Hall C Fast Raster

- Present Hall C fast raster is
  - 2 sets of X-Y coils to give a square pattern at the target.
  - The two frequencies are around 25 kHz with a triangular wave pattern.
  - A coil has 81 Gauss*cm per 1 Amp in the power supply.
  - The maximum raster size for 11 GeV/C beam with I_1/2 = 50 A is a full size of 6mm or +/- 3mm at the target.
  - I_1/2 = 50 A is the maximum that the supplies should run at. This is about 80% of the maximum current that the supplies can run.
- To modify the system to do a circular raster.
  - 2 sets of X-Y with sinusoidal frequencies at around 7.8kHz out of phase by $\pi/2$
  - The amplitudes modulated as a 49 Hz square root function of time.
  - Need to make changes to the EPICS software.
  - Need to modify the Beam Raster Monitor trip level detection circuit.

Theory

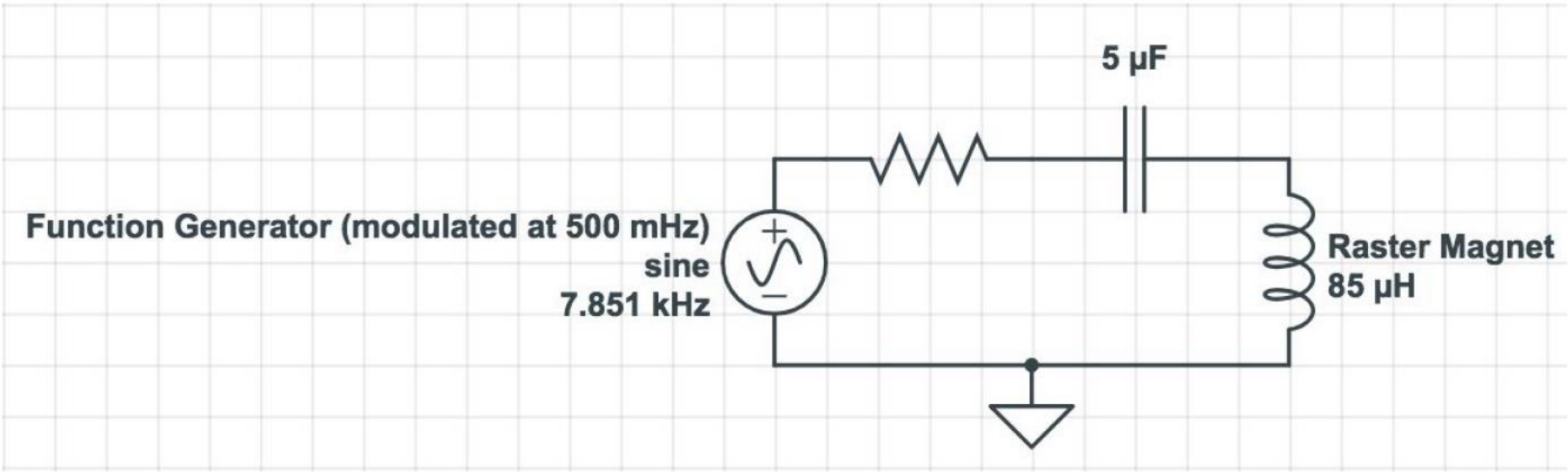
- Need a uniform circular raster - a breathing disk - for A1n experiment; ^{3}He target is a circle
- Uniformity: $\frac{dA}{dt} = C = \frac{d}{dt}(\pi r^2) = 2\pi r \frac{dr}{dt} \implies r \propto \sqrt{t}$
- Circular: $x = f(t)\sin(\omega_C t + \pi/2),\ y = f(t)\sin(\omega_C t)$
- ω_C is the "carry"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

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

Slides form talk by Michael Berkowitz, grad student, who perform the test in summer 2018.

Testing done in Summer 2018

Circuitry



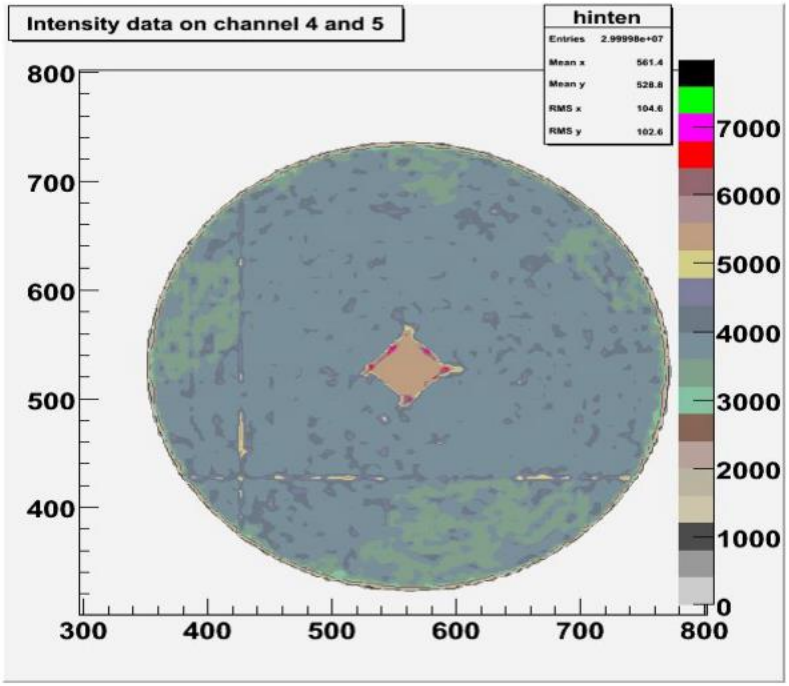
Note: $f_{Resonance}$ = 7.72 kHz but in reality, is closer to 8.5 kHz. We purposely run below resonance.

