Intra-beam scattering, space charge and beam-beam at SuperKEKB

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SuperKEKB optics meeting

Oct. 23, 2013

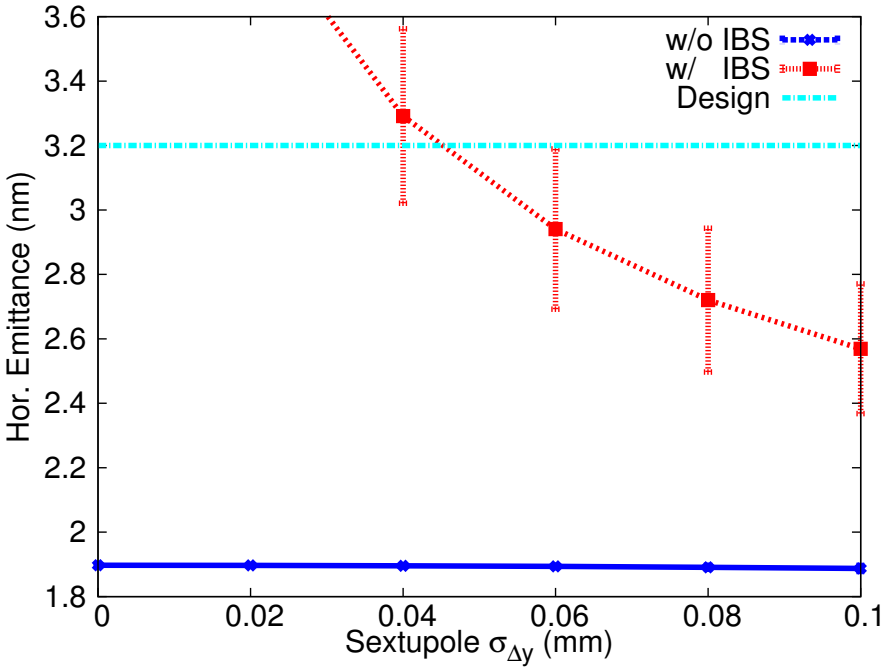
Outline

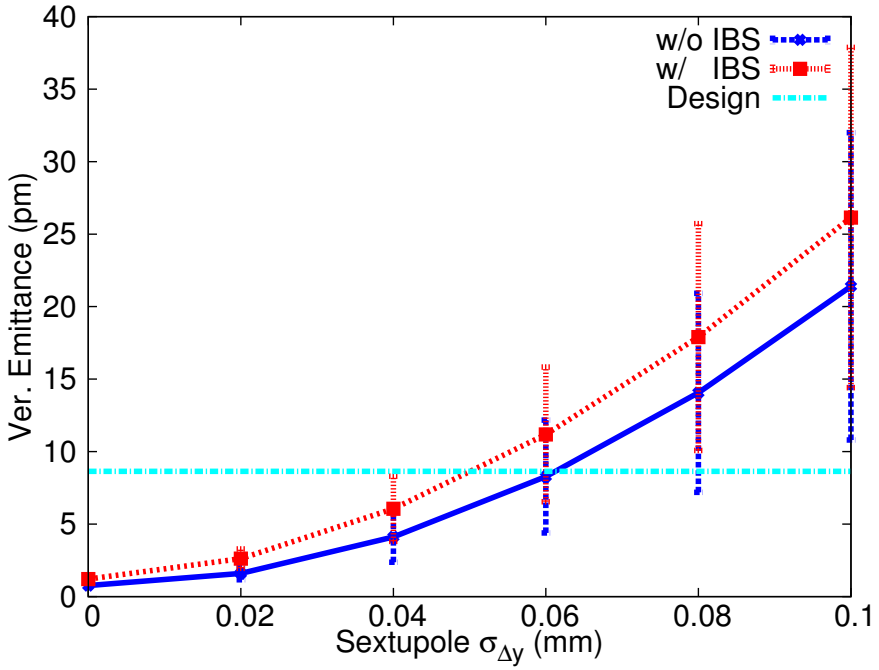
- Intra-beam scattering
- Space charge
- Luminosity tune survey
- Summary

1. IBS: LER: sler_1684

➤ **Emittance growth due to IBS (w/ errors in sext.)**

- ε_x decrease with increasing errors in sext.
- SAD script: FFS["dely "//sigdy//" S{DF}*"];
- No optics correction
- MINCOUP=0;

