August Update to Frequency Map Analysis

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Progress:

➢ Matched Bmad's frequency map analysis with Demin's
  ➢ Some noticeable differences between analysis methods

➢ Investigating whether FMA can be used as a tool to find more stable operable tunes
  ➢ Increase the particle lifetime from current (>3 damping times or 20,000 turns) to top-up time (20 seconds or 2,000,000 turns)

➢ Getting documentation ready for travel to Japan

➢ Practicing and learning how to use SAD
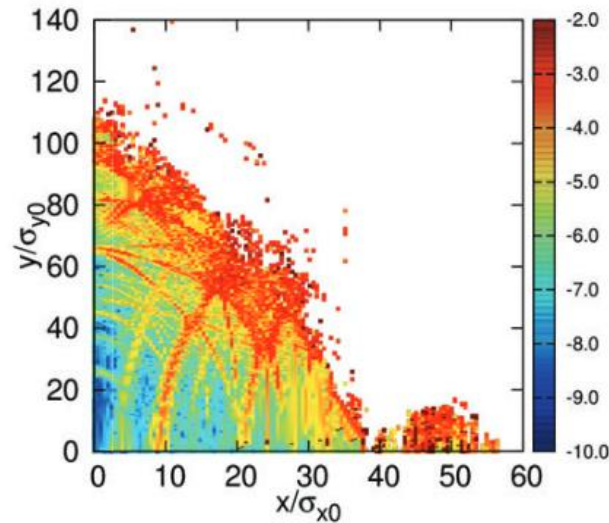
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Frequency Map Analysis: LER

First plot of the LER... later the range was increased to show a clean updated view of the upper half of the dynamic aperture.
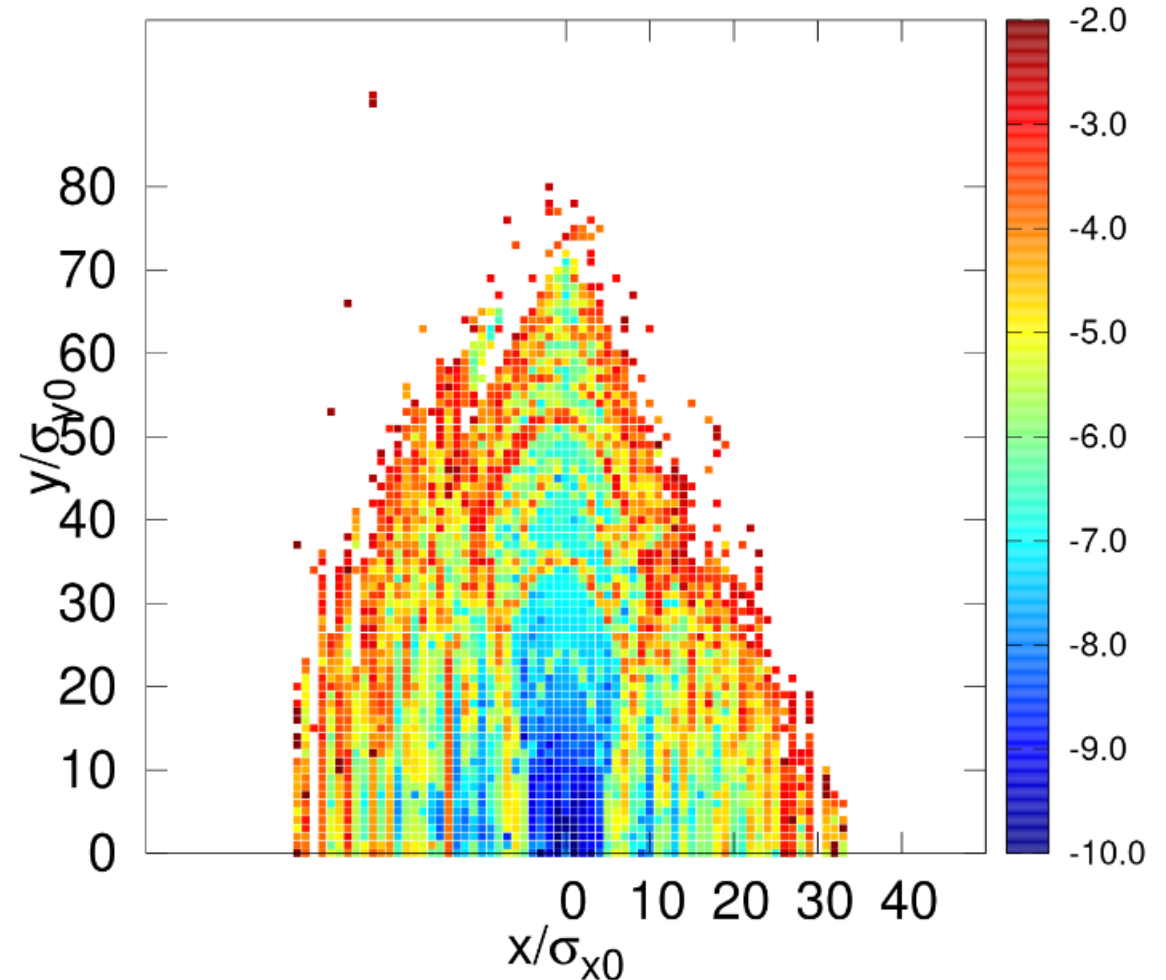
Bmad (Noah)
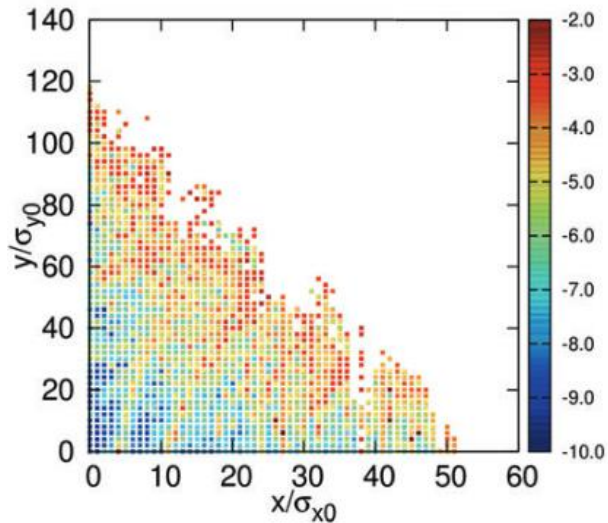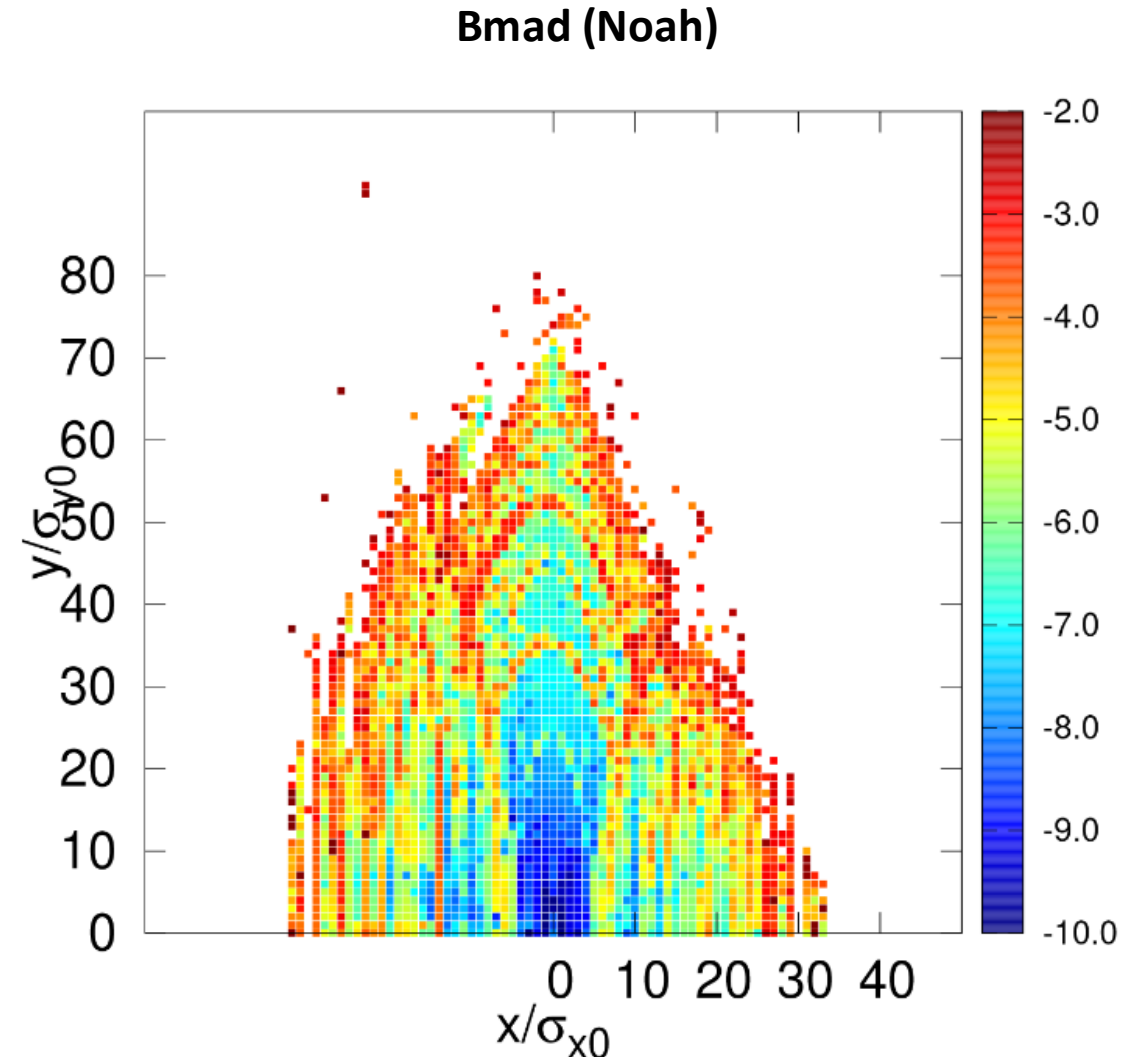
SAD Lattice (Demin)

