

Polarized ^3He Target Performance and Planning

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- Gradients and Compensation
- Water Calibration Status
- Target Tests and Performance
- Second Running Period Plans

Gradients and Compensation

Field Mapping

- Expected large gradients from $\frac{dB_z}{dy}$ and $\frac{dB_y}{dz}$
- Field mapped all nine components and found that $\frac{dB_z}{dz} > 100$ mG/cm ($I_{Septum} = 300$ A)
- $\frac{dB_x}{dx}$ and $\frac{dB_y}{dy} > 40$ mG/cm ($I_{Septum} \geq 300$ A)
- Vertical coils already designed and installed (Alexandre, Karl)
- Longitudinal coil made with 100 turns (Alexandre, Karl)
- Transverse coil had 30 turns added (Alexandre, Karl)

Notes on Gradient Plots

- For $\frac{dB_z}{dz}$, 0 is closest to the Septum
- For $\frac{dB_y}{dy}$, 0 is highest in the scattering chamber
- For $\frac{dB_x}{dx}$, 0 is closest to the Right Spectrometer
- The center of the target in beamline is X = 26 cm, Y = 6 cm, Z = 26 cm

Figure 1: Main Gradients at 76 A on Septum

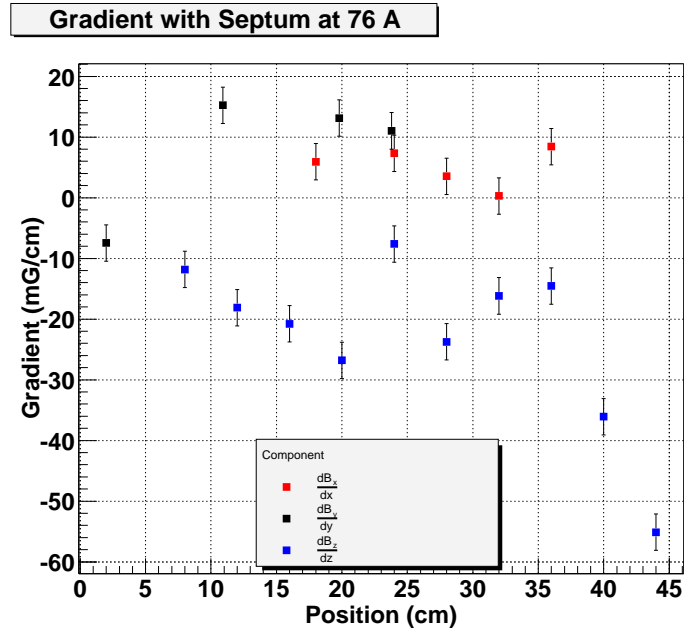


Figure 2: Main Gradients at 150 A on Septum

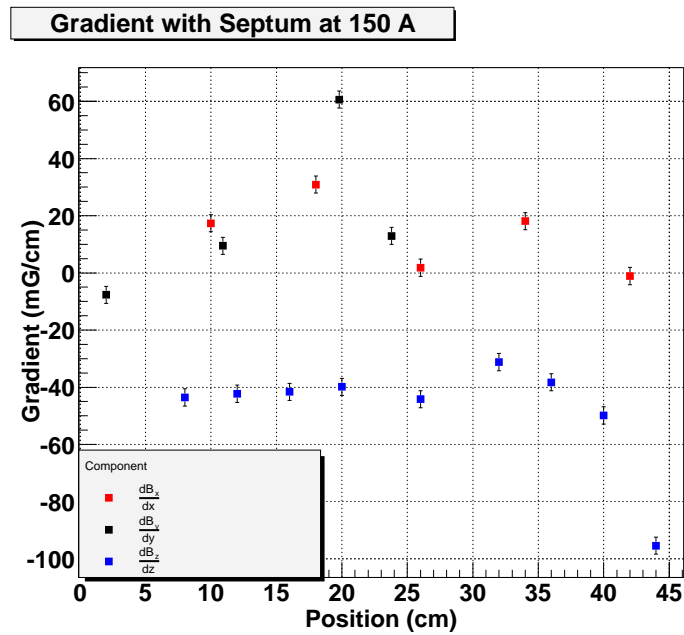


Figure 3: Main Gradients at 225 A on Septum

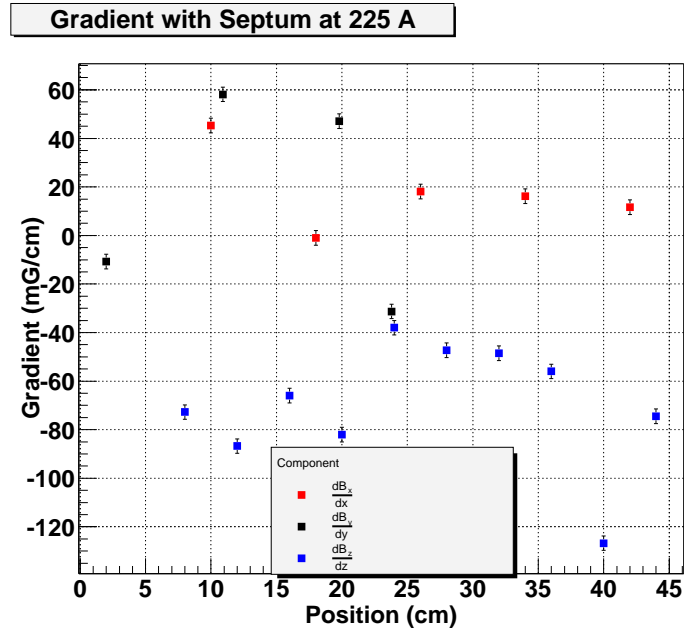


Figure 4: Main Gradients at 300 A on Septum

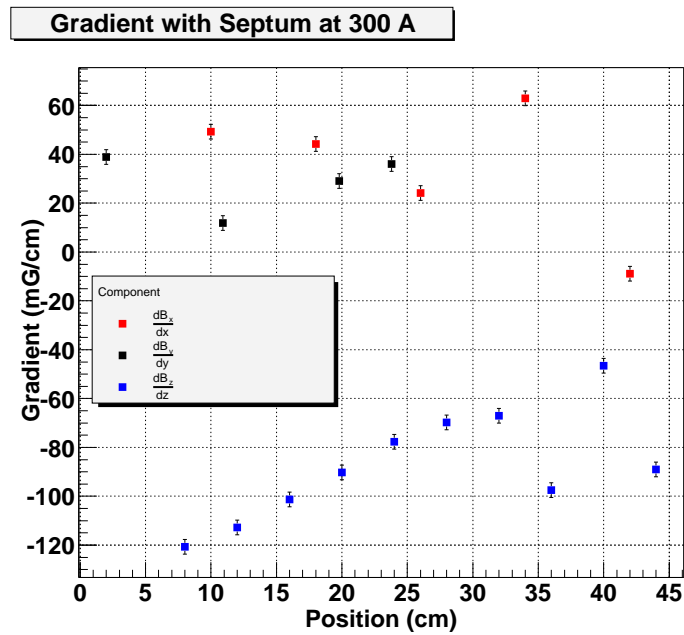


Figure 5: Main Gradients at 341 A on Septum

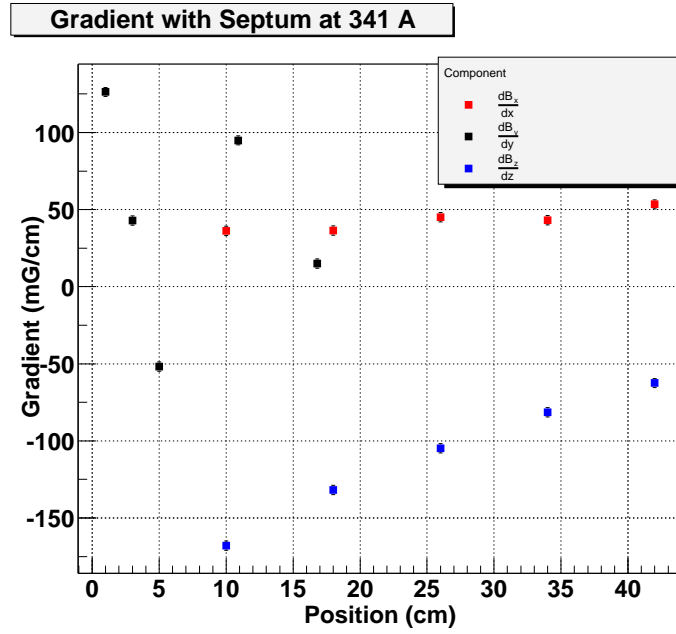


Figure 6: Gradients at 150 A on Septum plus compensation

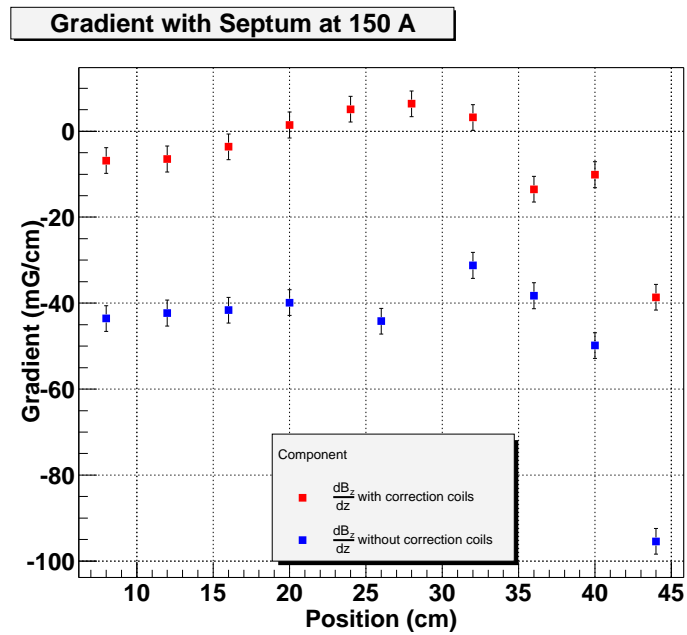
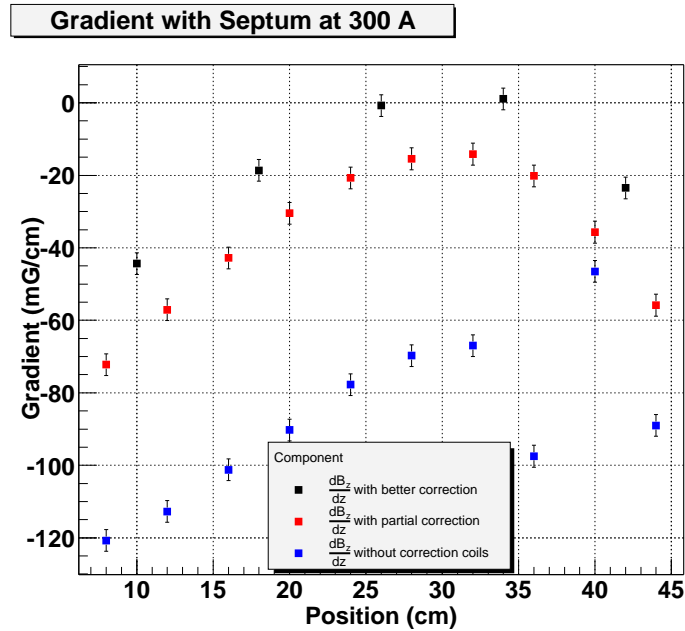


