

Update on GHC optics

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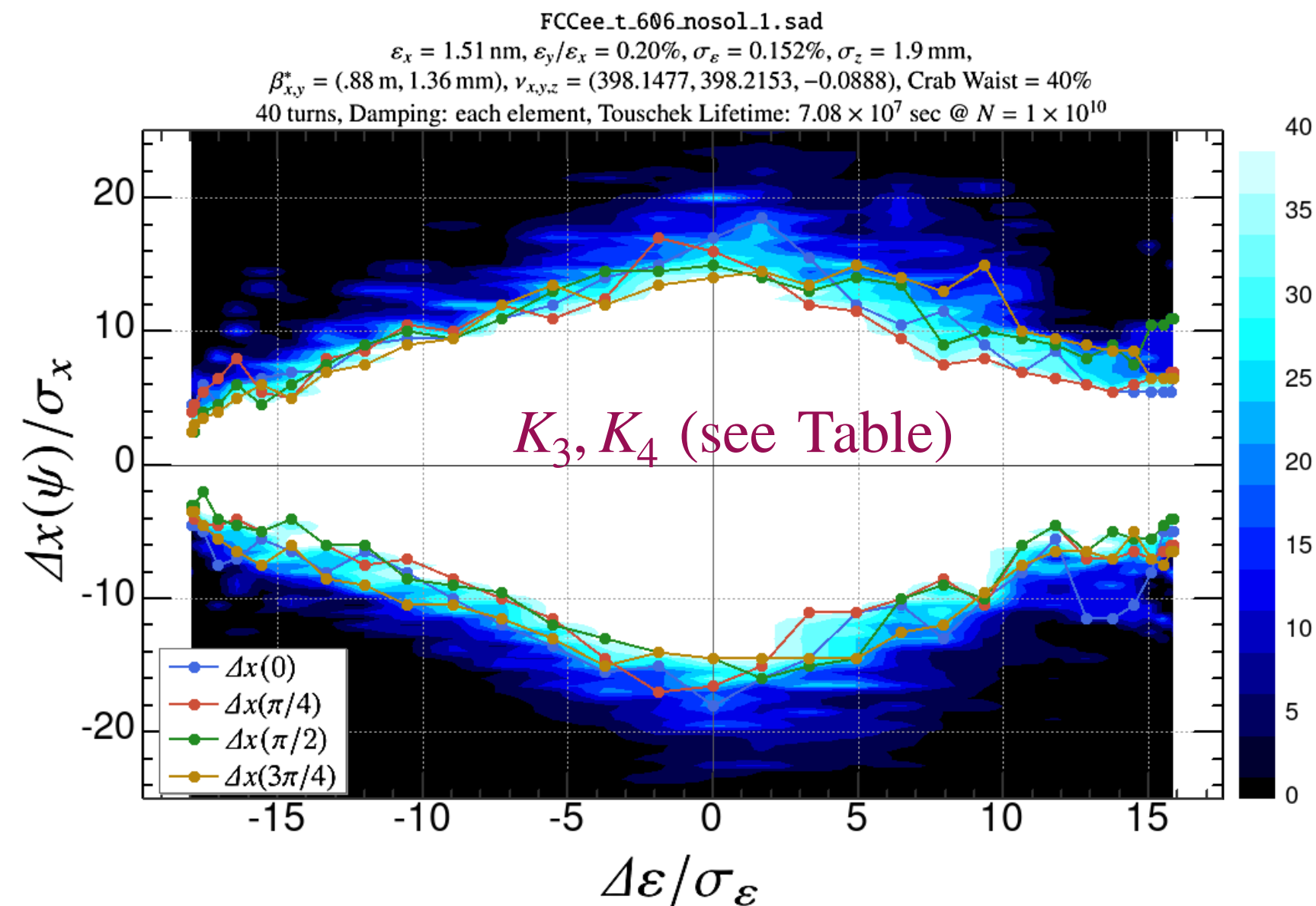
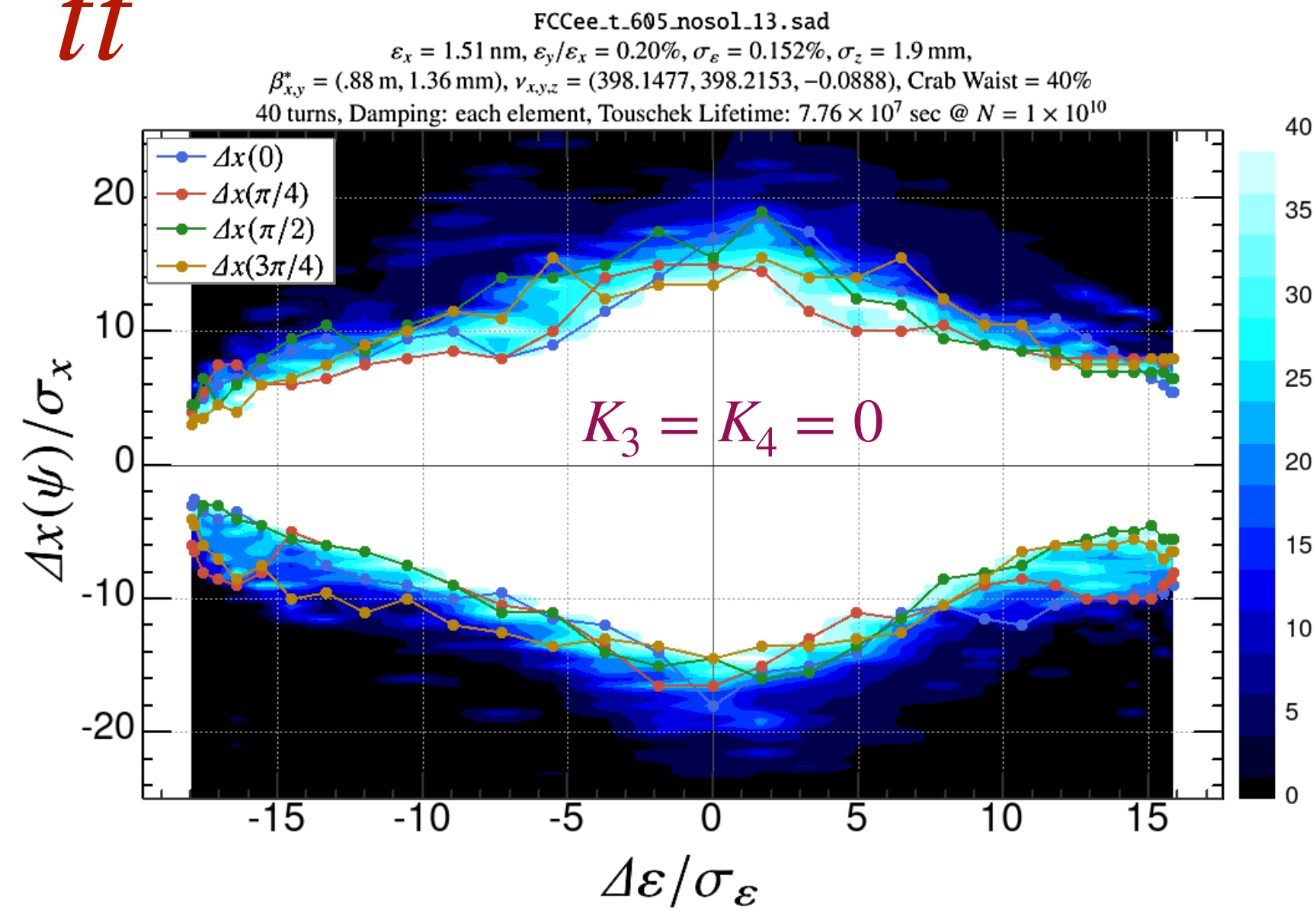
July 10, 2024 @ the 188th FCC-ee Accelerator Design Meeting

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FCCIS colleagues**

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Octupoles/decapoles on SY (YCCS/Crab) sextupoles

$t\bar{t}$



- As shown by Y. Cai at FCCW 2024, by adding octupoles/decapoles on SY (YCCS/Crab) sexts, the strengths of the arc sextupoles get weaker, by 12%.
 - The DA(MA) seems comparable.
- If such octs/decas are feasible, we may employ this scheme.

