

Beam-beam simulations for SuperKEKB Phase-3

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Acknowledgements:

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Outline

- **Introduction**
- **Tune scan using BBWS**
- **Simulation using BBSS**
- **Summary**

1. Introduction

➤ Phase-3 machine parameters (Road map)

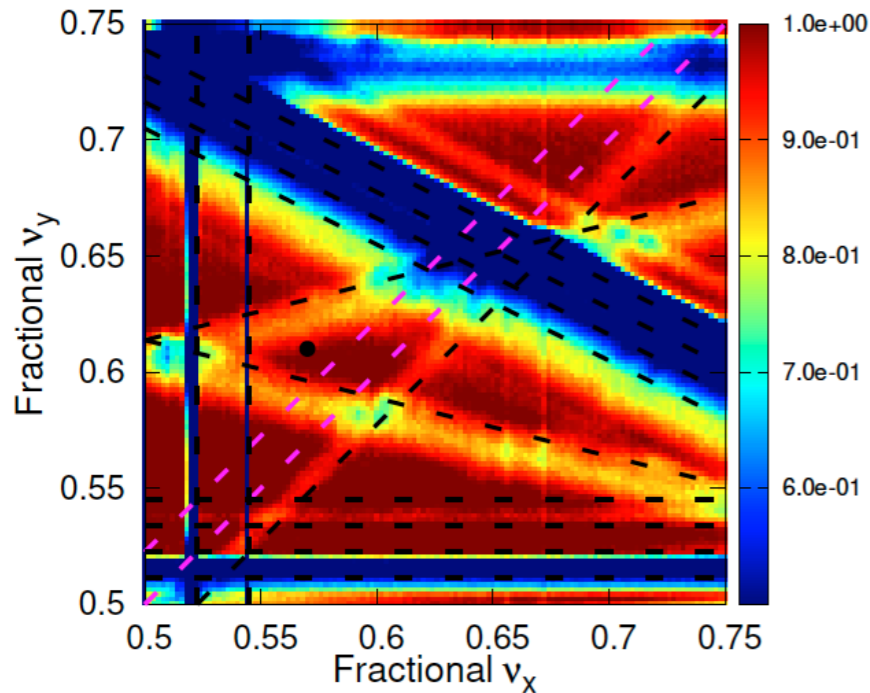
- Ref. A. Morita, Talk at SuperKEKB commissioning meeting, Oct. 12, 2018

	1		1ex		2		2ex		3		3'		3ex	
	HER	LER	HER	LER	HER	LER	HER	LER	HER	LER	HER	LER	HER	LER
I_b (A)	1.0	1.2	1.0	1.4	1.0	1.4	1.2	1.7	1.3	1.8	1.15	1.6	1.4	2.0
# bunch	1576		1576		1576		1576		1576		1576		1576	
ϵ_x (nm)	4.6	2.0	4.6	2.0	4.6	2.0	4.6	2.0	4.6	2.0	4.6	2.0	4.6	2.0
ϵ_y (pm)	368	160	230	150	138	140	128.8	130	138	140	101.2	100	101.2	100
β_x (mm)	100	100	100	100	100	100	100	100	100	100	100	100	100	100
β_y (mm)	3	3	3	3	2	2	2	2	1.4	1.4	1.25	1.25	1.2	1.2
σ_z (mm)	6	6	6	6	6	6	6	6	6	6	6	6	6	6
v_x	45.57	44.57	45.57	44.57	45.57	44.57	45.57	44.57	45.57	44.57	45.57	44.57	45.57	44.57
v_y	43.61	46.61	43.61	46.61	43.61	46.61	43.61	46.61	43.61	46.61	43.61	46.61	43.61	46.61
v_s	0.0258	0.0225	0.0258	0.0225	0.0258	0.0225	0.0258	0.0225	0.0258	0.0225	0.0258	0.0225	0.0258	0.0225
ξ_y (Geom.)	0.0272	0.0262	0.0328	0.0331	0.0278	0.0351	0.0351	0.0436	0.0302	0.0387	0.0301	0.0397	0.0369	0.0453
\mathcal{L} (Geom.)	1.06E+34		1.46E+34		2.08E+34		3.14E+34		4.11E+34		4.00E+34		6.20E+34	
\mathcal{L} (BBSS)	1.00E+34		1.30E+34		1.74E+34		2.16E+34		2.52E+34		2.55E+34		3.21E+34	