Bmad Lattice (Demin)
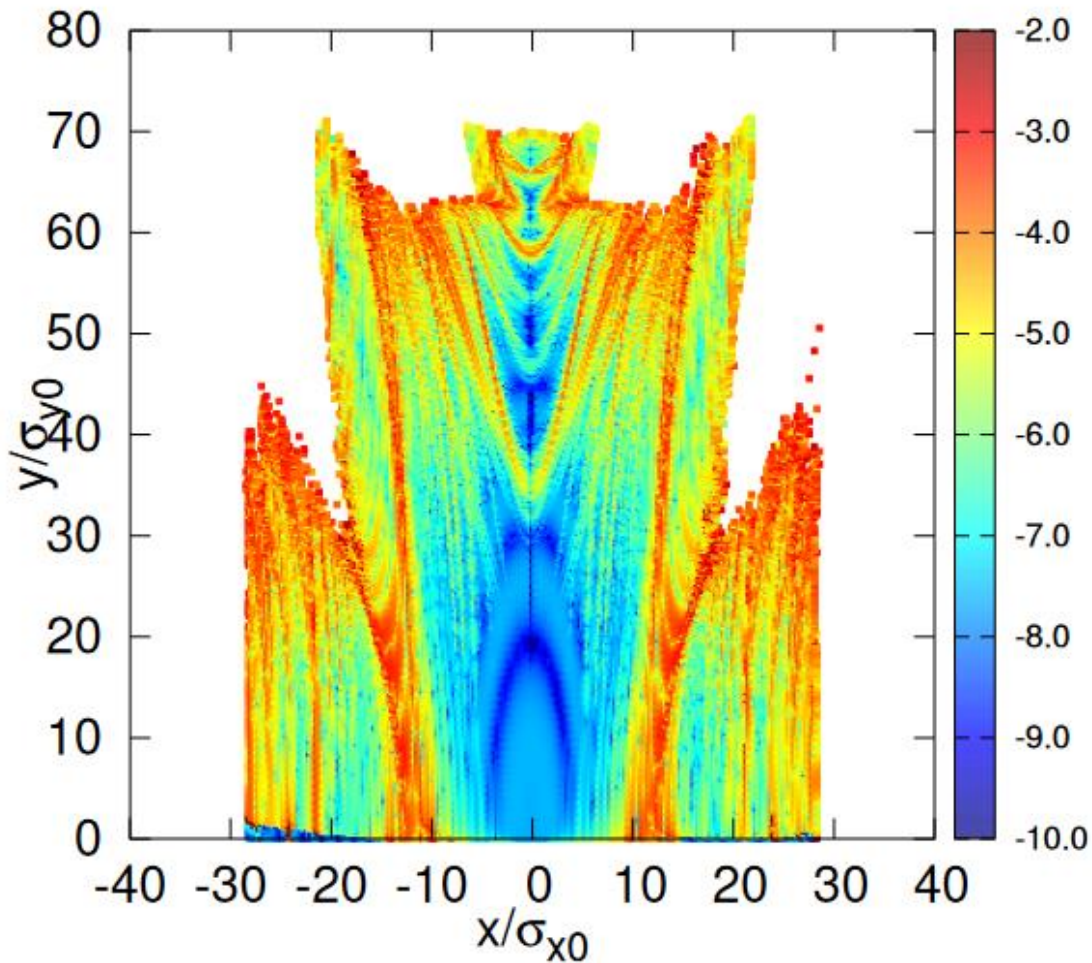
Frequency Map Analysis: LER

First plot of the LER... later the range was increased to show a clean updated view of the upper half of the dynamic aperture.

➢ We still haven't decided if we should hand calculate the beam sigmas from the output of Bmad, or use the beam sigmas suggested by Demin.

➢ The hand calculated value of the vertical beam sigma is half the size of Demin's
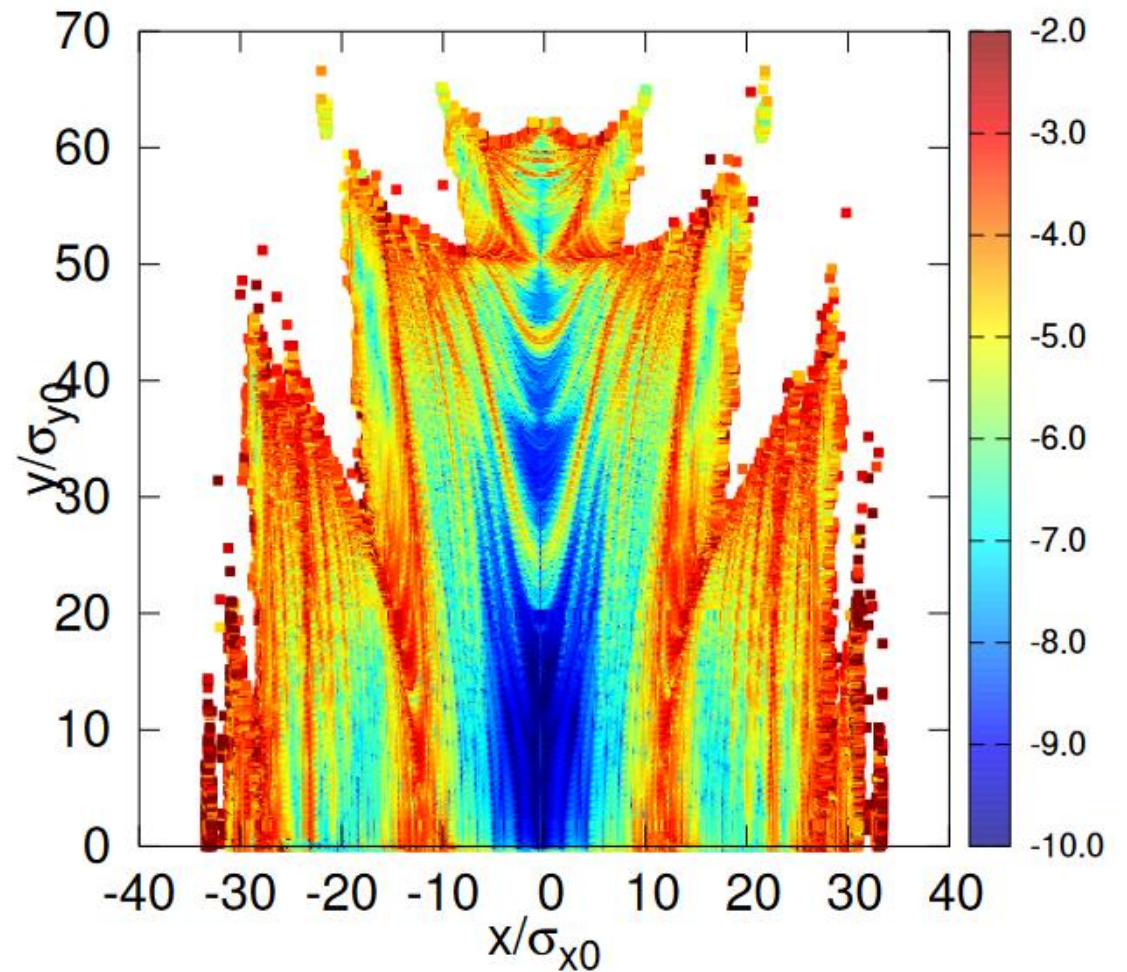
$$\sigma_{x,y} = \sqrt{\varepsilon_{x,y} \times \beta^*_{x,y}}$$

Bmad (Noah)