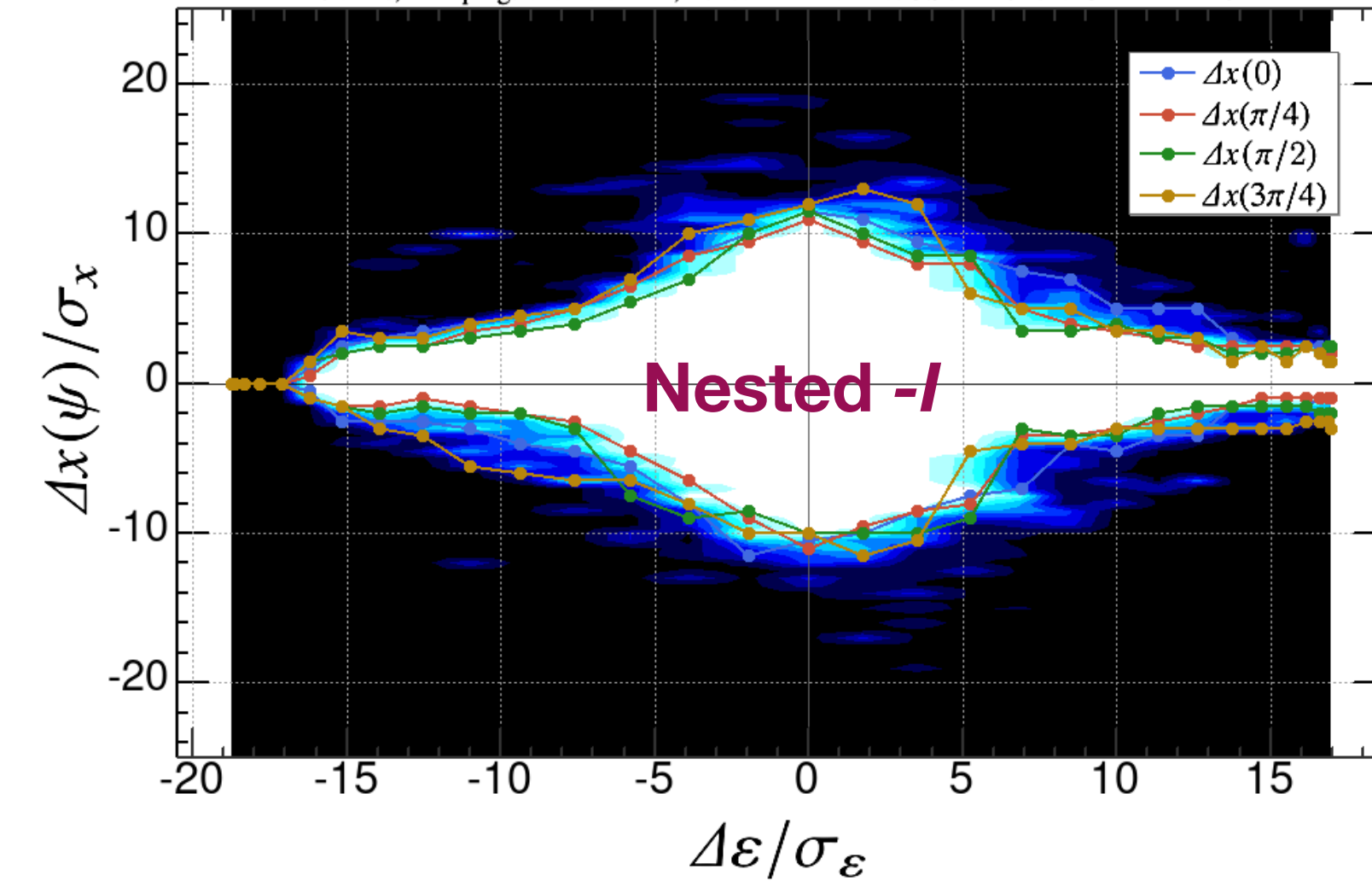
	FCCW 2024	t_606	
$ B_3 _{\max}$	0	0.81	T
$ B_4 _{\max}$	0	0.40	T
$ K_{2,\text{arc}} _{\max}$	1.7	1.5	$1/\text{m}^2$
$\sum B''^2 L$	11.3	10.5	$10^{12} \text{ T}^2/\text{m}$