Figure 7: Gradients at 300 A on Septum plus compensation



Water Calibration Status

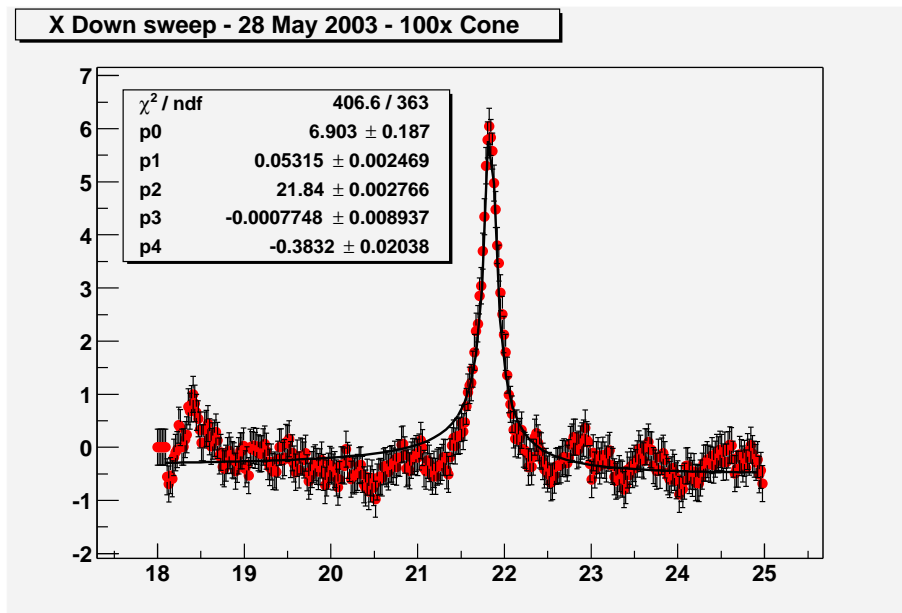
Pre-experiment

- Improved water signal over a few weekends
- Noticed more vibration with new pivot
- RF easily affected by vertical correction coils
- RF background was better than during Duality (200x gain)
- Good water signal

Post-experiment

- Had to move vertical coils to reduce RF background
- Good water signal at 100x gain, ~ 800 sweeps
- Second water signal at 200x gain worse

Figure 8: Post-experiment water signal



Target Tests and Performance during SAGDH

Target Tests:

- AFP and rotation loss tests at various Septum Currents
- NMR-EPR Calibrations with Septum on and off
- Temperature Tests with 3 and 4 lasers

AFP Loss Results

Septum Current (A)	AFP Loss/sweep (mV)	Relative Loss (%)
0.0	0.009	0.13
50.75	0.042	0.57
100.5	0.088	1.22
150.25	0.109	1.59
202.0	0.073	1.09
250.0	0.052	0.85
300.0	0.076	1.33
300.0	0.050	0.74
350.0	0.075	0.91

Notes: The second result at 300 A had better compensation than the first. The spin relaxation equation is given below during AFP sweeps.

$$1/T = 0.28 * |\nabla B_z|^2 / (B_{rf})^2$$
$$|\nabla B_z|^2 = (dB_z/dx)^2 + (dB_z/dy)^2 + (dB_z/dz)^2$$

Target Performance:

- Proteus reached $\sim 45\%$ polarization
- Below 250 A on Septum with a few μA beam, $P \sim 40\%$
- At 2.2 GeV $P \sim 30\%$ (Septum > 300 A)
- At 3.3 GeV $P \sim 33\%$ (Septum > 300 A)
- EPR $\sim 1\text{-}2\%$ absolute loss each measurement
- Vertical gradients were not compensated
- Longitudinal coil limited range (8.2 A)

Plans

Second Period Plans:

- Polarized ^3He Target will remain on the Pivot
- Target tests on Pivot (?)
- Field map of Helmholtz coils, correction coils, and Septum
- Standard 40cm Water Calibrations

Equipment:

- Checkout of target lifting motor
- Repair key switch for Coherent # 2
- Improve EPR coupler mounting
- Modify upstream collimator base