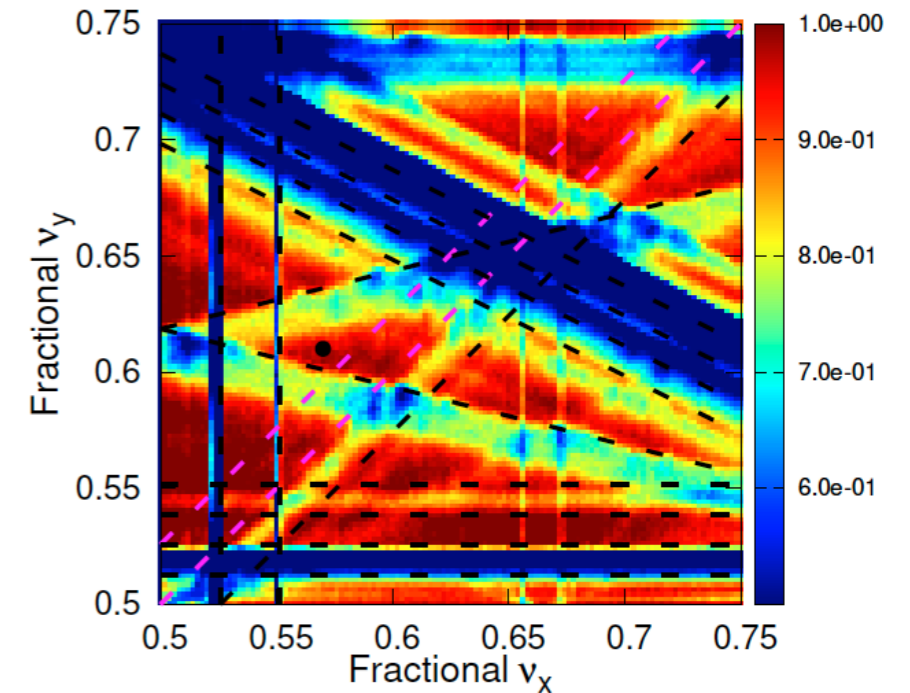
2. BBWS simulation: Tune scan

► Parameter set (3ex)