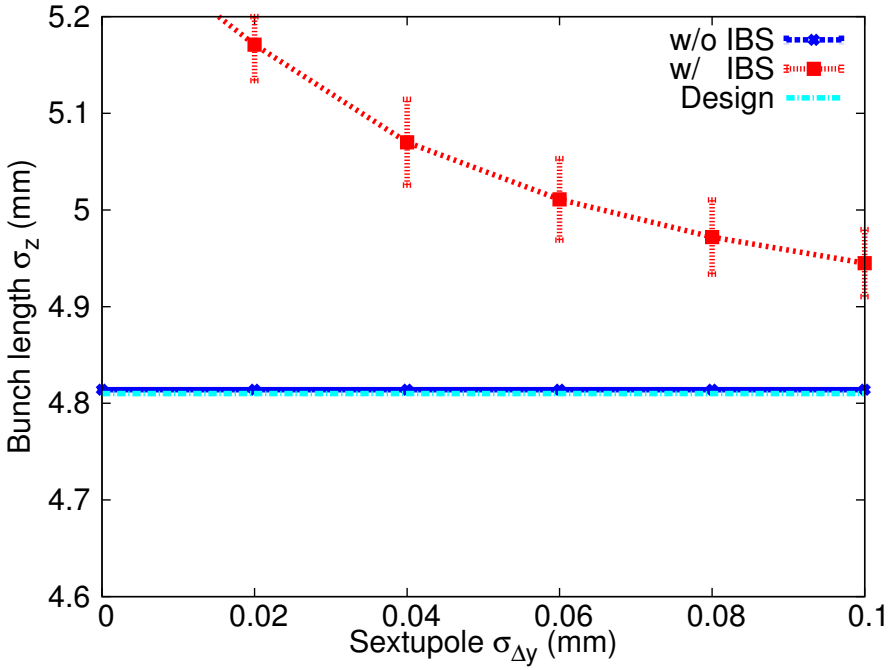


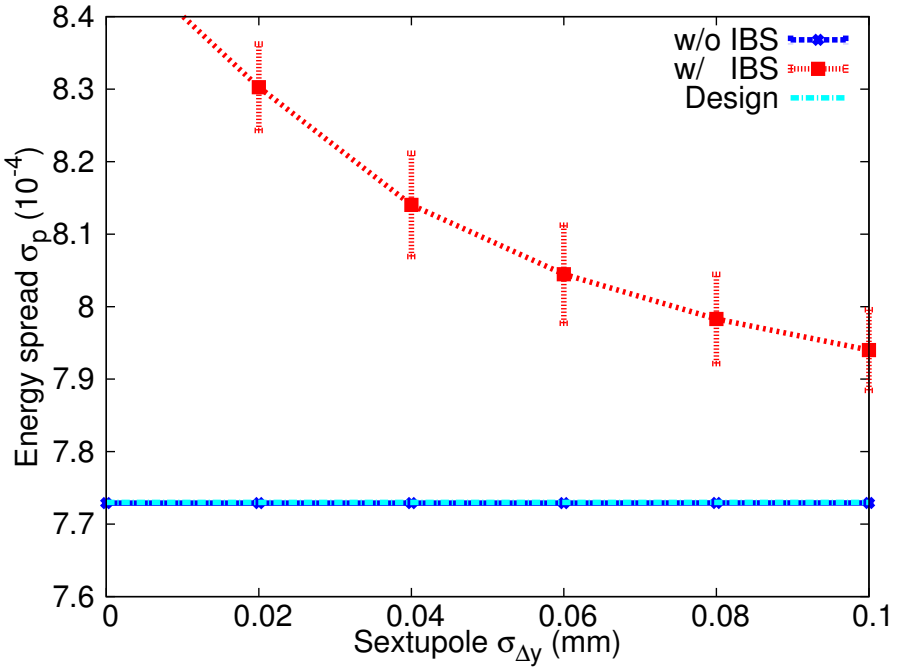


1. IBS: LER: sler_1684

➤ **Bunch lengthening and energy spread due to IBS**

- **Both σ_z and σ_p slightly increase due to IBS**
- **Fairly not negligible in LER**





