12 GeV Circular Raster

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Theory

- Need a uniform circular raster a breathing disk for A1n experiment; ³He target is a circle
- Uniformity: $\frac{dA}{dt} = C = \frac{d}{dt}(\pi r^2) = 2\pi r \frac{dr}{dt} \implies r \propto \sqrt{t}$
- Circular: $x = f(t) \sin(\omega_C t + \pi/2), y = f(t) \sin(\omega_C t)$
- $\omega_{\rm C}$ is the "carry" frequency, $\omega_{\rm R}$ is the "refresh" frequency:

$$r = \sqrt{x^2 + y^2} = f(t) \propto \sqrt{t} \implies \begin{array}{l} x = \alpha(t)\sin(\omega_C t + \pi/2) \\ y = \alpha(t)\sin(\omega_C t) \end{array}, \ \alpha(t) = \begin{cases} C_N\sqrt{t}, & t \le T_R/2 \\ C_N\sqrt{T_R - t}, & t > T_R/2 \end{cases}, \ T_R = \frac{2\pi}{\omega_R}$$

Plots



Plots



Plots





Note: $f_{\text{Resonance}} = 7.72$ kHz but in reality, is closer to 8.5 kHz. We purposely run below resonance.

Setup in EEL 126



Trickery Around Resonance



Results of X-Y Raster Test

- 84.71% Uniformity
- % Nonuniformity = $\frac{\sum_i |h_i \text{avg}|}{\text{hits} \times \text{avg}}$
- Conversion from current to voltage:
 - V = (2.5 mV/A)i
- Conversion from histogram bin to voltage:

• V = -0.2484b + 138.491

- X: 350-760
 - $\circ \quad \rightarrow \text{-50.30 mV} \text{-} \text{51.55 mV}$
 - $\circ \rightarrow$ -20.12 A 20.62 A
 - $\circ \rightarrow$ 40.74 A (peak-peak)
- Y: 320-740
 - $\circ \rightarrow$ -45.33 mV 59.00 mV
 - $\circ \rightarrow$ -18.13 A 23.60 A
 - $\circ \rightarrow$ 41.73 A (peak-peak)



X-Y Raster Lego Plot



Results of X-X Raster Test

- Conversion from current to voltage:
 - V = (2.5 mV/A)i
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To-Do

- Determine and fix the source of the central diamond artifact
 - Current hypothesis: at low amplitudes, the function generator frequency has dependence on the amplitude; this leads to rapid movement on the RLC impedance and phase response curves.
- Stand up and test full setup with 2 function generators, 4 resonator boxes, 4 Bogens, and 4 raster magnets (2 X, 2 Y)
- Run tests with full setup on the beamline
 - Could be phase/resistance complications from long wiring required on beamline