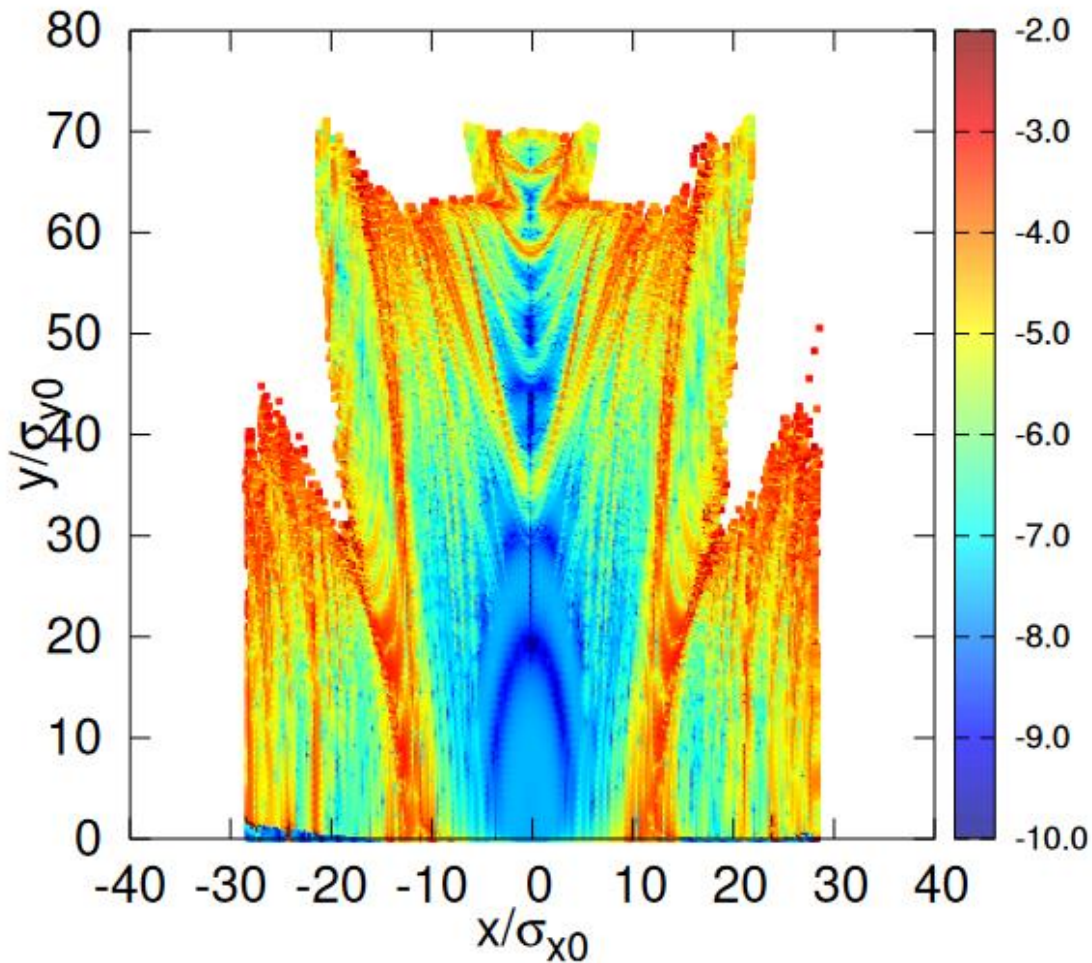# Frequency Map Analysis: HER
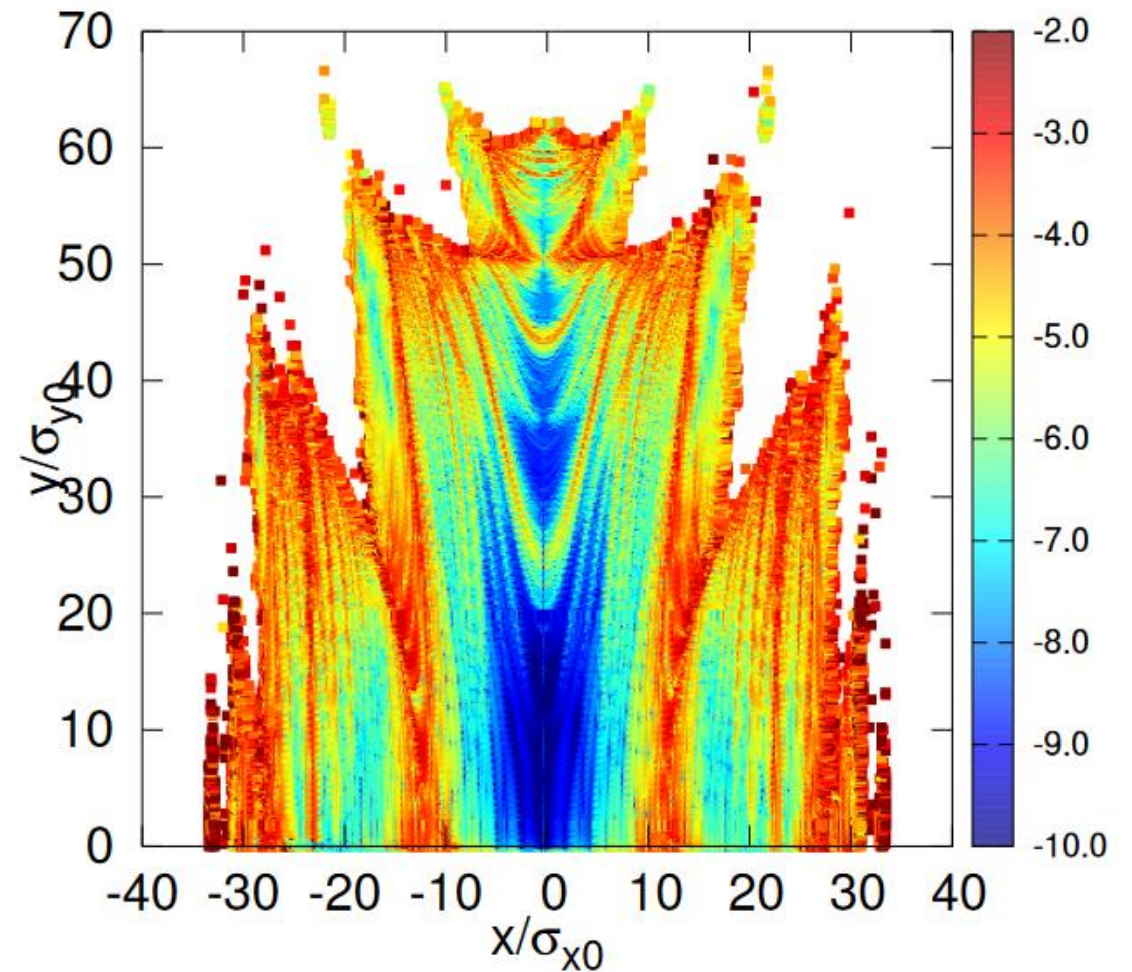

