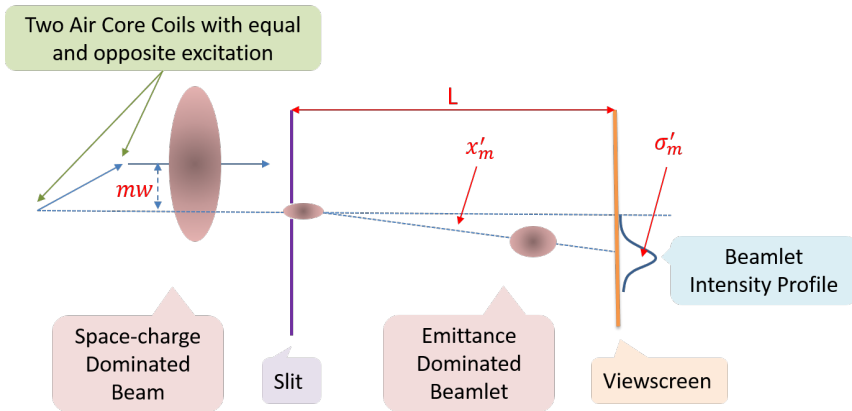


GTS Emittance Measurement with Single Slit and Viewscreen

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Single Slit and View Screen Setup



- Drift Length (L) = 500 mm
- Slit Width (d) = 0.040 mm
- Constant step size $w \approx 0.6$ mm
- Measurement steps $m = 1, \dots, N$: $N = 6$

Calculations

$$x'_{m,c} = \frac{\langle x_m - x_{m,c} \rangle}{L} = \frac{\langle x_m - mw \rangle}{L}$$

$$\sigma'_m = \sqrt{\frac{\langle x_m^2 \rangle}{L^2} - (x'_{m,c})^2} = \frac{\sigma_m}{L}$$

$$\langle x^2 \rangle = \frac{\sum_{m=1}^N I_m x_{m,c}^2}{\sum_{m=1}^N I_m}$$

$$\langle x'^2 \rangle = \frac{\sum_{m=1}^N I_m (x'^2_{m,c} + \sigma_m'^2)}{\sum_{m=1}^N I_m}$$

$$\langle xx' \rangle = \frac{\sum_{m=1}^N I_m x_{m,c} x'_{m,c}}{I_m}$$

$$\varepsilon_x \equiv \sqrt{\langle x^2 \rangle \langle x'^2 \rangle - \langle xx' \rangle^2}$$

x_c = Vertical position of the centroid of the slit image on V_2 of the center beamlet

x_m = Vertical position of the centroid of the slit image on V_2 of the m^{th} beamlet

$x_{m,c}$ = Both x_m and x_c

$x'_{m,c}$ = Correlated beam divergence

σ'_m = RMS spread in divergence

I_m = Peak intensity of the m^{th} beamlet

$\langle x^2 \rangle, \langle x'^2 \rangle, \langle xx' \rangle$ = Second moments of the trace space distribution (assuming beamlet distributions are symmetric about their centroids)

ε_x = RMS emittance

Results

MCRGT02V (G-cm)	Centroid (pixels)	σ_m (pixels)	Peak Intensity	x_m (pixels)	x'_m	σ'_m
-5	14.8146	0.961	8.4134	-4.8857	-0.001032133	0.0001922
0	11.8648	0.7986	14.4176	-1.9359	-0.000442173	0.00015972
5	9.9289	0.8548	18.5942	0	-5.49933E - 05	0.00017096
10	8.4728	0.9777	14.8711	1.4561	0.000236227	0.00019554
15	6.8365	0.7519	13.7286	3.0924	0.000563487	0.00015038
20	6.006	0.8615	9.454	3.9229	0.000729587	0.0001723

Table: Raw Data

$\langle x^2 \rangle$ (pixels)	7.085732145
$\langle x'^2 \rangle$ (pixels)	3.07515E-07
$\langle xx' \rangle$ (pixels)	0.001394881
Emittance (pixels)	0.000482986
Emittance (mm)	4.82986E-05
Normalized Emittance (mm)	5.94073E-05
Thermal Angle (mrad)	0.560446249

Table: Calculation of Emittance and Thermal Angle