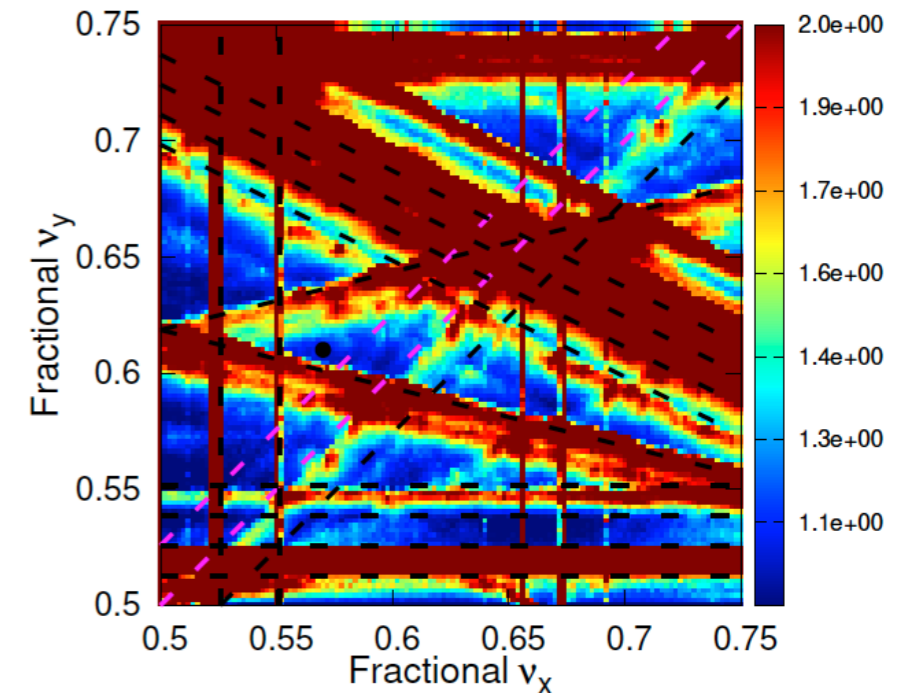
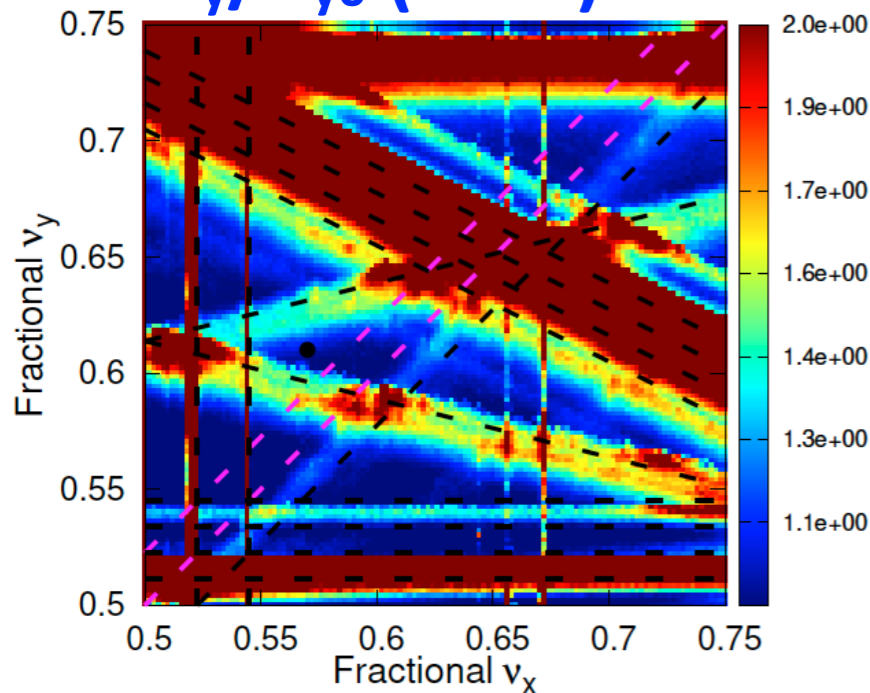
$e+(W)e-(S)$
Lum. (L/L_0)



$e+(S)e-(W)$



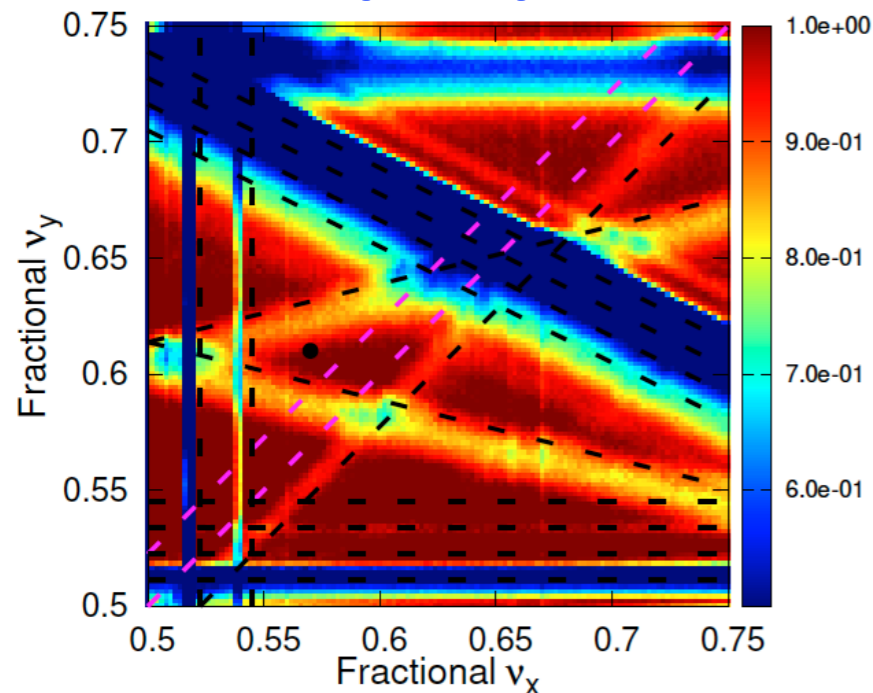
σ_y/σ_{y0} (RMS)