August 2018 Test Setup

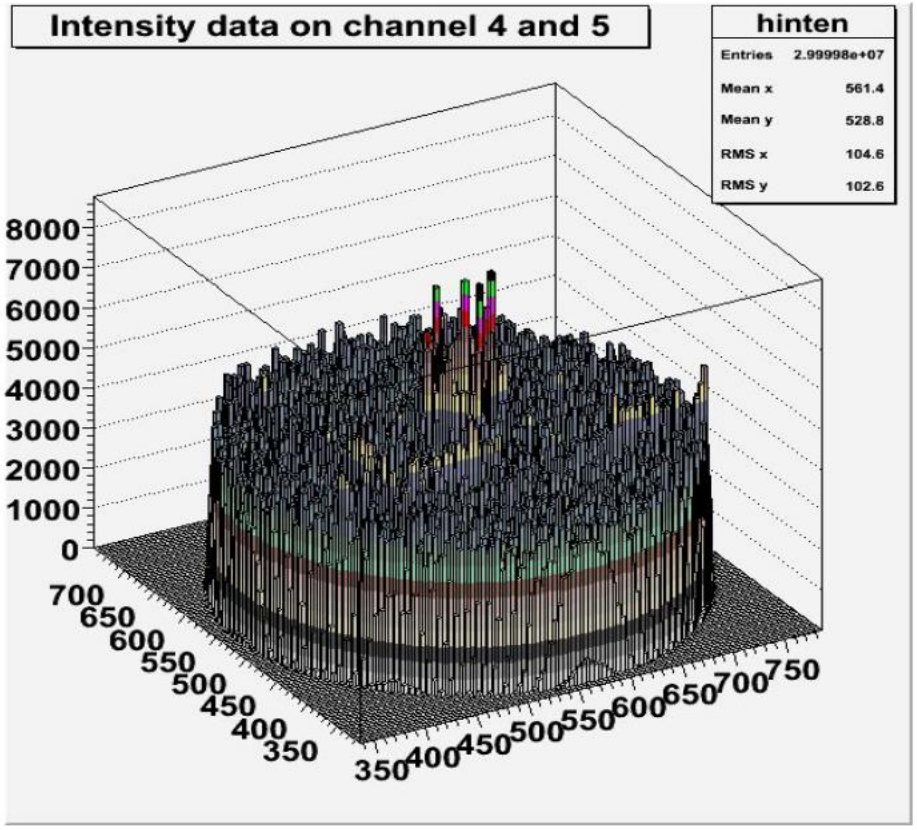
Setup in EEL 126

Results of X-Y Raster Test

- 84.71% Uniformity
- $\%\ \text{Nonuniformity} = \frac{\sum_i |h_i - \text{avg}|}{\text{hits} \times \text{avg}}$
- 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
  - → -50.30 mV - 51.55 mV
  - → -20.12 A - 20.62 A
  - → 40.74 A (peak-peak)
- Y: 320-740
  - → -45.33 mV - 59.00 mV
  - → -18.13 A - 23.60 A
  - → 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
- Conversion from histogram bin to voltage:
  - V = -0.2484b + 138.491
- X: 350-760
  - → -50.30 mV - 51.55 mV
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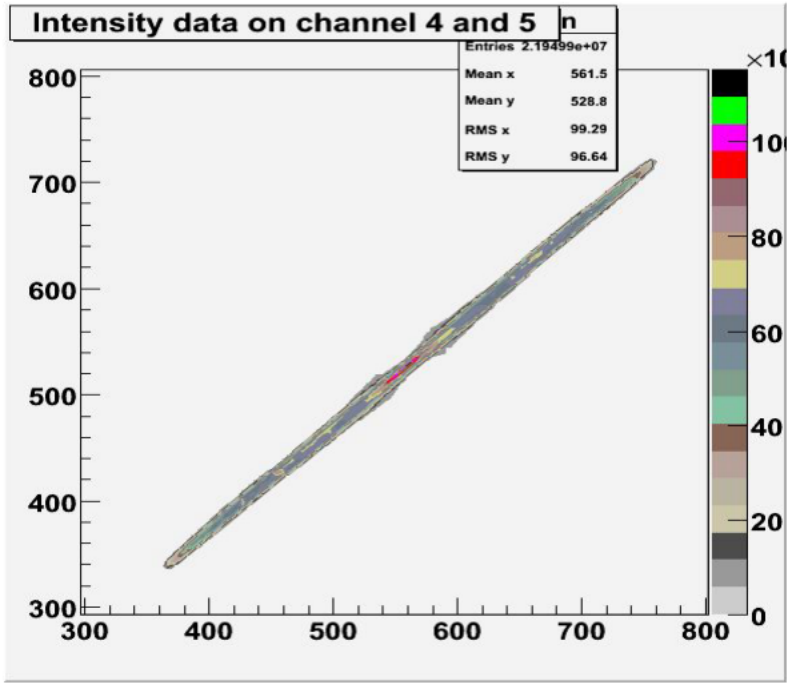

Status and plans

- Purchased 6 Bogens (4 for running and 2 spares).
- Purchased an Aligent Signal Generator.
- Bill Gunning is presently doing further tests of the Bogens.
- Starting in August will need to install Bogens in the Hall. Have to remove present supplies and put in the Bogens.
- Need to make changes to the EPICS software.
- Need to modify the Beam Raster Monitor trip level detection circuit.