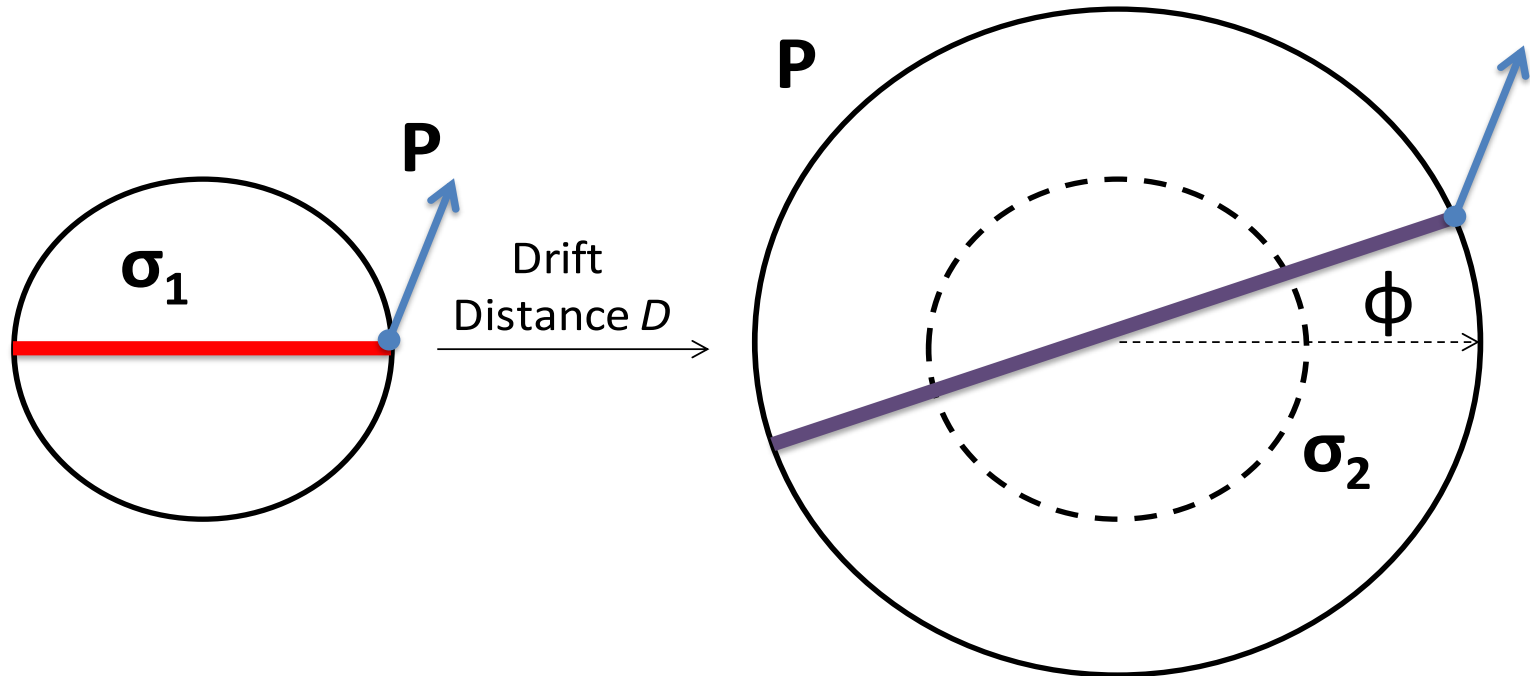
710303

710303



# Measuring Beam Magnetization

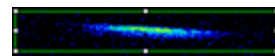
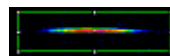
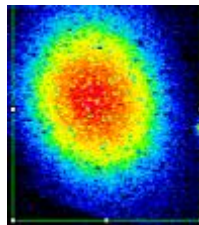
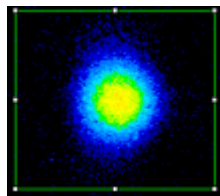
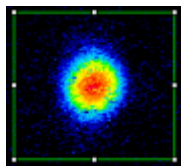
- Use slit and viewscreens to measure mechanical angular momentum:



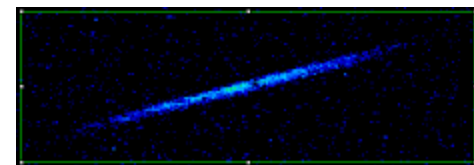
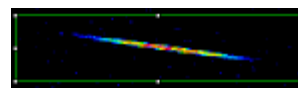
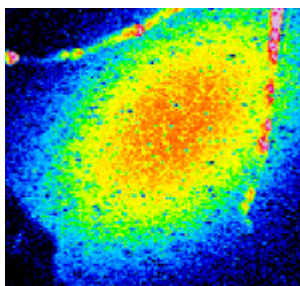
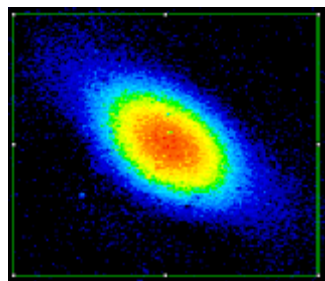
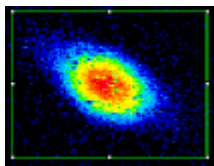
$$\langle L \rangle = 2p_z \frac{\sigma_1 \sigma_2 \sin \phi}{D} = eB_z a_0^2$$

$B_z$ : solenoid field at photocathode  
 $a_0$ : laser rms size  
 $\Phi$ : rotation (sheering) angle