2. BBWS simulation: Tune scan

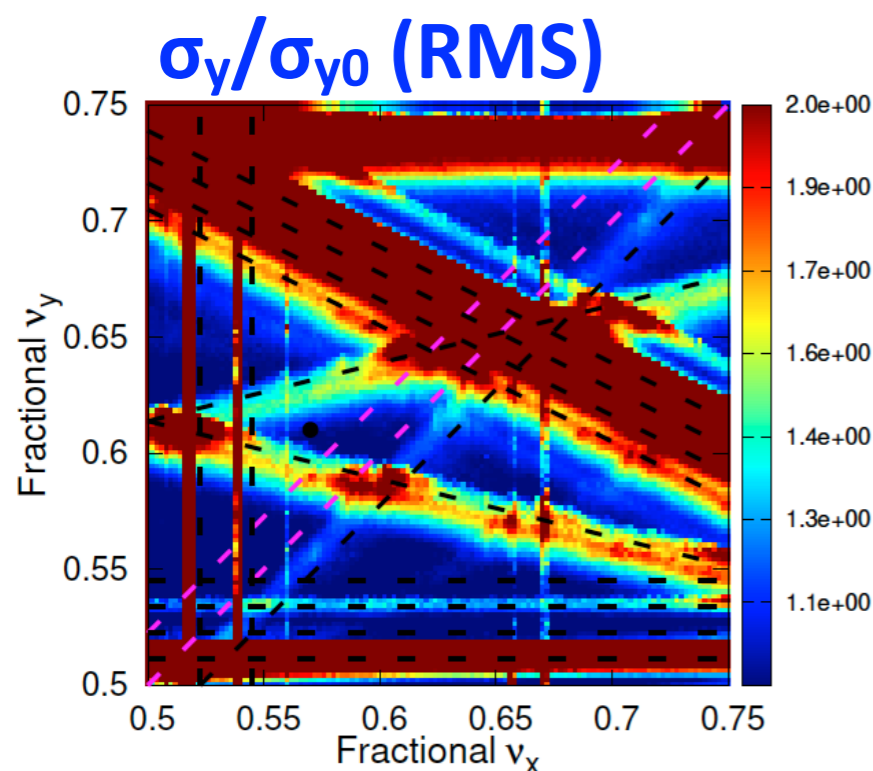
► Parameter set (3ex): $v_s=0.02$

$e+(W)e-(S)$
Lum. (L/L_0)



$v_x+k*v_s=N$ shifted as expected
when changing v_s .

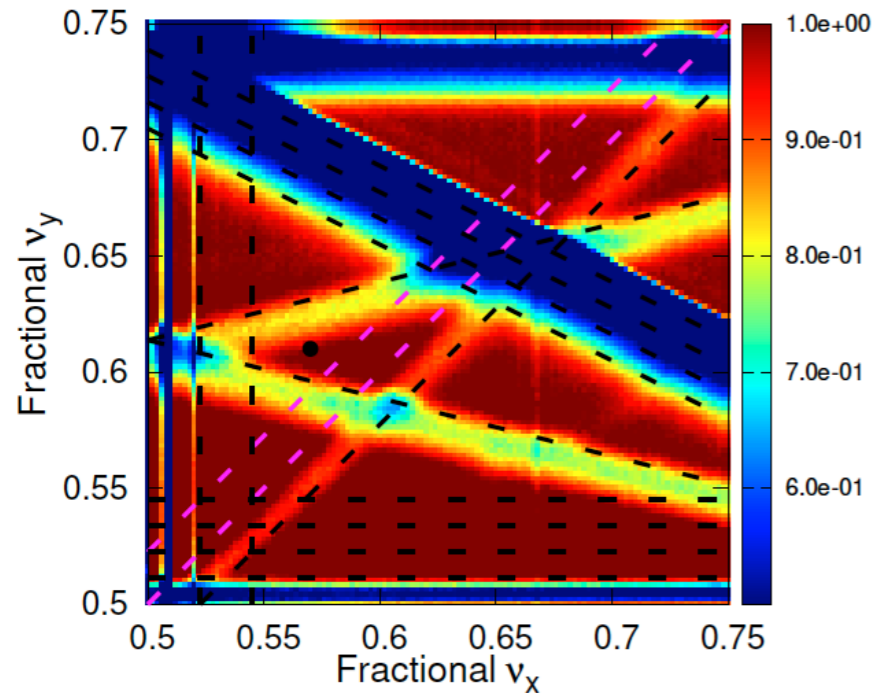
BUT resonance lines of
 $\pm v_x+4v_y+C=N$ NOT shifted?
What is C?