SAD lattice, Demin's FMA code

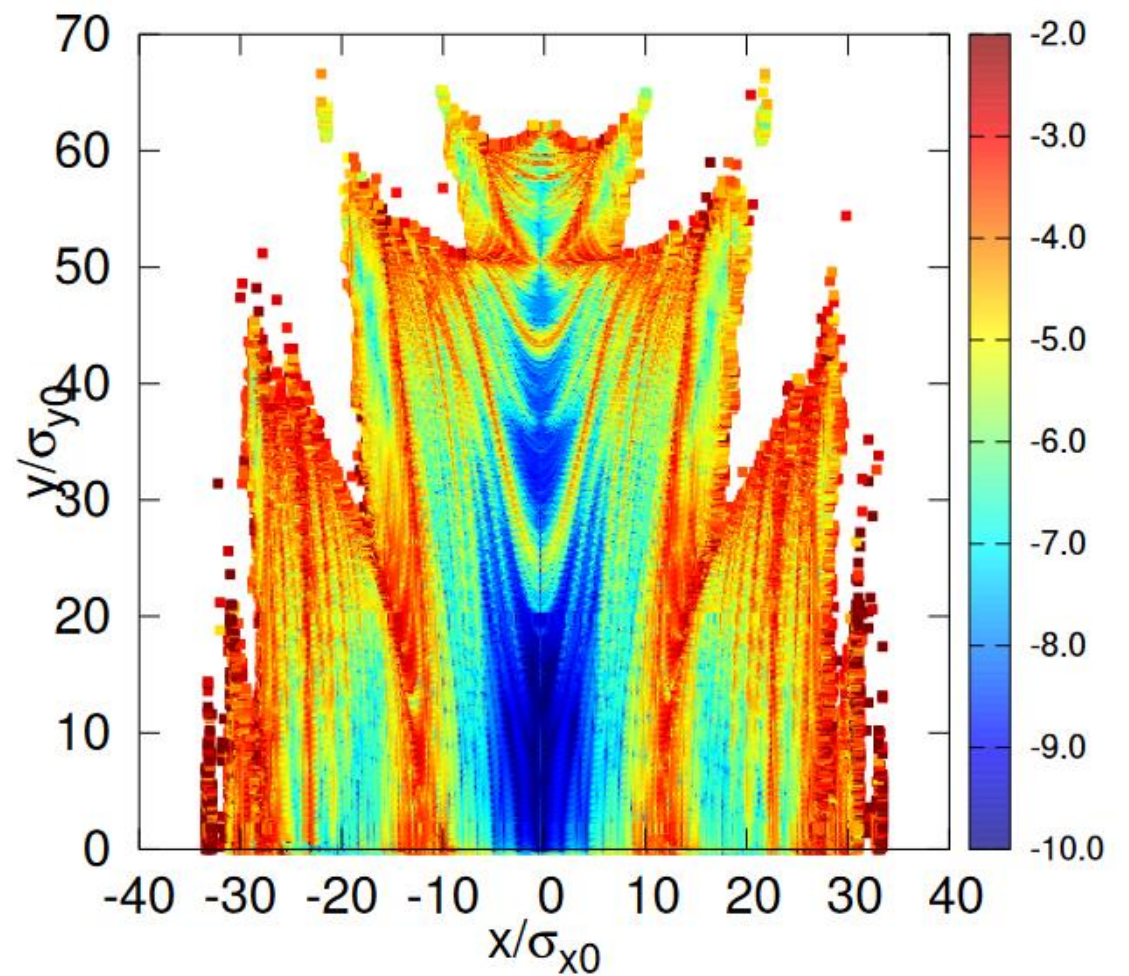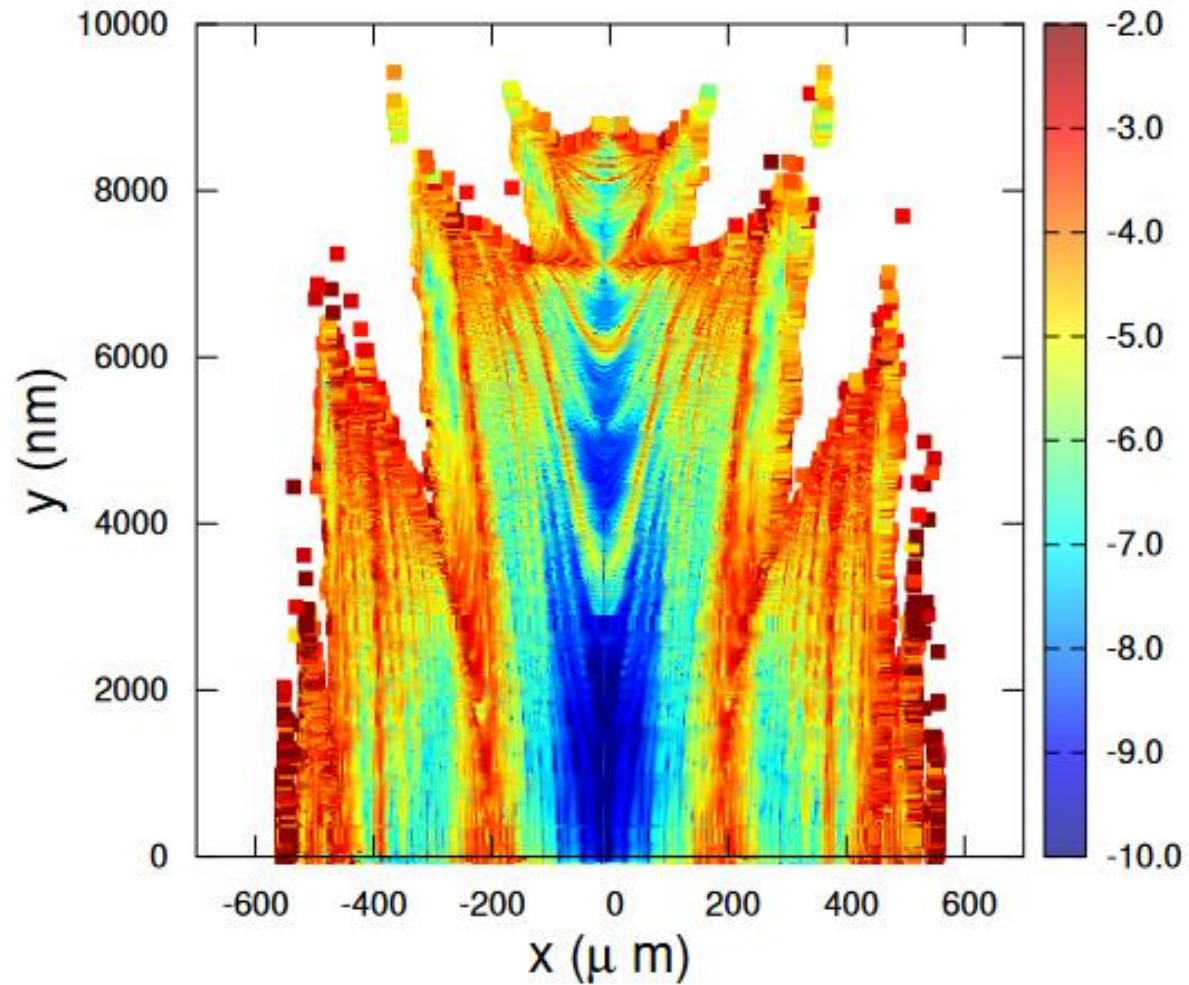Bmad lattice, Bmad's FMA code

Frequency Map Analysis: HER

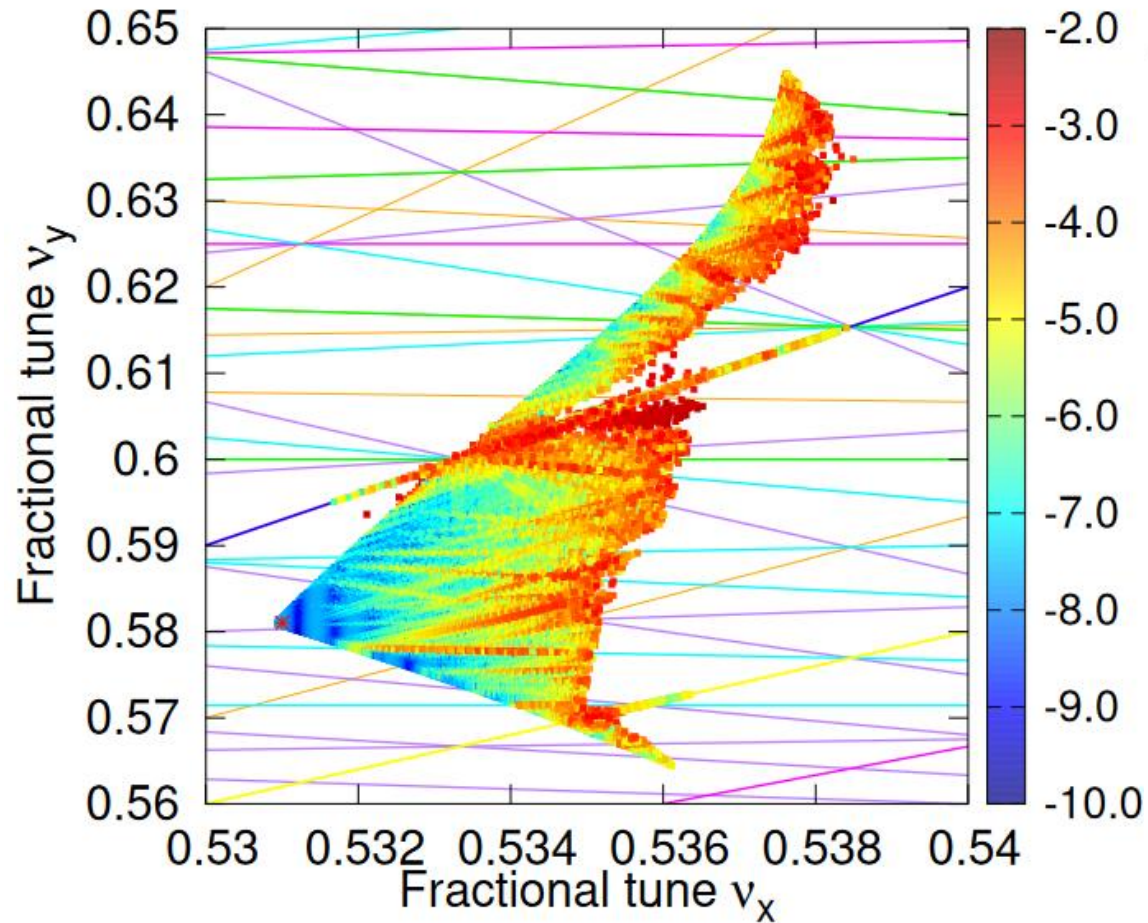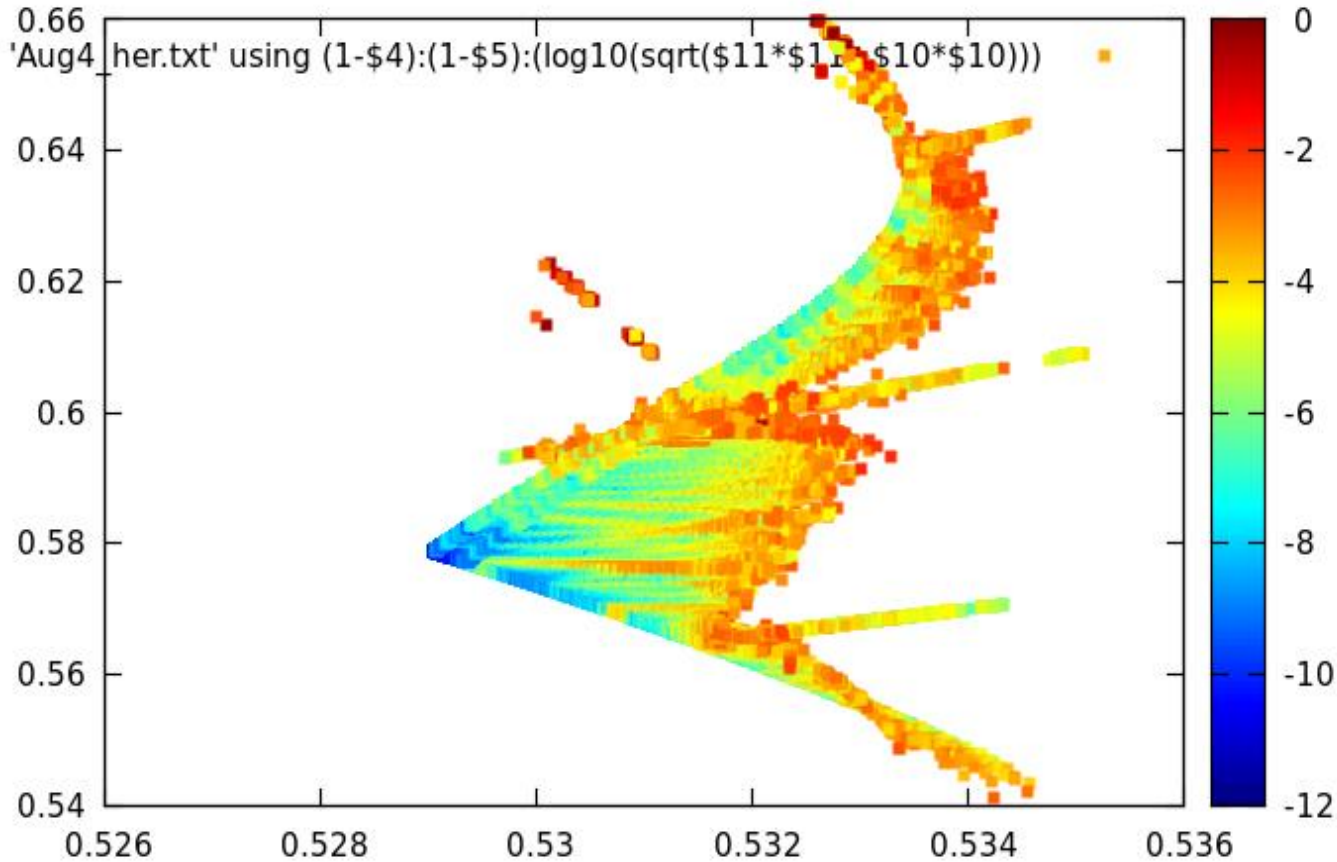Beam parameters (Demin's) (m): Sigma_x = 1.66157e-05   Sigma_y = 1.41440e-07