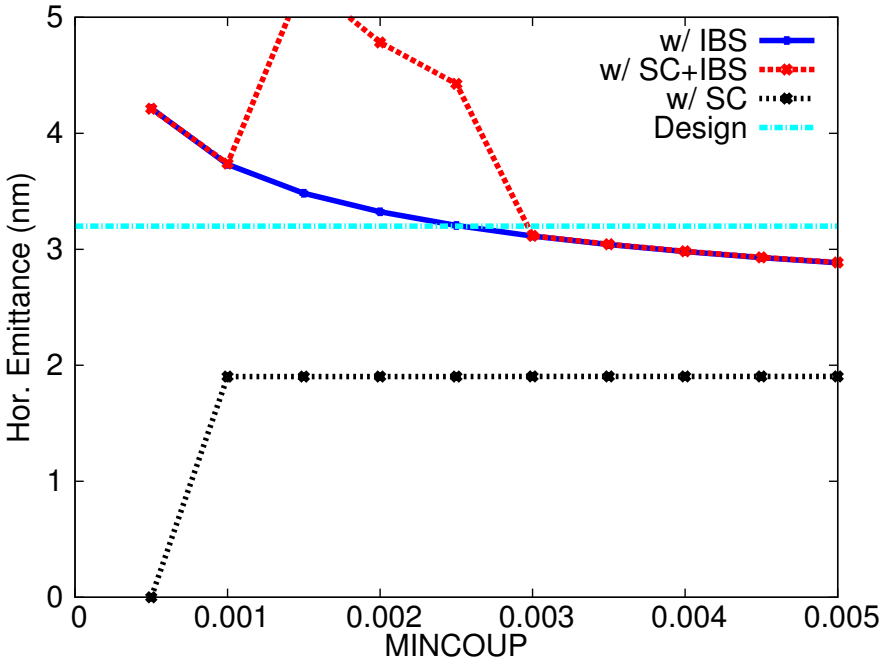
1. IBS: LER: sler_1684: +SC

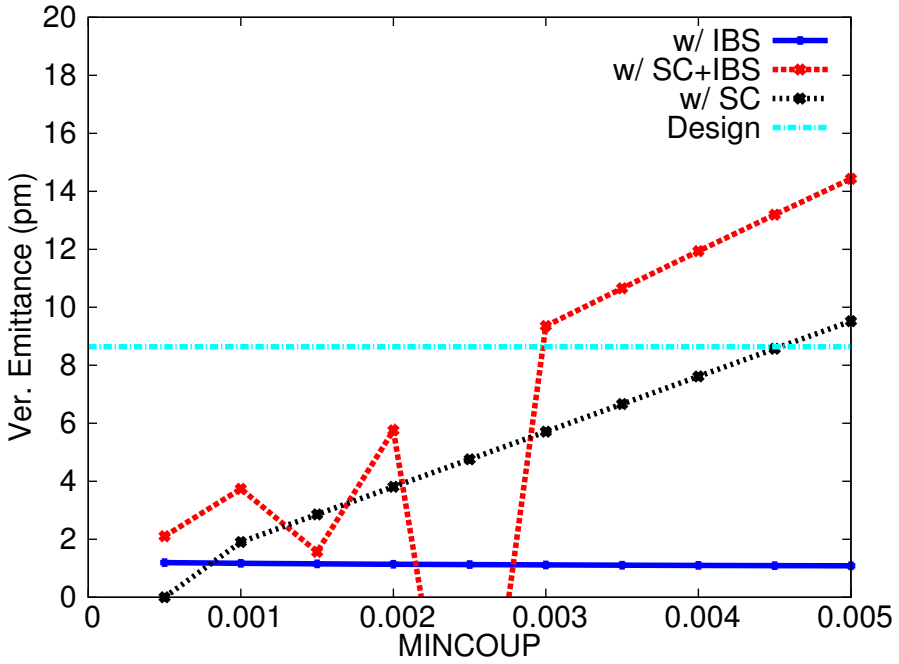
➤ **Optics matching with space charge using SAD**

- Use MINCOUP to manipulate emittance
- Optics matching w/ SC not easy:

  Linear tune shift

  X-Y coupling

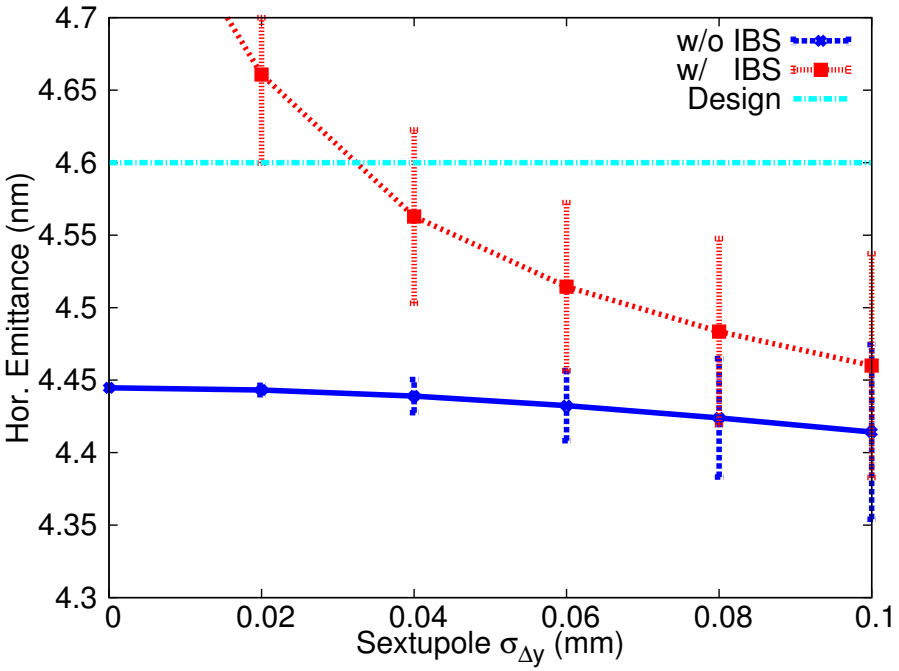


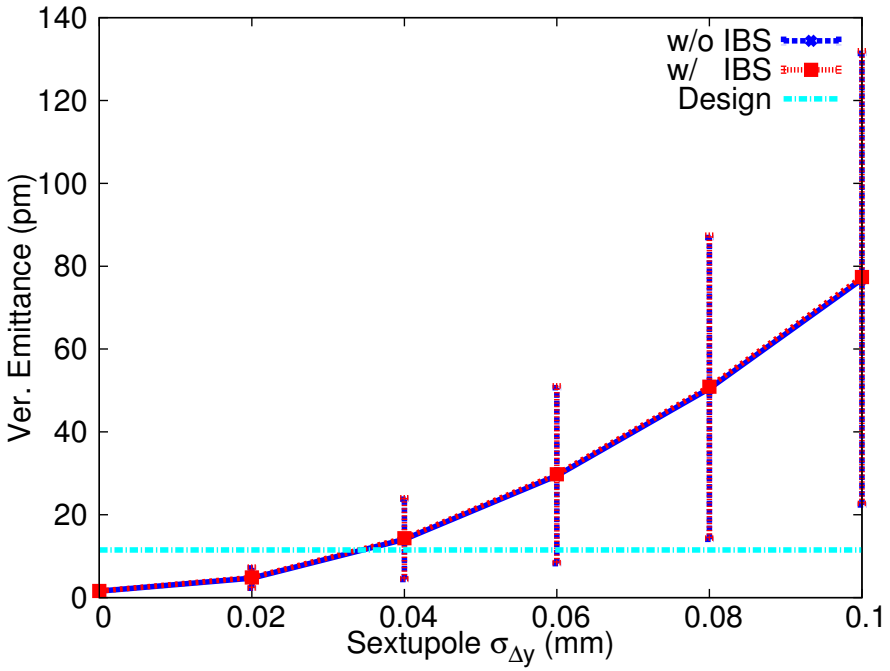


1. IBS: HER: sher_5755

➤ **Emittance growth due to IBS (w/ errors in sext.)**

- ε_x slightly decrease with increasing errors in sext. $\Delta\varepsilon_x$ < 3%
- Negligible in vert. direction
- Effects of IBS in HER almost negligible
- MINCOUP=0;