2. BBWS simulation: Tune scan

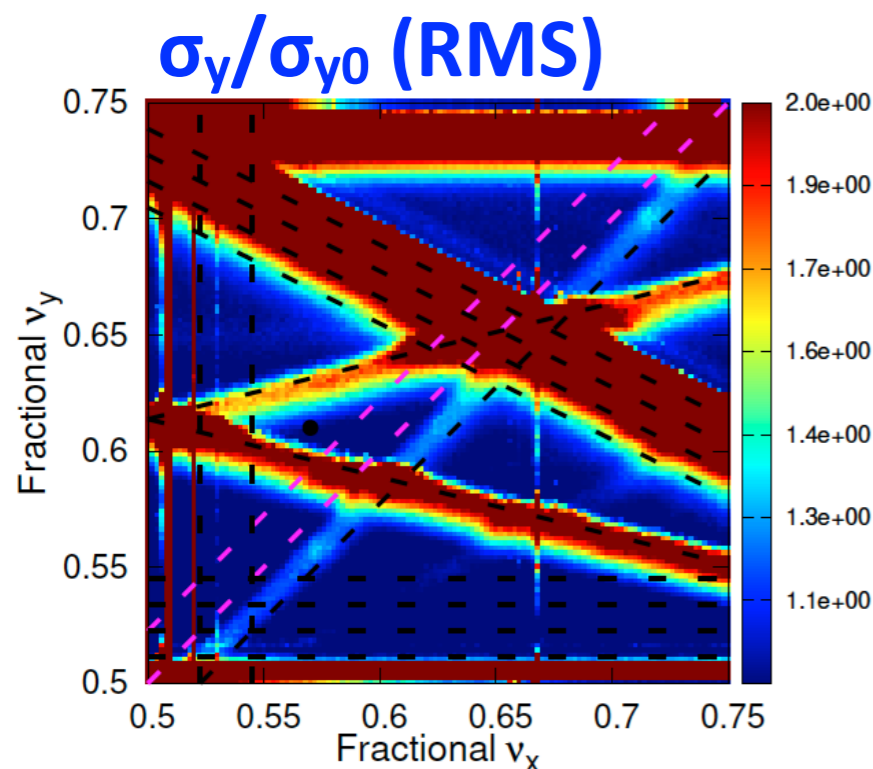
➤ Parameter set (3ex): $v_s=0.01$

$e+(W)e-(S)$
Lum. (L/L_0)



$v_x+k*v_s=N$ shifted as expected
when changing v_s .