Frequency Map Analysis: HER

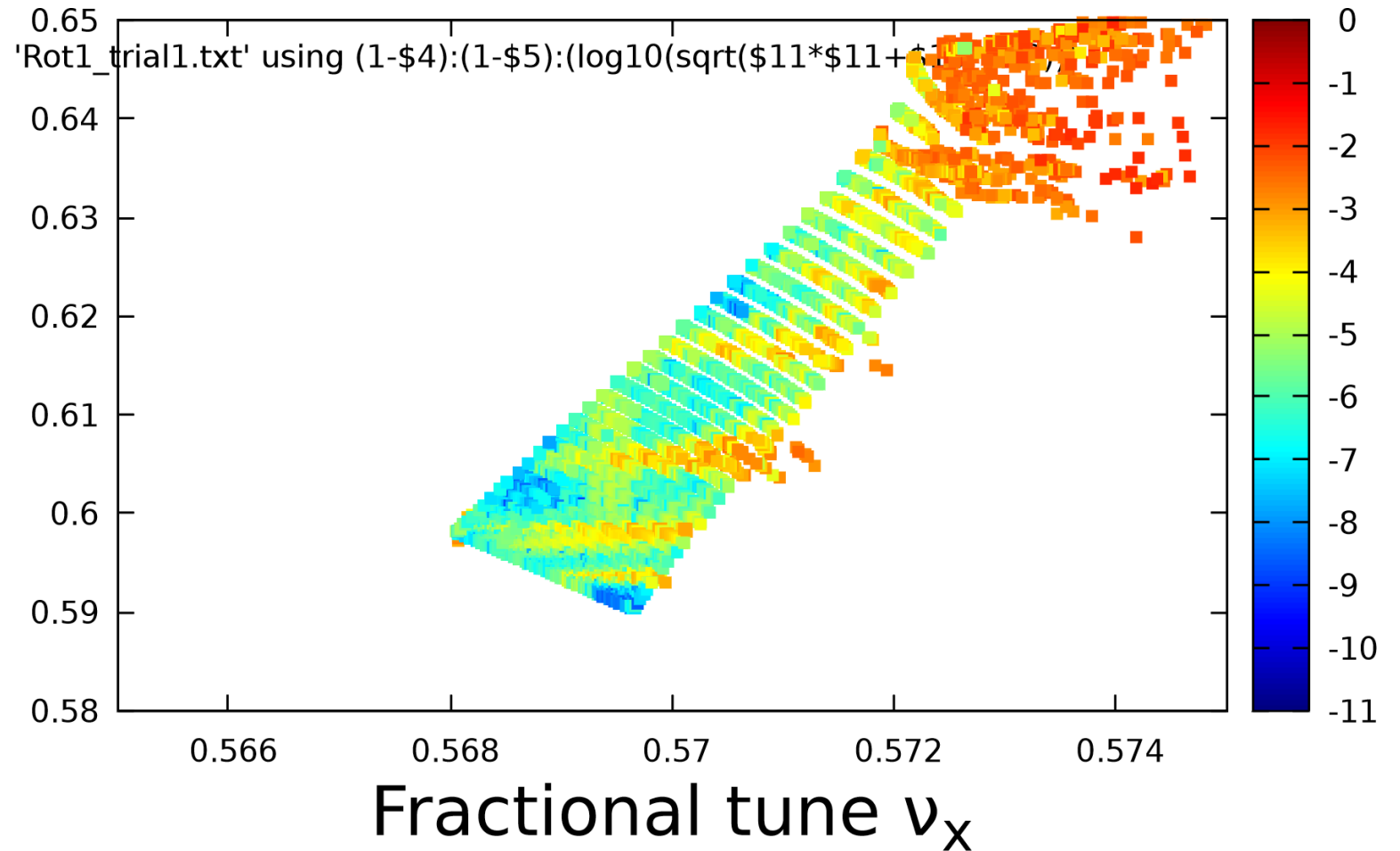# Frequency Map Analysis: HER

SAD lattice, Demin's FMA code

Bmad lattice, Bmad's FMA code
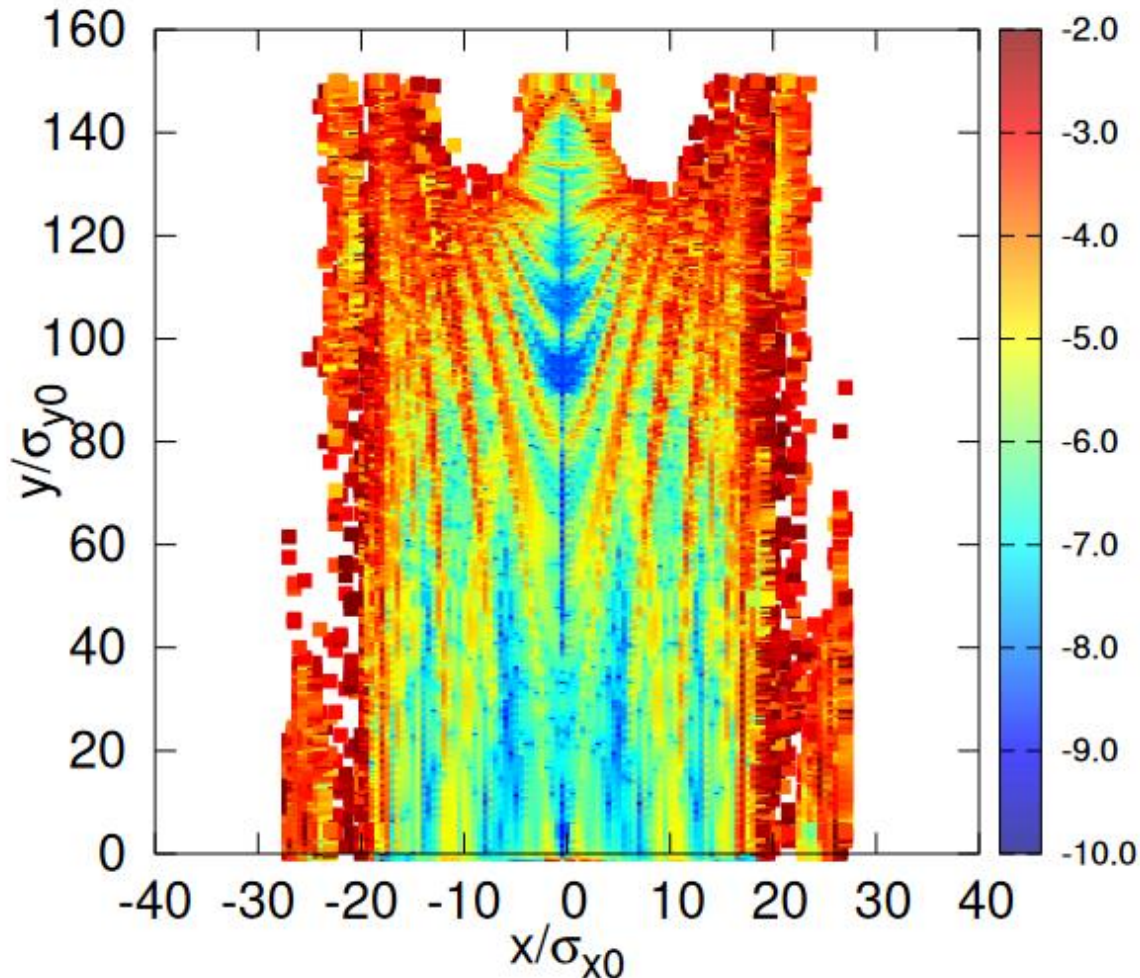(higher resolution, Bmad produces 1-tune)

Rotator Stability Trials

➢ The combined HER + Spin Rotator design must be stable up to and beyond the bunch top-up time (approximately 2 million turns)

➢ Using FMA, we retune the Rotator Lattice file and adjust the tunes to be within the most stable region of the FMA tune diagrams

➢ Starting from most stable design (Rot1.bmad) and incrementing beyond (Rot1.5, Rot1.6, etc...)