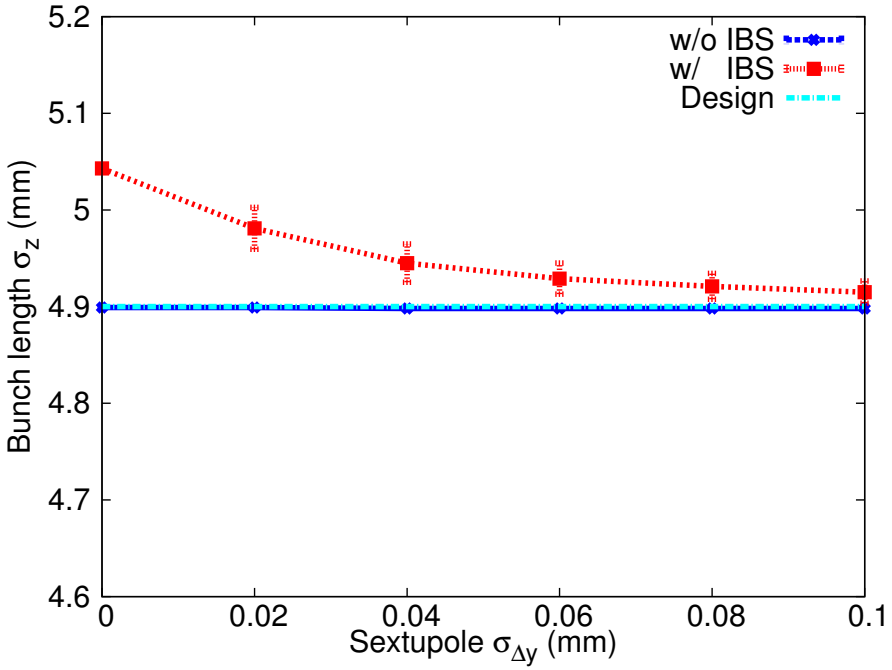


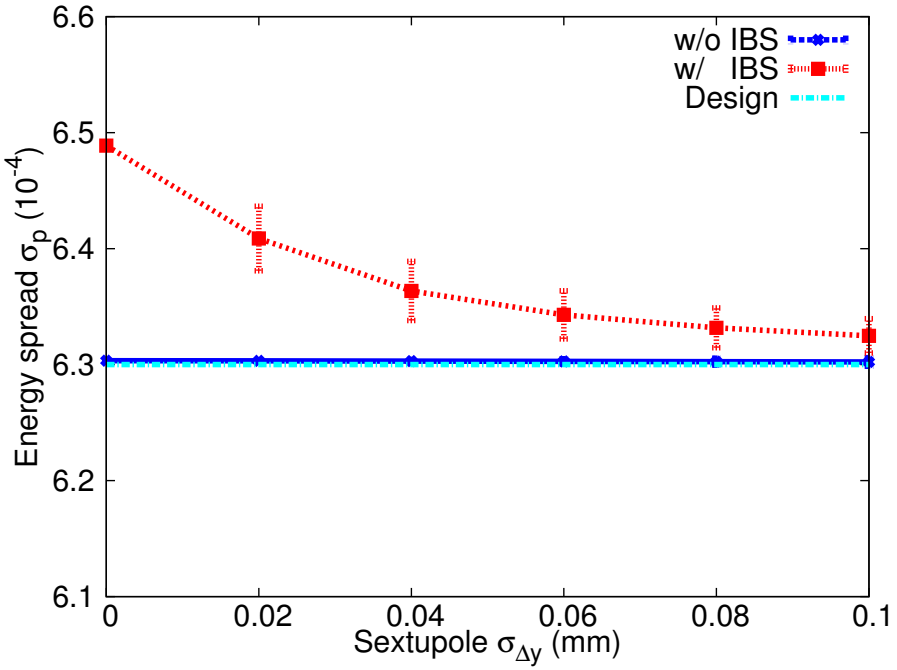


1. IBS: HER: sher_5755

➤ **Bunch lengthening and energy spread due to IBS**

- **Both σ_z and σ_z slightly increase due to IBS**
- **Fairly negligible in HER**
- **Effects of IBS in HER almost negligible**