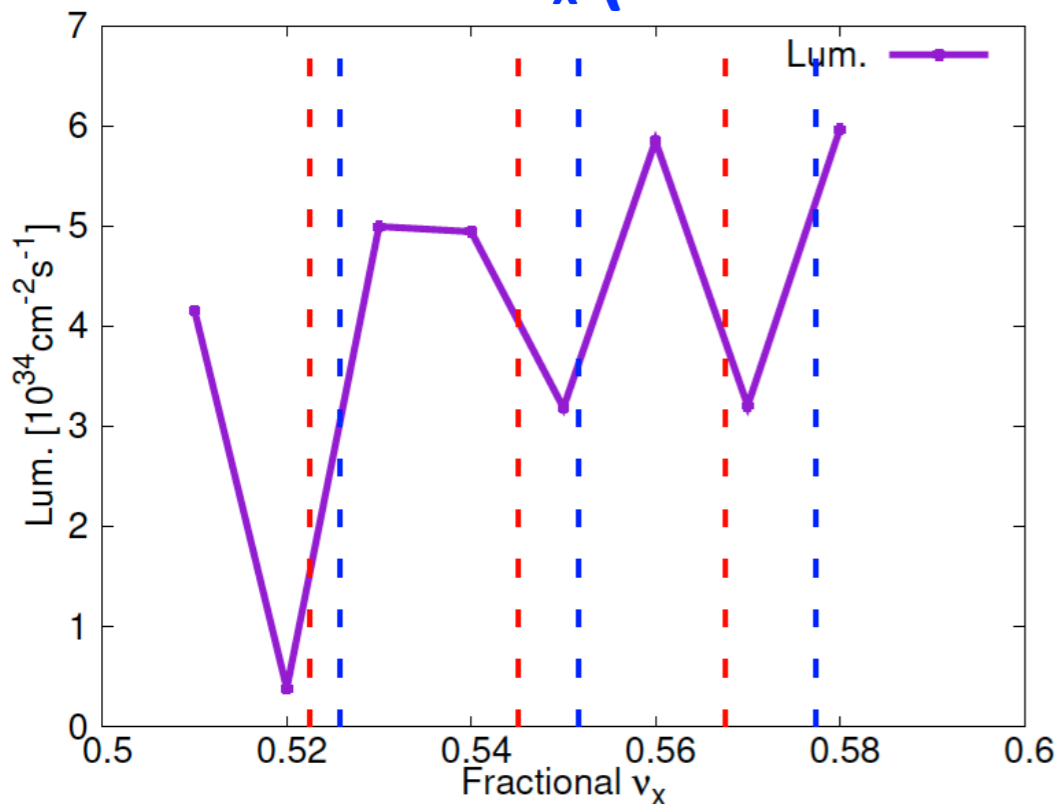
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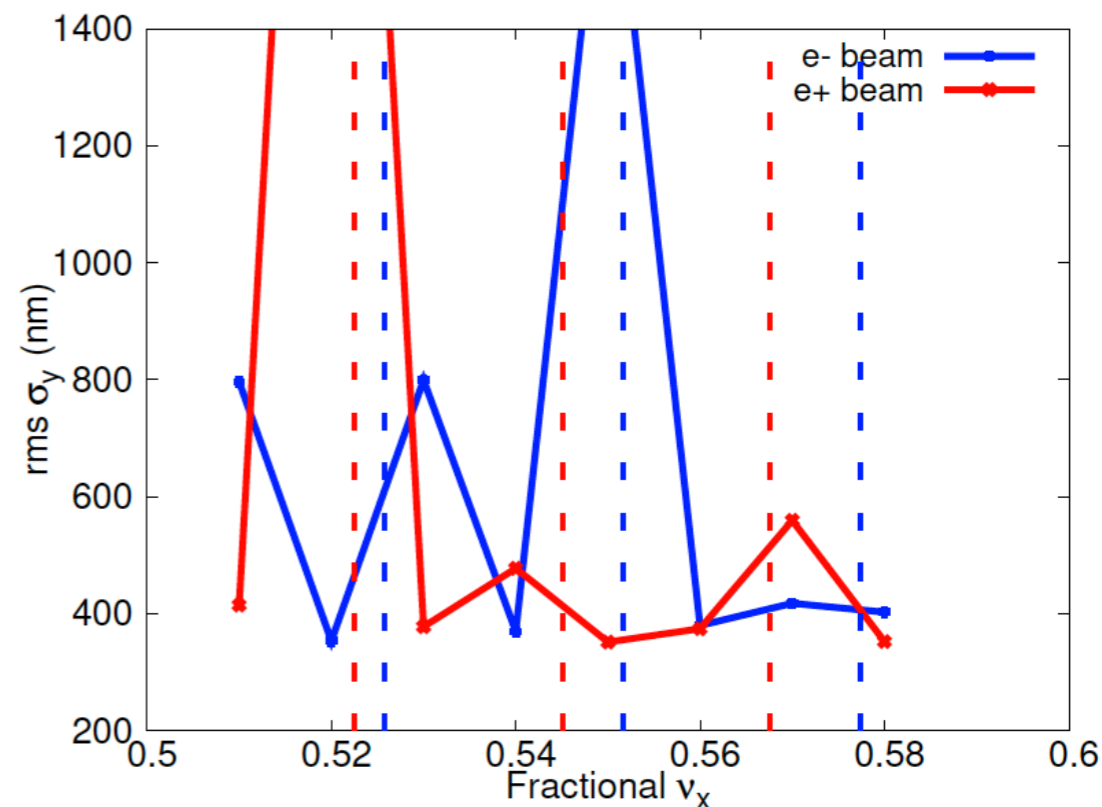
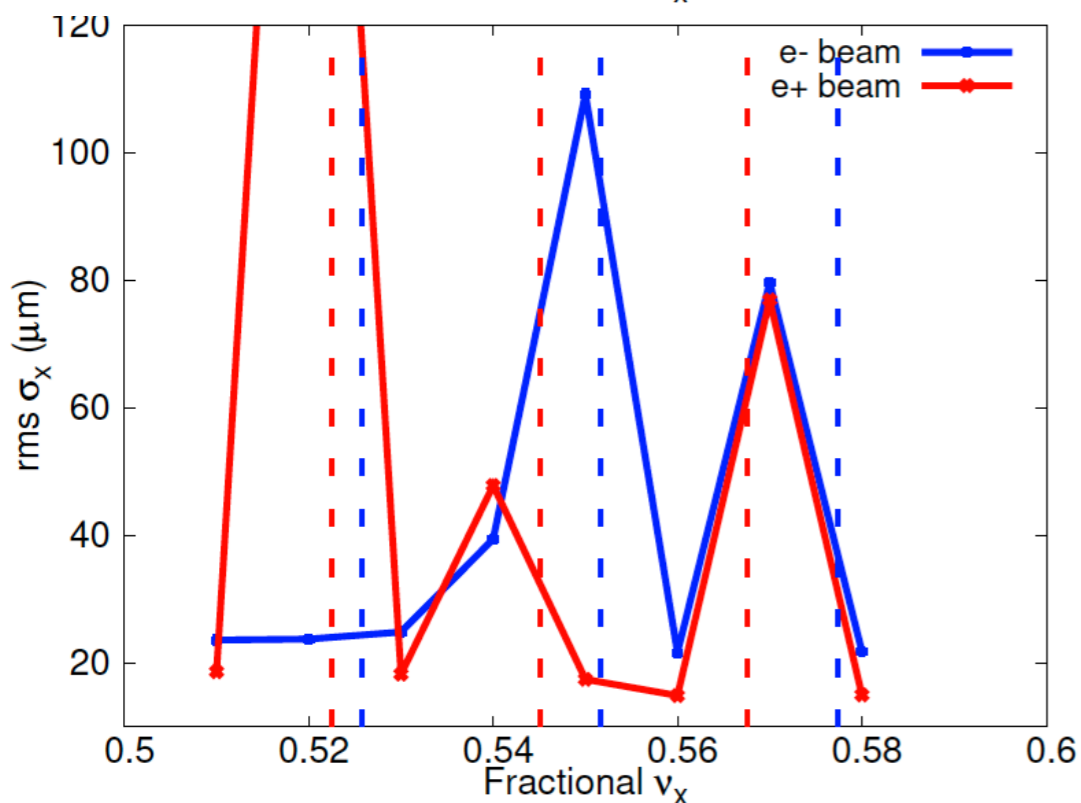
3. BBSS simulation