➢ With retuning, the chromaticity also needs to be adjusted.

➢ We test the stability using Bmad's long_term_tracking code, single particle for now.

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Frequency Map Analysis: Rot1

Design	Q_x	Q_y
Rot1	45.570003	43.600035
Rot1.5	45.569580	43.591322
Rot1.6	45.568007	43.587226

'Rot1_trial1.txt' using (1-$4):(1-$5):(log10(sqrt($11*$11+$1...
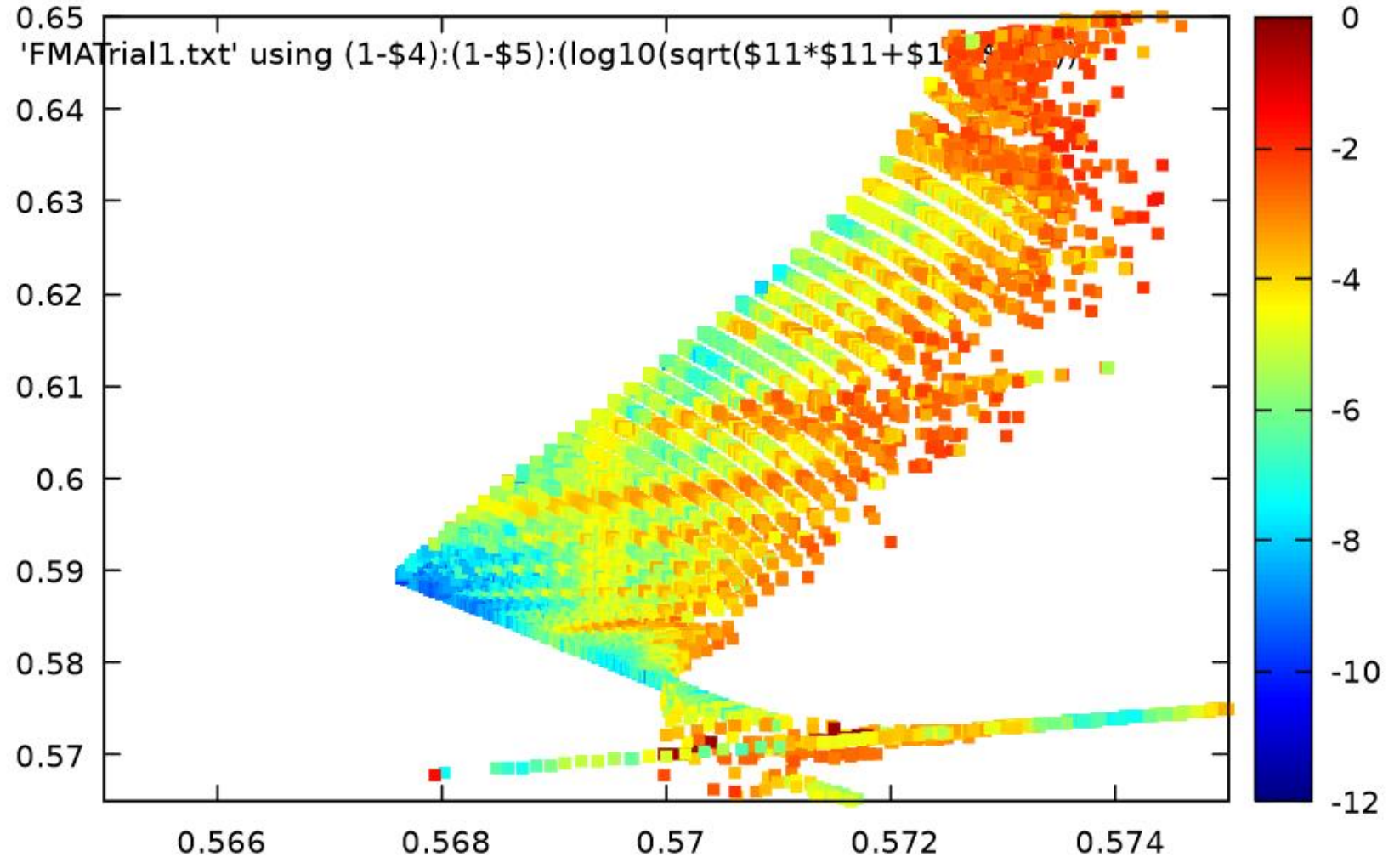
Fractional tune ν_x

Frequency Map Analysis: Rot1
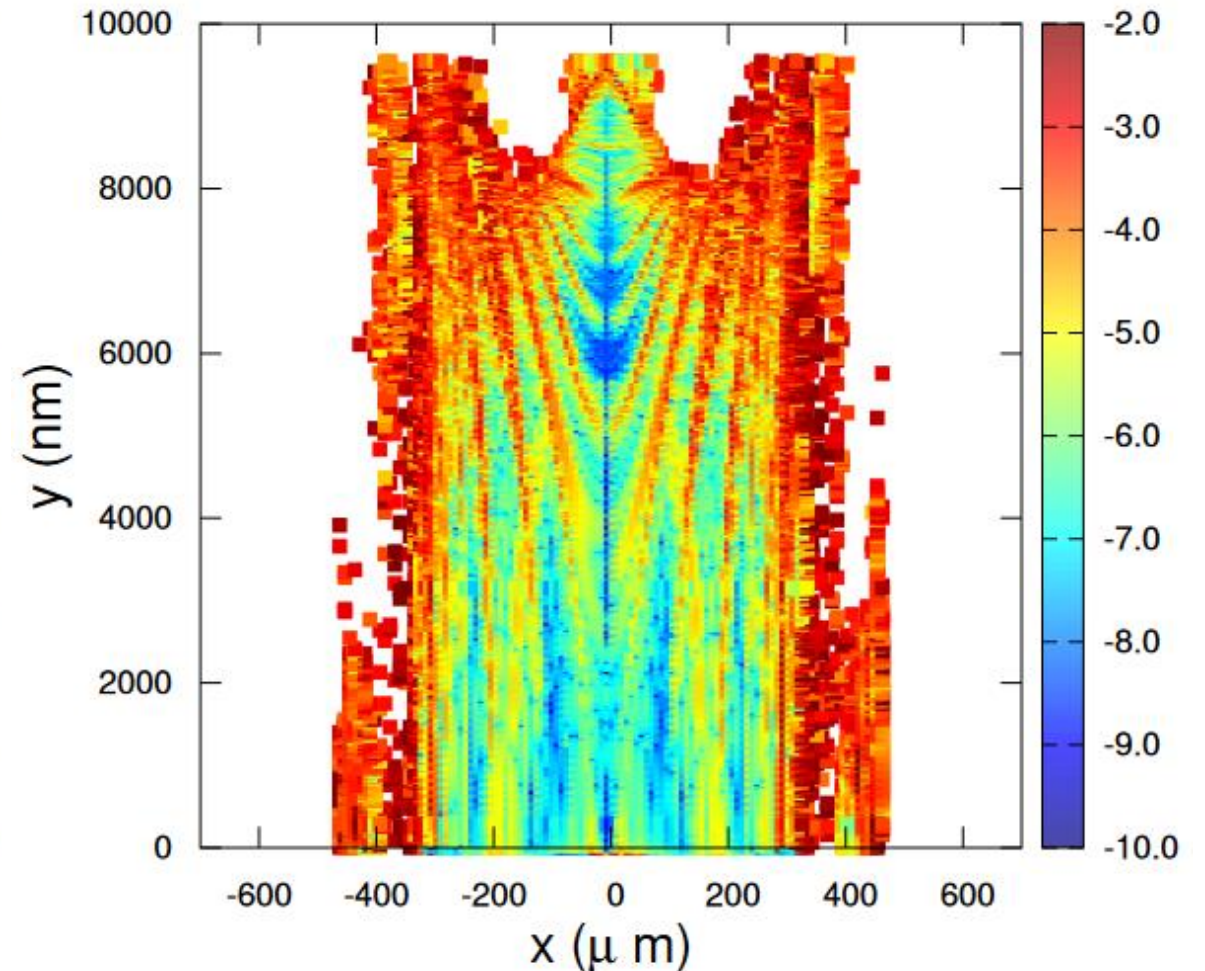
Beam parameters (Calculated) (m):   Sigma_x = 1.71304e-05   Sigma_y = 6.36766e-07

Frequency Map Analysis: Rot1.5

Design	Q_x	Q_y
Rot1	45.570003	43.600035
Rot1.5	45.569580	43.591322
Rot1.6	45.568007	43.587226