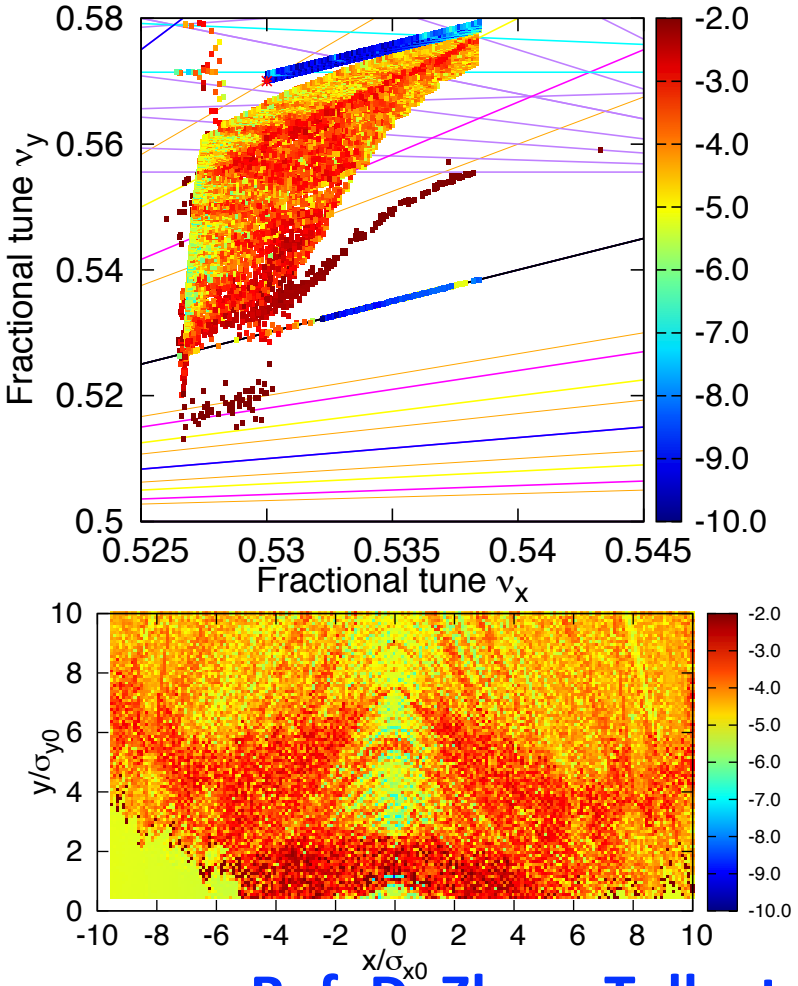


sler_1684

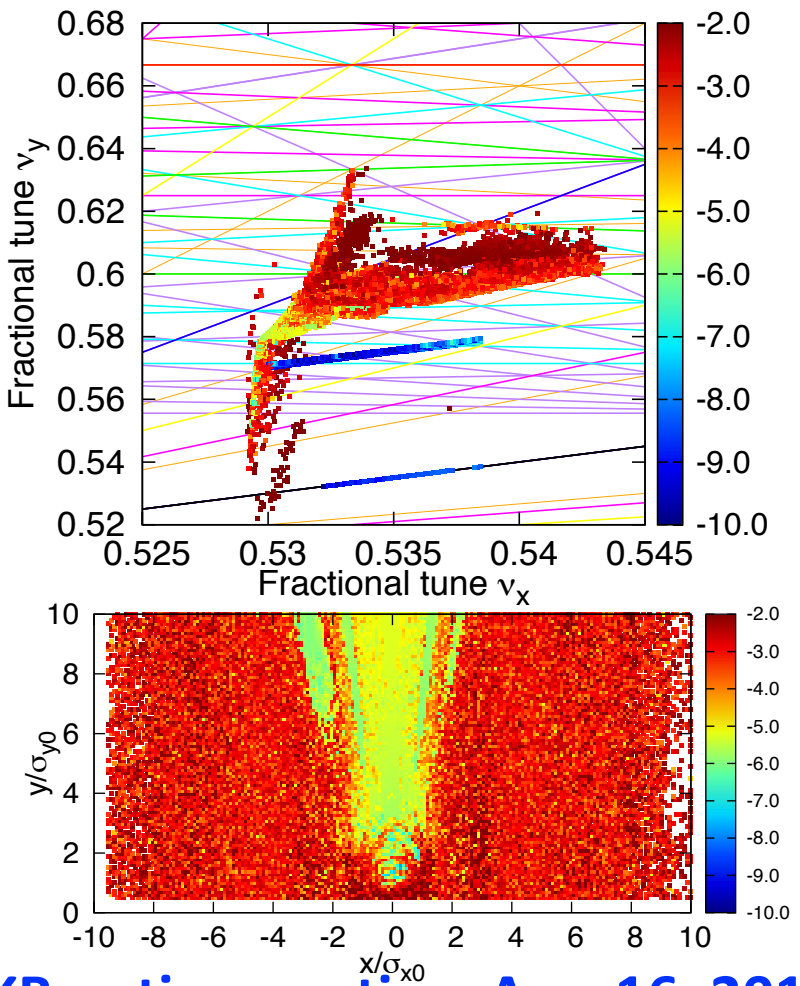
2. Lum.: LER: SC effect

- FMA with beam distribution: $10\sigma_x \times 10\sigma_y$
- Question: How to compensate SC effect?