➤ All parameter set (3ex): $v_y = *.61$

● Scan of v_x (same fractional part for LER and HER)



Need to do more BBSS simulations ...



4. Summary

➤ Tune scan using BBWS

- Near the (.57,.61) working point, the beam-beam resonance $\nu_x+4\nu_y+C=N$ is strong. BUT, what is C? To be understood ...

- x-z instability not seen in weak-strong simulations.

➤ Simulations using BBSS

- x-z beam-beam instability (or blow-up) easily seen in BBSS simulations

- Need more BBSS simulations (limited by available CPUs: typically one job needs 1 week with 8 CPUs)

5. Proposal

➤ Organization of a Virtual Working Group on “Beam dynamics issues at SuperKEKB”

- We are short of human resources to do investigations on beam dynamics issues at SuperKEKB.
- Collaborators from outside KEK need better communications.
- Possible members:
 - * Salvatore Dicarolo (LAL, Beam-beam simulations)
 - * Renjun Yang and Dima El Khechen (CERN, Background)
 - * Kouki Hirosawa (Beam-beam simulations with lattice nonlinearity)
 - * Others: K. Ohmi, K. Oide (Supervisors), D. Zhou, ...
- If approved:
 - * Mailing list: skb-bd@ml.post.kek.jp?
 - * Group webpage?
 - * Periodic video meetings via eZuce?