Alternative arcs (unsuccessful so far)

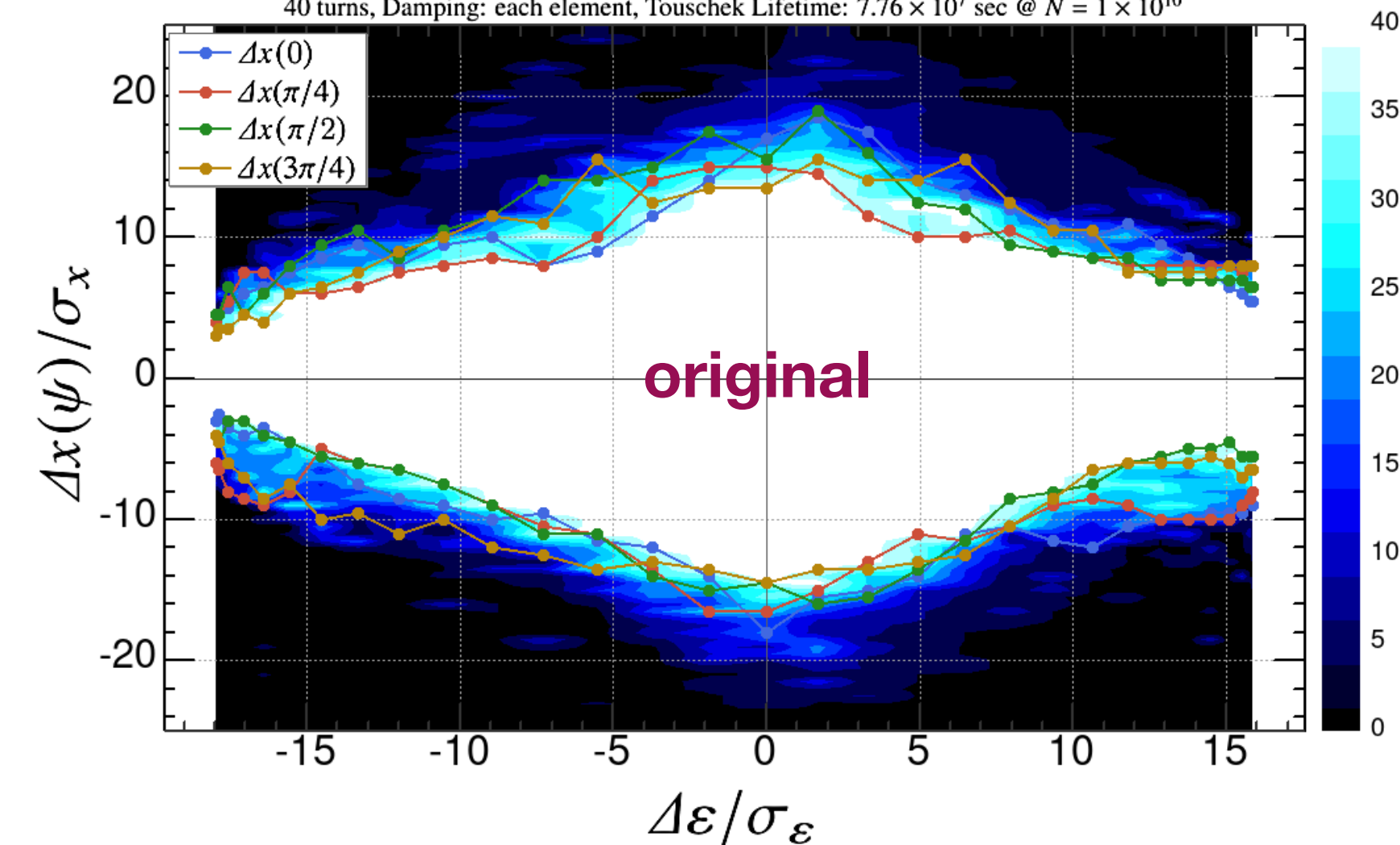
$t\bar{t}$

- Several arc schemes have been tried:
 - Modulated FODO: higher $\beta_{x,y}, \eta_x$ at sexts.
 - Interleaved FODO sexts: a sext at every quad, amplitude-detuning “optimized”.
 - Nested -I: SD pair (-I) nested within SF pair ($3\pi/2\pi$).
 - Noninterleaved SF/SD pair ($3\pi/2\pi$) (even didn't reach a solution to examine DA yet)