LN + SC



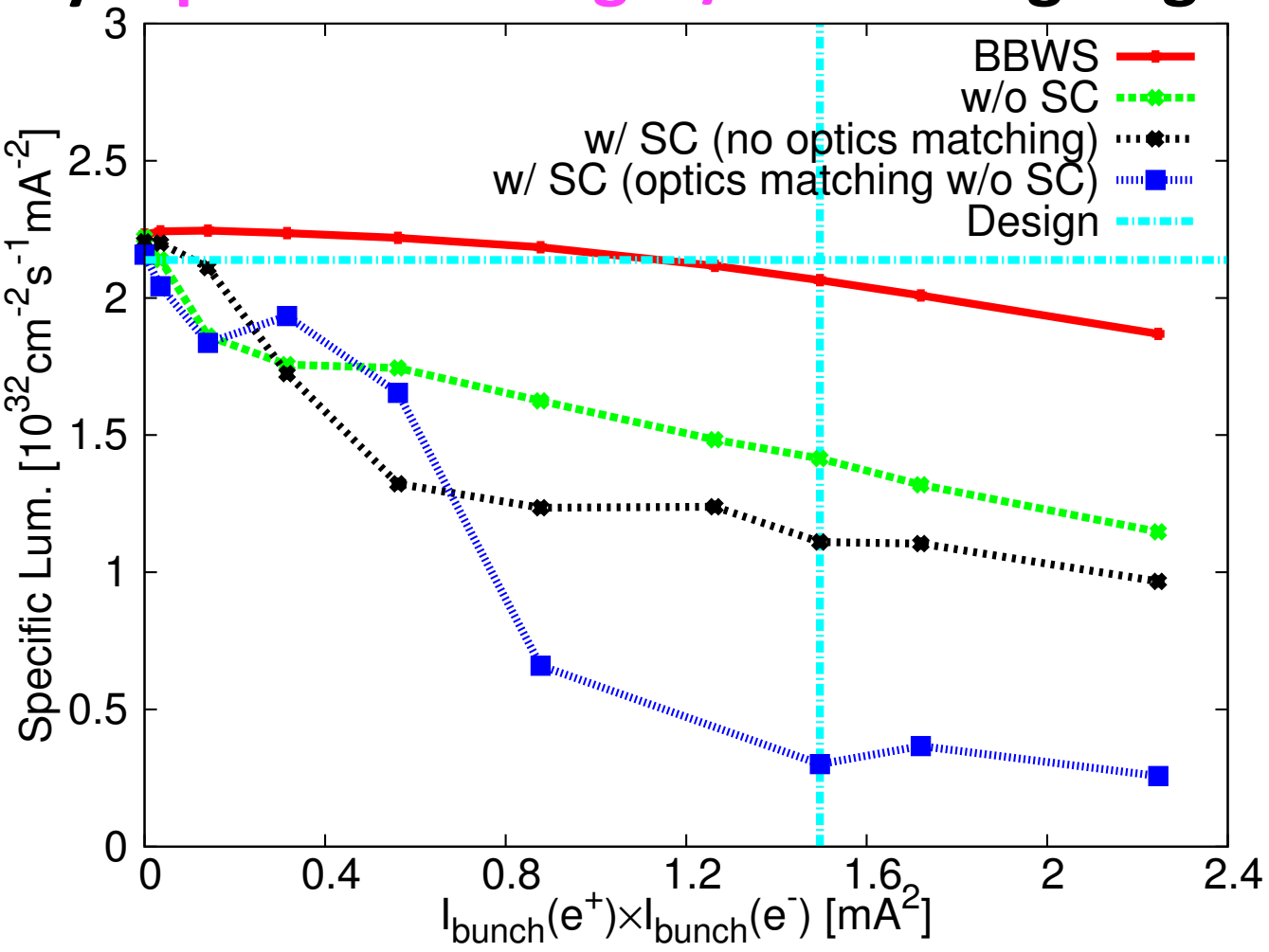
LN + SC + BB



Ref. D. Zhou, Talk at SuperKEKB optics meeting, Apr. 16, 2013

2. Lum.: LER: SC effect

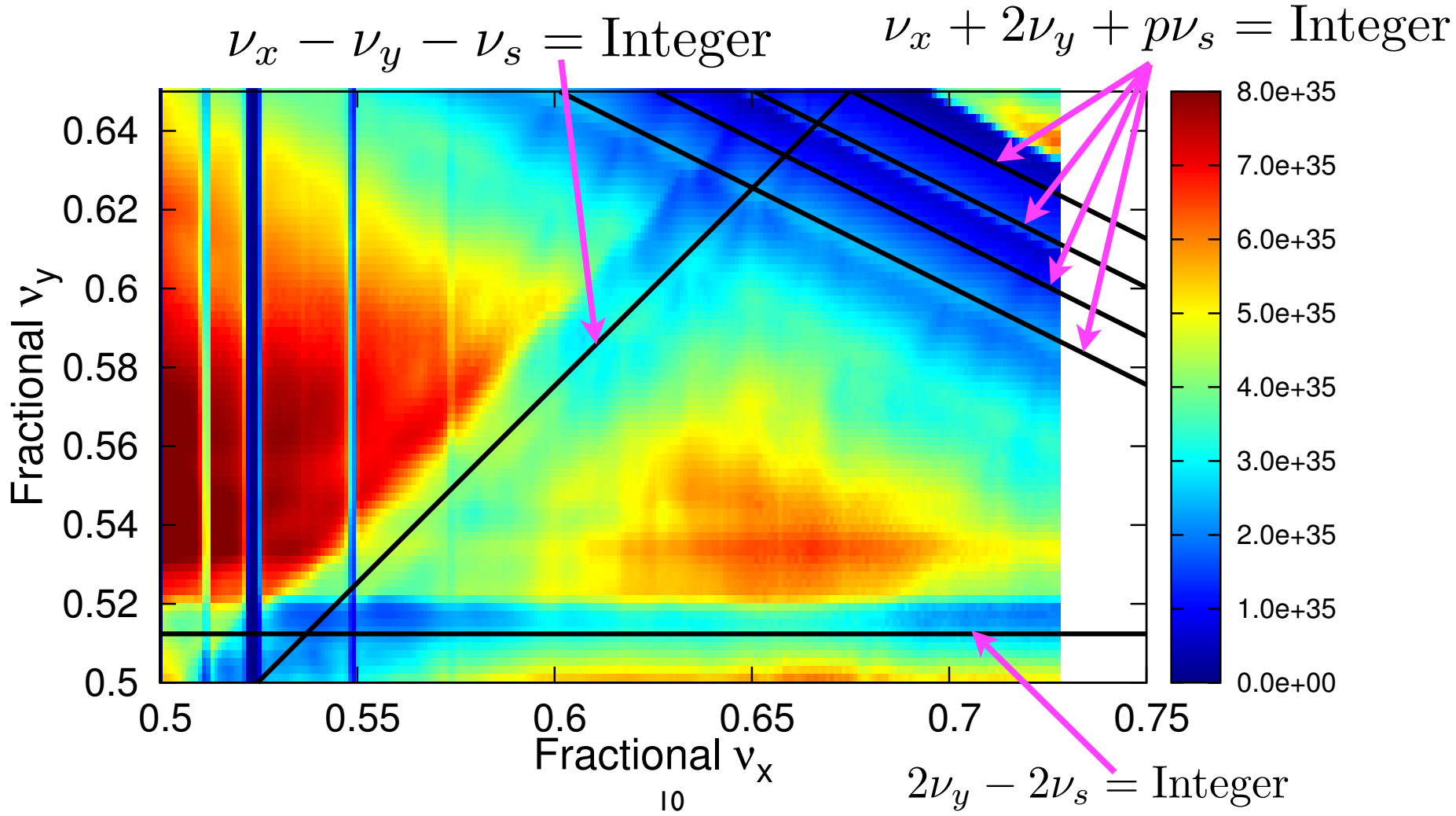
- First try: optics matching w/o SC
- Compensate linear SC tune shift => Failure?
- Next try: optics matching w/ SC => Ongoing