Frequency Map Analysis: Rot1.5

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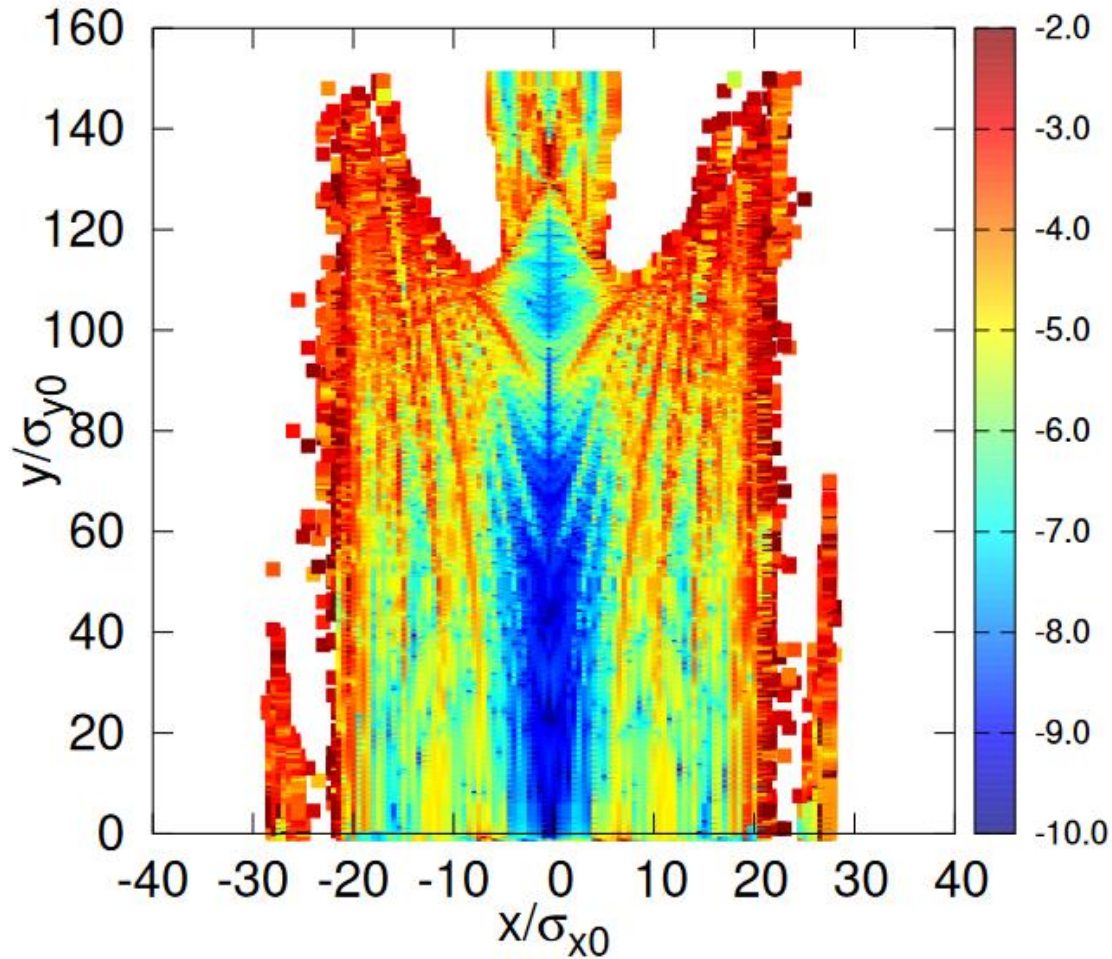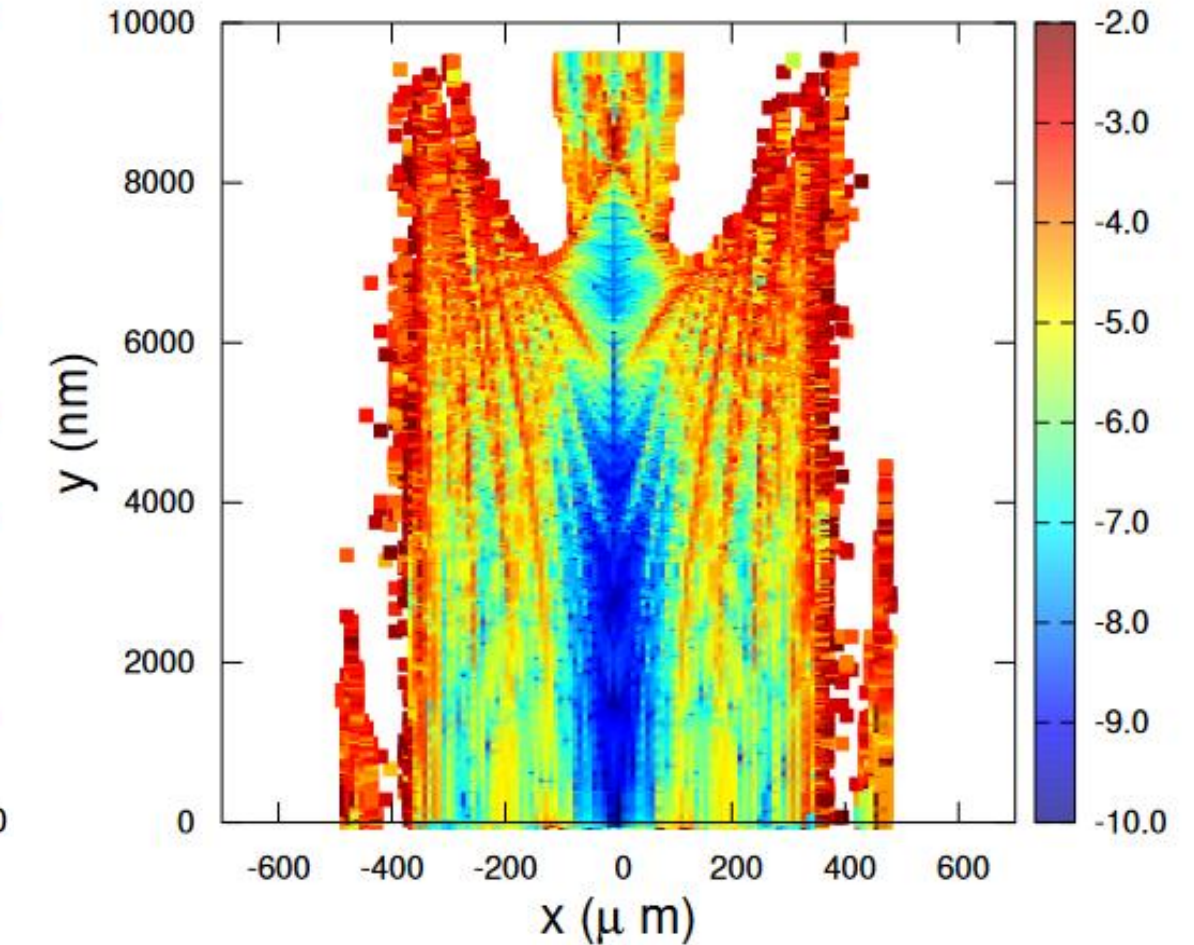
Beam parameters (Calculated) (m):   Sigma_x = 1.71289e-05   Sigma_y = 6.36215e-07

Frequency Map Analysis: Rot1.6

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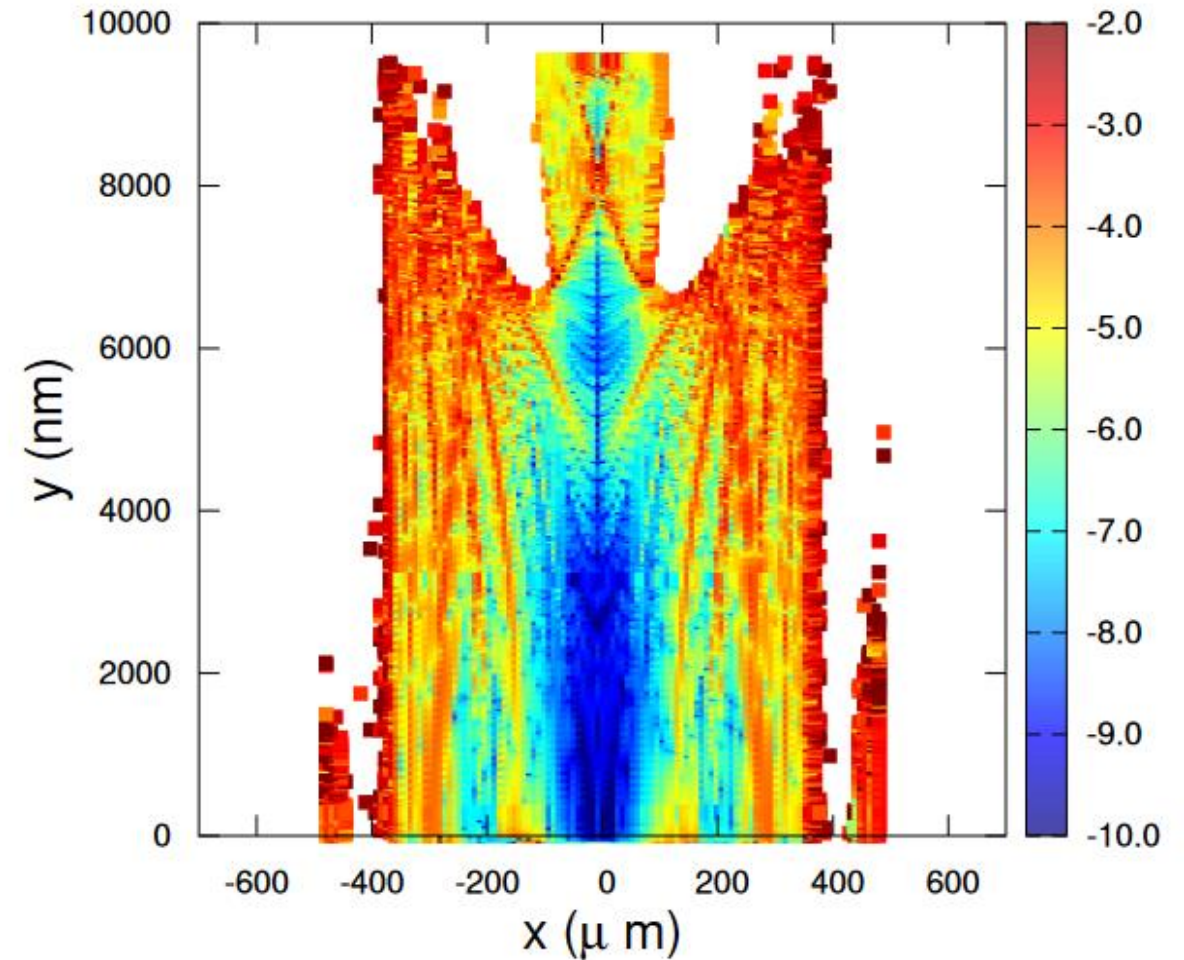| Design	Q_x	Q_y
Rot1	45.570003	43.600035
Rot1.5	45.569580	43.591322
Rot1.6	45.568007	43.587226