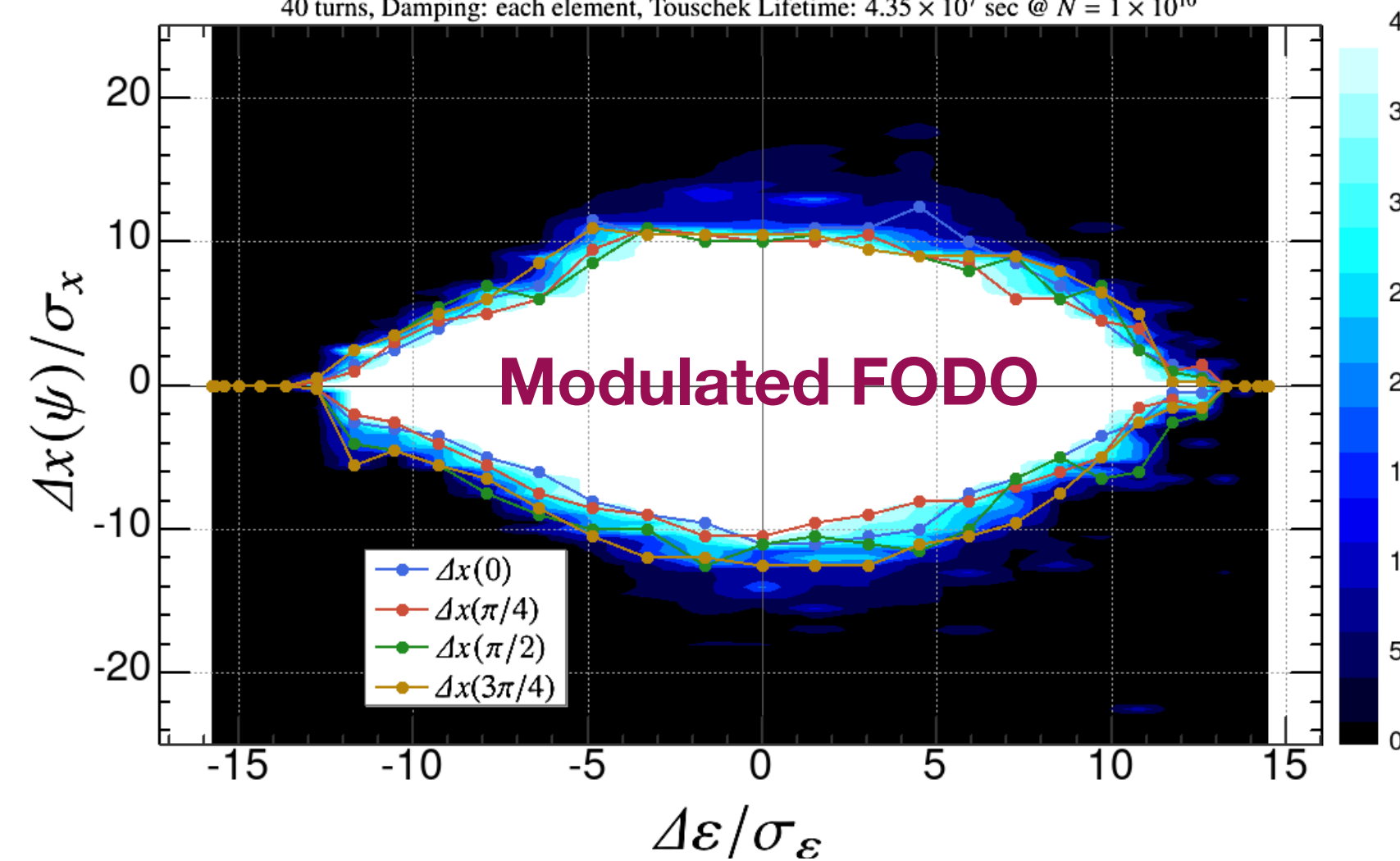
FCCee_t_a001_nosol_1.sad
 $\epsilon_x = 1.88 \text{ nm}, \epsilon_y/\epsilon_x = 0.20\%, \sigma_\epsilon = 0.145\%, \sigma_z = 1.9 \text{ mm},$
 $\beta_{x,y}^* = (.88 \text{ m}, 1.34 \text{ mm}), \nu_{x,y,z} = (386.1456, 290.2112, -0.0937), \text{Crab Waist} = 40\%$
 40 turns, Damping: each element, Touschek Lifetime: $3.97 \times 10^7 \text{ sec}$ @ $N = 1 \times 10^{10}$