3. Lum.: LER: Tune survey

➤ **w/o crab waist:**

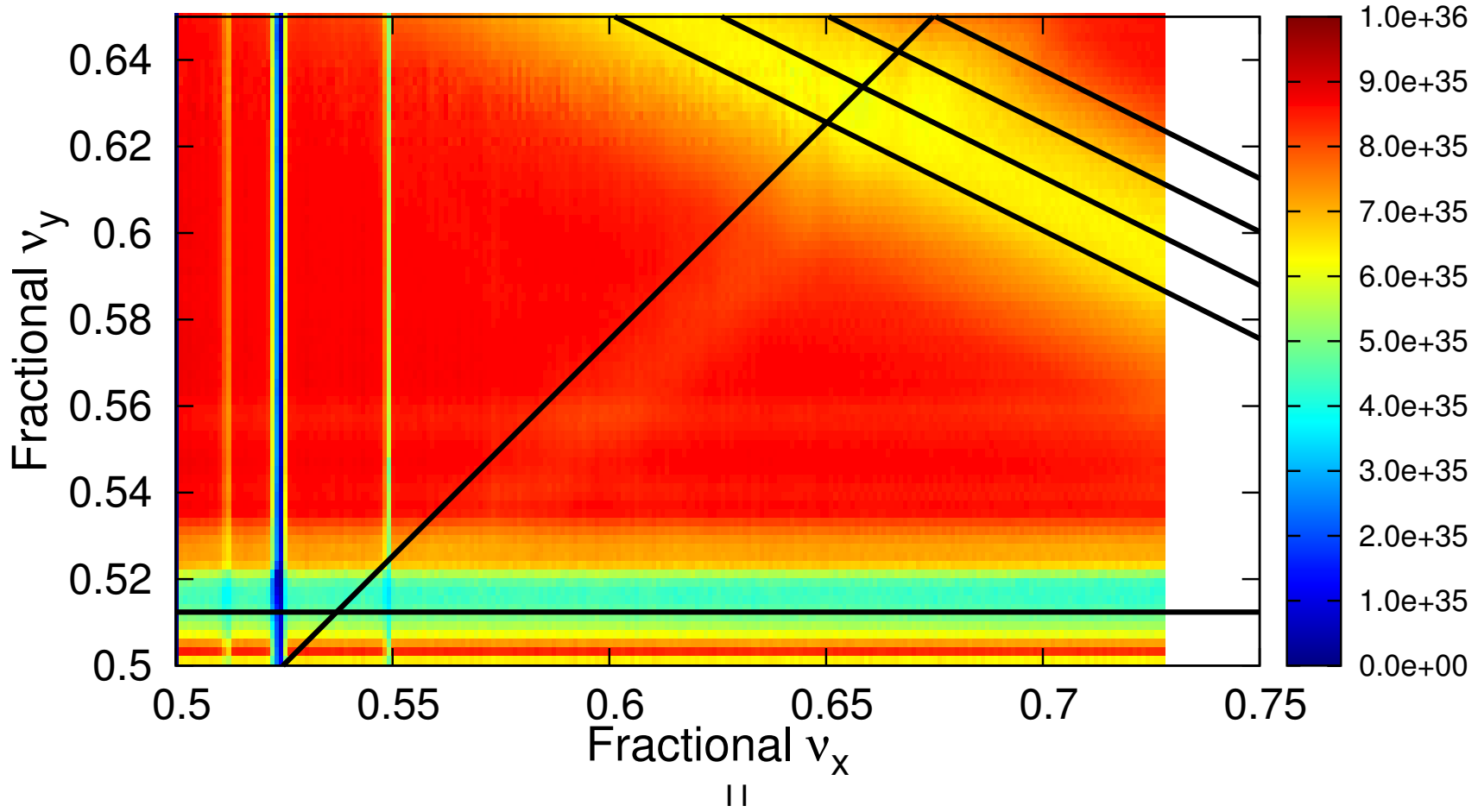
- **Beam-beam resonances (in general enhanced by LN)**
- **Working point: (.53,.57) => (.65, .535)?**



3. Lum.: LER: Tune survey

➤ **w/ crab waist:**

- **Beam-beam resonances significantly suppressed**
- **Choice of working point relaxed**



4. Summary

➤ **Optics matching for compensation of SC effect**

- Seems to be challenging
- Work on progress

➤ **Luminosity tune survey**

- (.53,.57): L≈8e35 $cm^{-2}s^{-1}$
- (.65, .535): L≈7e35 $cm^{-2}s^{-1}$ => Good choice if consider DA survey (ref. H. Sugimoto)?

➤ **Open questions**

- SC affects DA and lifetime?
- Alternative methods for SC compensation via optics matching?