'FMARot1.6.txt' using (1-$4):(1-$5):(log10(sqrt($11*$11+$10*$10)))
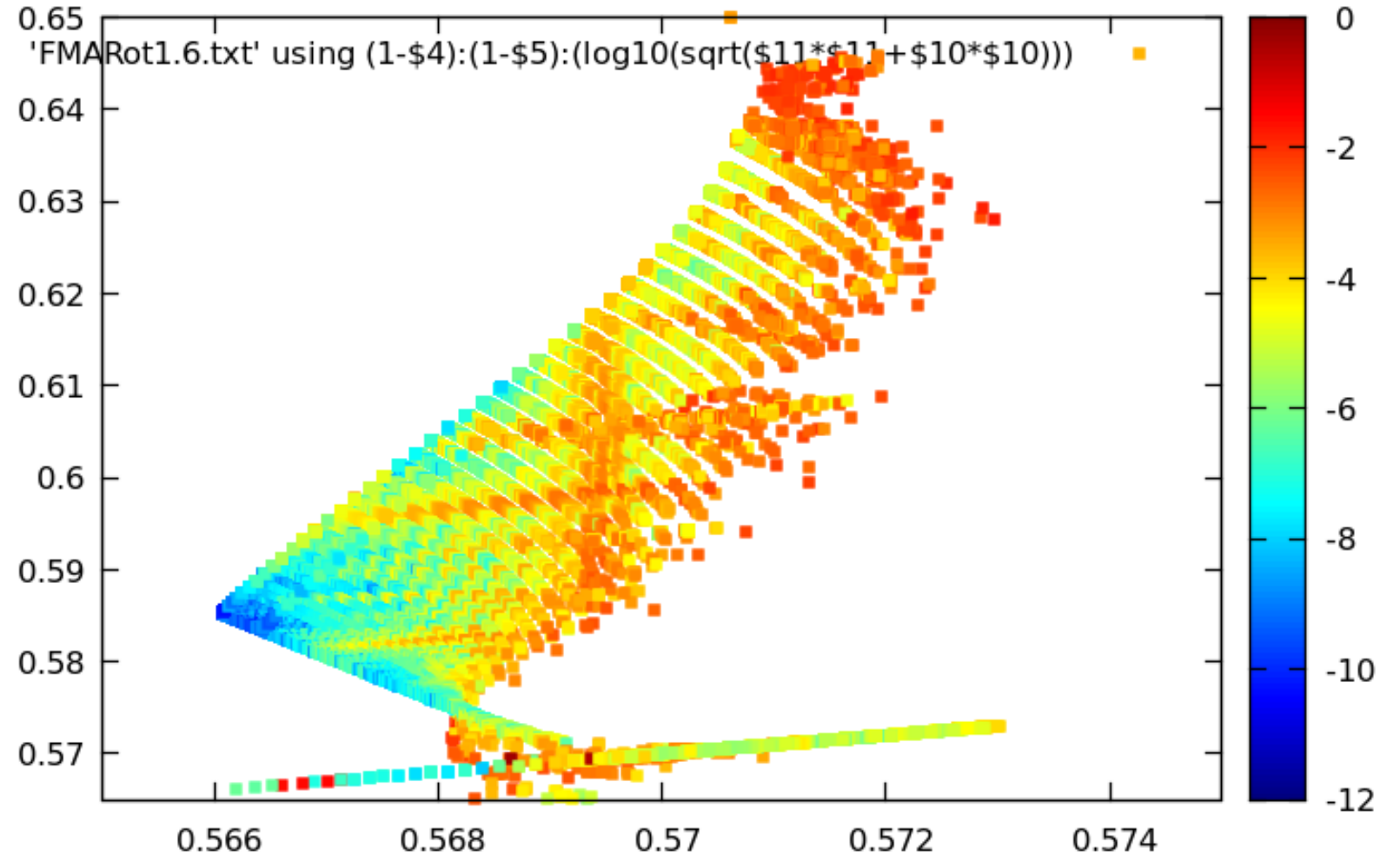
Frequency Map Analysis: Rot1.6
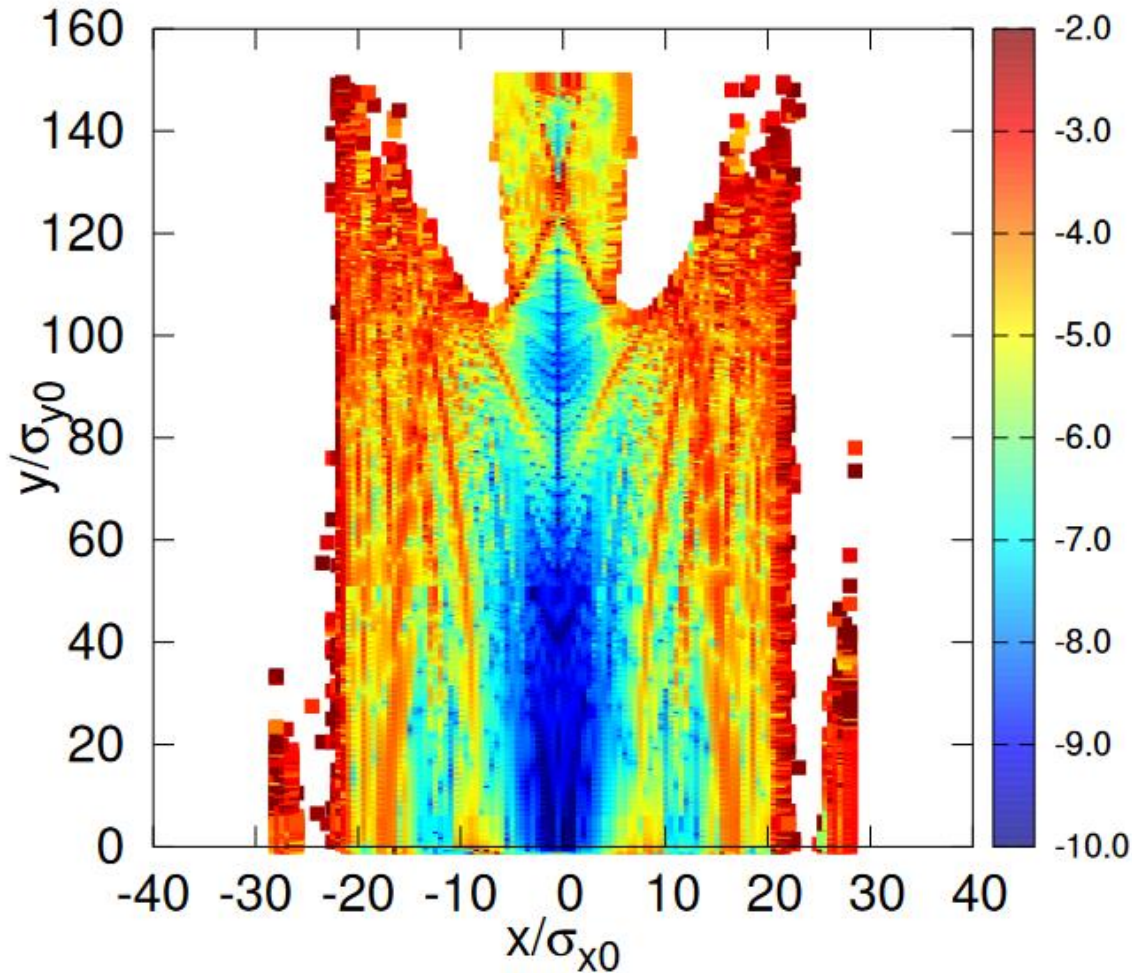
Beam parameters (Calculated) (m):   Sigma_x = 1.71289e-05   Sigma_y = 6.36216e-07

Long Term Tracking Stability Results

Design	Q_x	Q_y	Chrom_x	Chrom_y	Lifetime
Rot1	45.570003	43.600035	1.845958	1.635596	~20,000 turns
Rot1.5	45.569580	43.591322	1.593508	1.622865	86,730 turns
Rot1.6	45.568007	43.587226	1.593508	1.622865	3,945 turns

Next goal: Need to rule out fluxuations