0 G  
at photocathode



1088 G  
at photocathode



# Magnetized Beam Sizes

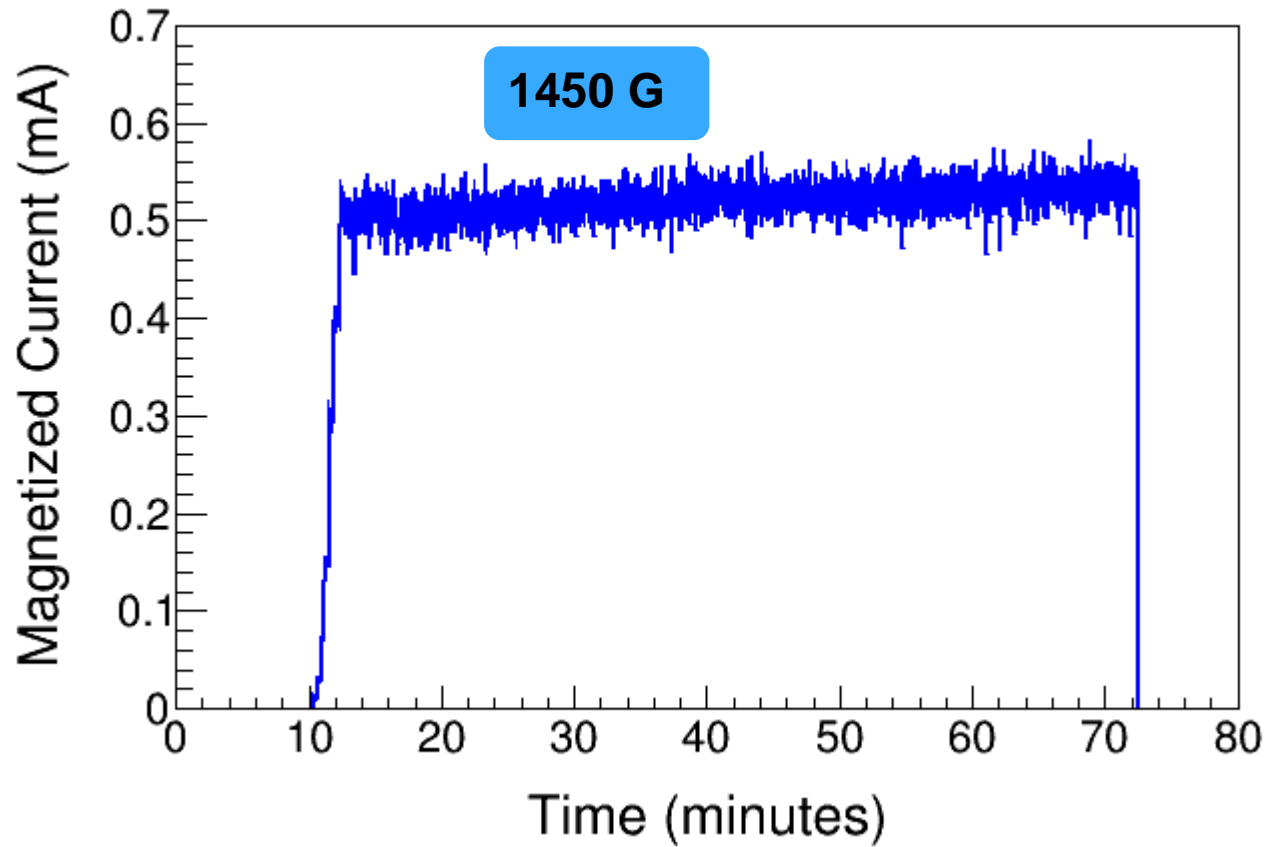
Solenoid Current (A)	Field (G)	$\sigma_1$ (mm)	$\sigma_2$ (mm)	$\sigma_3$ (mm)
0	0	1.66	2.18	4.84
25	91	0.35	0.44	0.71
50	181	1.39	2.10	4.09
75	272	1.82	0.67	1.46
100	363	4.36	1.43	2.40
150	544	0.35	0.49	1.02
200	725	0.46	0.95	4.22
250	907	1.08	2.02	6.54
300	1088	1.88	3.28	7.11

All beamline solenoids are off

# Magnetized Beam Rotation Angles

Solenoid Current (A)	Field (G)	$\phi_2$ (deg)	$\phi_3$ (deg)	$\phi_2 - \phi_3$ (deg)
0	0	0	0	0
25	91	3.6	18.9	15.3
50	181	-1.7	-5.7	-4.0
75	272	5.8	11.7	5.9
100	363	-3.6	-7.5	-3.9
150	544	-78.1	-54.1	24.0
200	725	5.7	8.8	3.1
250	907	-4.1	-8.5	-4.4
300	1088	-7.6	-18.8	-11.2

# High Current Magnetized Beam



- Delivered 0.5 mA
- Plan for 5 mA by end of summer



# Summary of Progress

- Submitted LDRD proposal for 3<sup>rd</sup> year funding
- Delivered 0.5 mA magnetized beam with 1450 G on photocathode
- Measured beam sizes and rotations with magnetic fields up to 1088 G on photocathode
- Filed patent disclosure entitled “Non-invasive RF Cavity to Measure Beam Magnetization”

# Outlook: June – September

- Measure beam sizes and rotations with magnetic fields up to 1450 G on photocathode
- Simulation of magnetized beam sizes and rotation angles
- Run 5 mA magnetized beam
- Build and install a  $TE_{011}$  cavity at GTS to measure beam magnetization in collaboration with Brock and SRF Institute