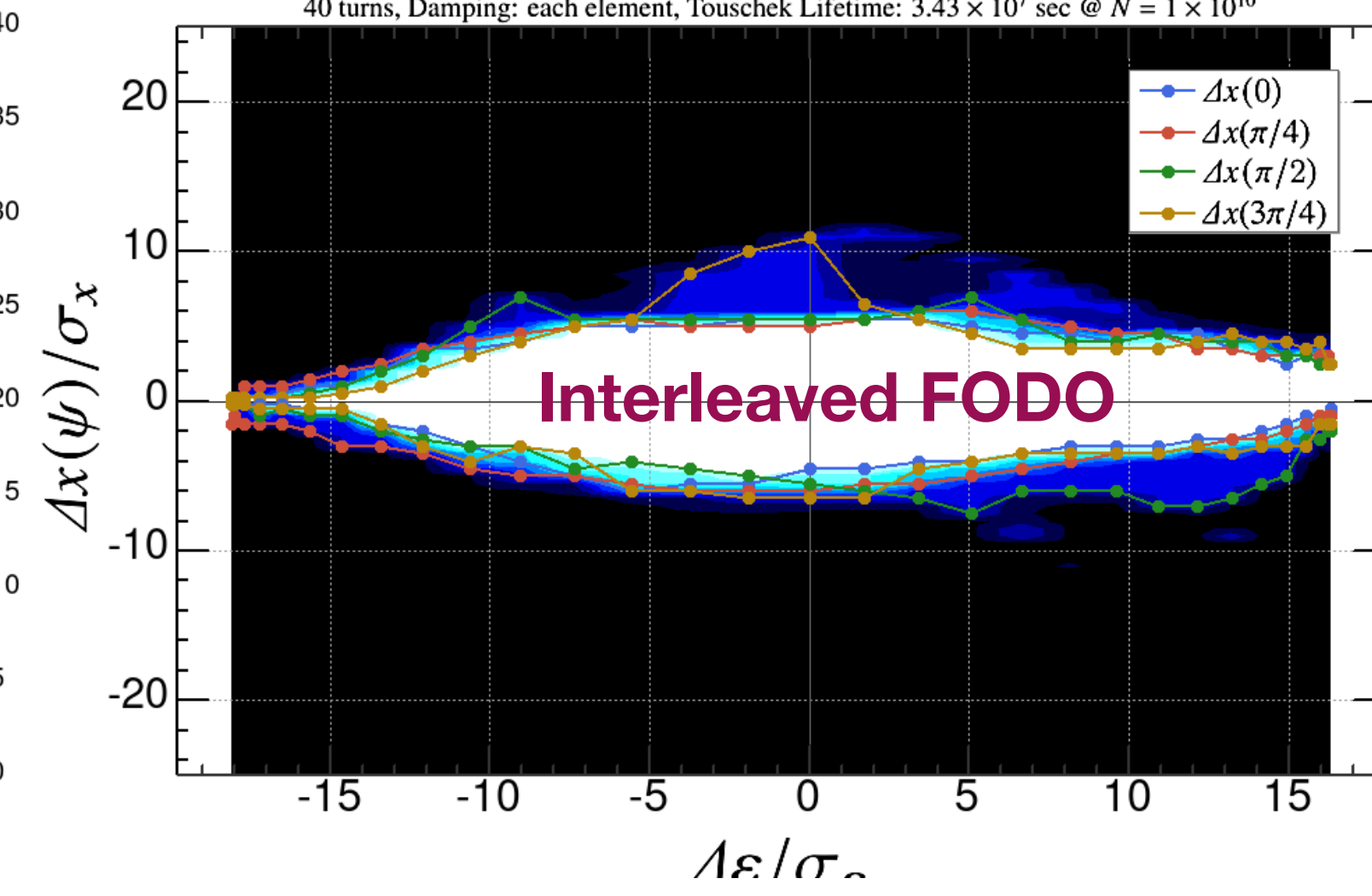
FCCee_t_605_nosol_13.sad
 $\epsilon_x = 1.51 \text{ nm}, \epsilon_y/\epsilon_x = 0.20\%, \sigma_\epsilon = 0.152\%, \sigma_z = 1.9 \text{ mm},$
 $\beta_{x,y}^* = (.88 \text{ m}, 1.36 \text{ mm}), \nu_{x,y,z} = (398.1477, 398.2153, -0.0888), \text{Crab Waist} = 40\%$
 40 turns, Damping: each element, Touschek Lifetime: $7.76 \times 10^7 \text{ sec}$ @ $N = 1 \times 10^{10}$



