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Review and Double-check of technote "Reasonable Beam Deviation Envelope for Ray-tracing"

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This note summarizes an independent review and double-check on the technote titled “Reasonable Beam Deviation Envelope for Ray-tracing” (BNL-211206-2019-TECH and NSLSII-ASD-TN-269) written by W. Guo [1]. The NSL-II Lattice used here includes 17 installed IDs prepared by V. Smalyuk. Here only the horizontal envelope was double-checked.

1. There are two physical aperture data files (red crosses and black dots) provided but in different formats. First, they were compared and found that they agree with each other.

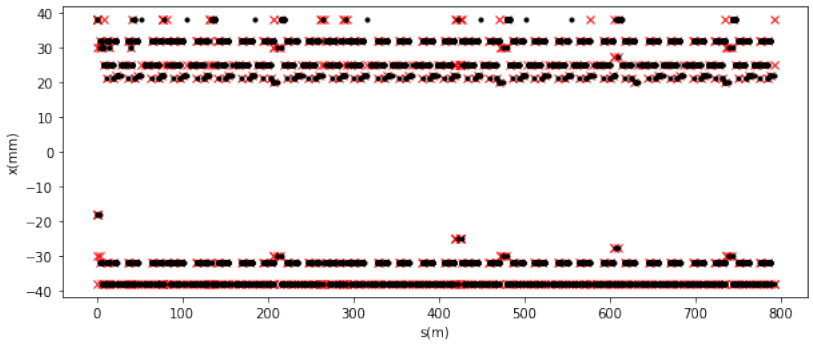

Figure 1. Horizontal physical aperture along the longitudinal direction

2. According to the assumptions in Ref. [1], all corrector strengths were set randomly (with a standard deviation 0.04 mrad), and the beam’s off-energy was varied with the RF frequency in the range of +/-500Hz. In this case, some of closed orbits are beyond the apertures. Therefore, we conclude that 0.04 mrad kicks are too strong and need to be scaled down.

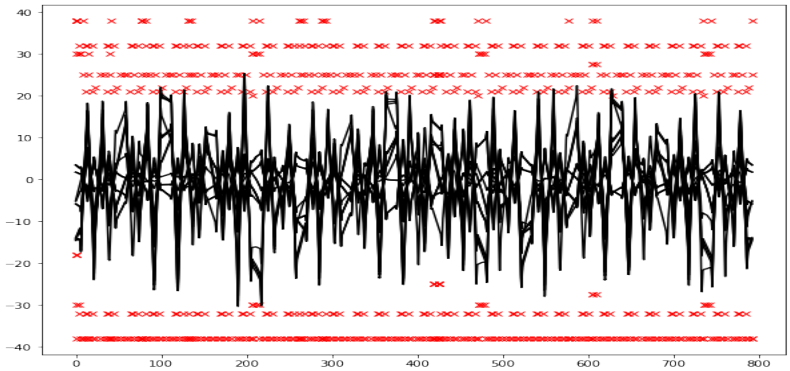

Figure 2. Some of closed orbits are beyond the apertures

3. Then the corrector strengths were scaled down to 0.03 mrad, and the RF frequency variation range is still [-500, +500] Hz. The closed orbits are well confined within the apertures in this

case. Therefore, we think such settings can generate a reasonable closed orbit envelope in the machine.

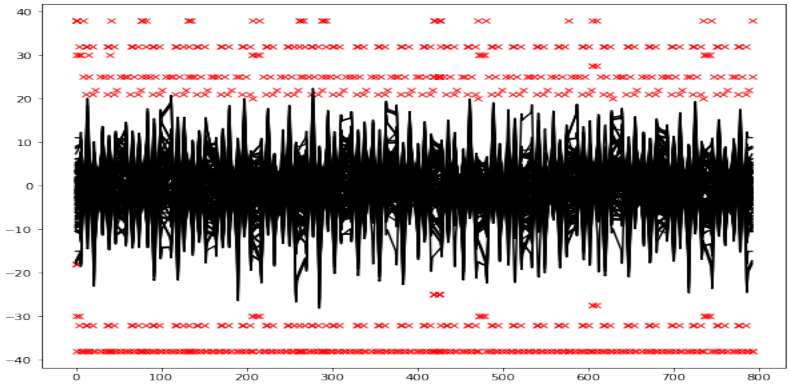

Figure 3. Closed orbits are well confined within the apertures

4. To be conservative, we computed the RMS values closed orbit along the longitudinal direction as the envelope for the protection system. The magnitude is found to be at the same order of Fig. 6 in Ref. [1] analysis. Based on this double-check, I concluded that the calculation and results in Ref. [1] are reasonable.

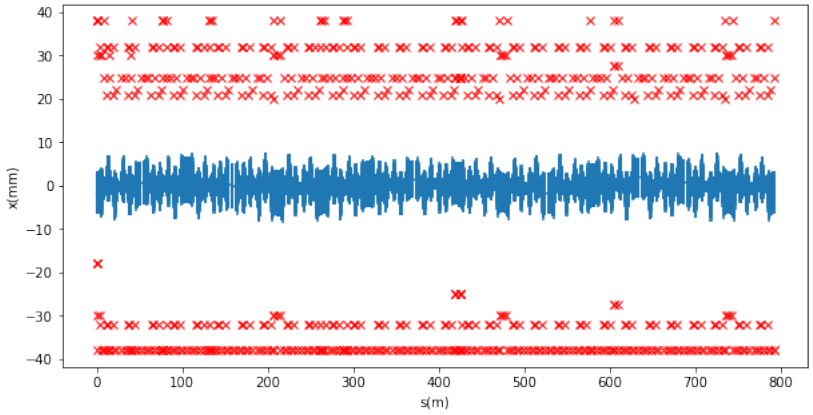

Figure 4. RMS closed orbit envelope for the whole ring

For example, at the injection point, the envelope range in Ref. [1] is about +/-5mm (Fig.6 in ref. [1]). We plotted out the histogram of closed orbit distribution there and calculated the RMS value, which is about 4.85mm. Because we used only 250 random seeds, and much more seeds were used in Ref. [1], the original report result should be more accurate.

In conclusion, we confirmed the orbit envelope values listed in Table 1 of Ref. [1], which were calculated with the assumptions listed on page 2 of Ref. [1].

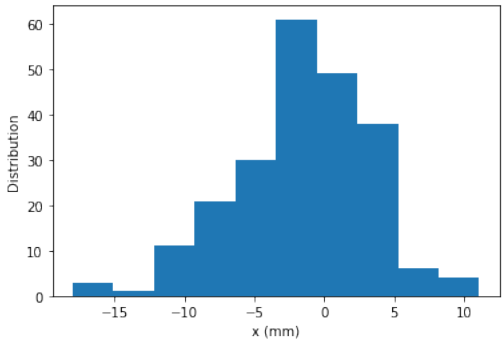

Figure 5. Distribution of closed orbit at the injection point, i.e., s = 0 m. The standard deviation is about 4.85 mm, which is comparable with the result (about 5 mm) in Ref. [1].

Reference:

[1] W. Guo, Reasonable Beam Deviation Envelope for Ray-tracing, BNL-211206-2019-TECH and NSLSII-ASD-TN-269, 2018