FCCee_t_m004_nosol_1.sad
 $\epsilon_x = 1.7 \text{ nm}, \epsilon_y/\epsilon_x = 0.20\%, \sigma_\epsilon = 0.148\%, \sigma_z = 1.9 \text{ mm},$
 $\beta_{x,y}^* = (.88 \text{ m}, 1.33 \text{ mm}), \nu_{x,y,z} = (398.1478, 386.2100, -0.0940), \text{Crab Waist} = 40\%$
 40 turns, Damping: each element, Touschek Lifetime: $4.35 \times 10^7 \text{ sec}$ @ $N = 1 \times 10^{10}$



FCCee_t_s002_nosol_1.sad
 $\epsilon_x = 1.86 \text{ nm}, \epsilon_y/\epsilon_x = 0.20\%, \sigma_\epsilon = 0.150\%, \sigma_z = 1.9 \text{ mm},$
 $\beta_{x,y}^* = (.88 \text{ m}, 1.32 \text{ mm}), \nu_{x,y,z} = (362.1488, 258.2091, -0.1009), \text{Crab Waist} = 40\%$
 40 turns, Damping: each element, Touschek Lifetime: $3.43 \times 10^7 \text{ sec}$ @ $N = 1 \times 10^{10}$



Summary

- Octupoles/decapoles on SY sextupoles seem effective on DA(MA): make it possible to reduce arc sextupole strength by 12%.

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$\sum B''^2 L$	11.3	10.5	$10^{12} \text{T}^2/\text{m}$

- Alternative arc designs are not successful yet.