

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

Y. Li

February 2022

Photon Sciences

Brookhaven National Laboratory

U.S. Department of Energy

USDOE Office of Science (SC), Basic Energy Sciences (BES) (SC-22)

Notice: This technical note has been authored by employees of Brookhaven Science Associates, LLC under Contract No. DE-SC0012704 with the U.S. Department of Energy. The publisher by accepting the technical note for publication acknowledges that the United States Government retains a non-exclusive, paid-up, irrevocable, world-wide license to publish or reproduce the published form of this technical note, or allow others to do so, for United States Government purposes.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

NSLS-II TECHNICAL NOTE BROOKHAVEN NATIONAL LABORATORY	NUMBER NSLSII-ASD-TN-373
AUTHORS: Li, Yongjun	DATE 02/11/2022
<i>Review and Double-check of technote “Reasonable Beam Deviation Envelope for Ray-tracing”</i>	

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

Y. Li
Feb. 2022

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.

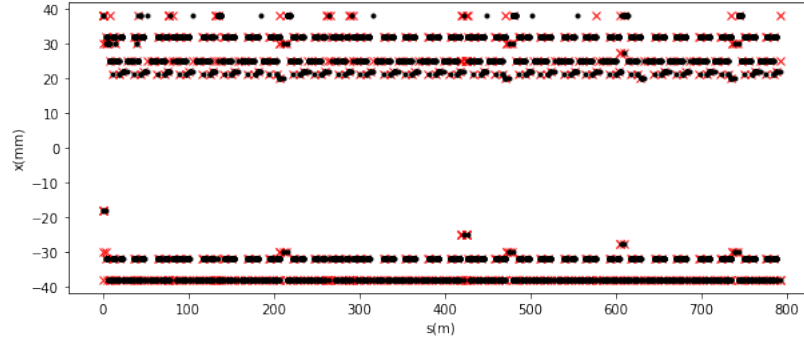


Figure 1. Horizontal physical aperture along the longitudinal direction

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 ± 500 Hz. 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.

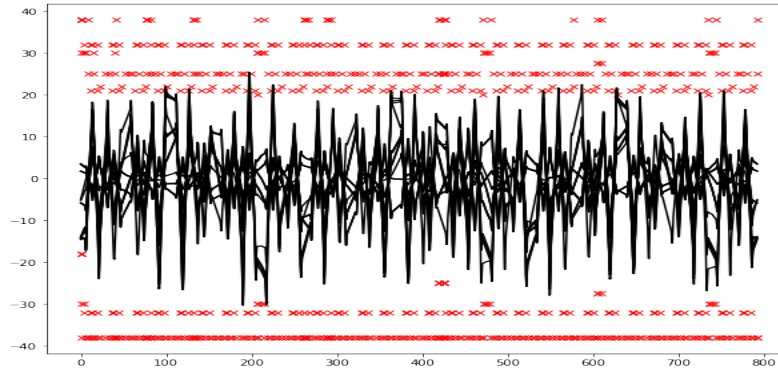


Figure 2. Some of closed orbits are beyond the apertures

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.

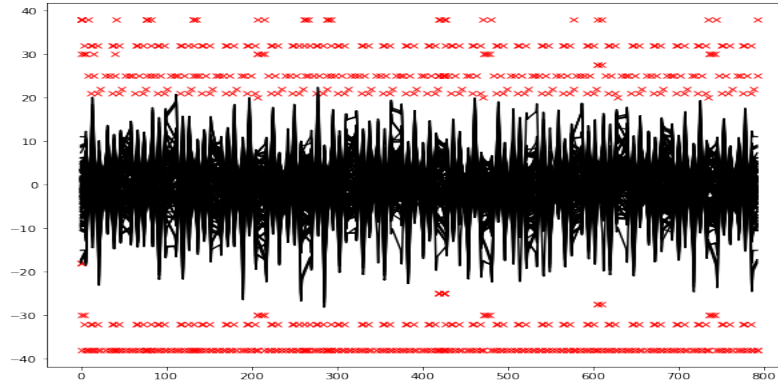


Figure 3. Closed orbits are well confined within the apertures

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.

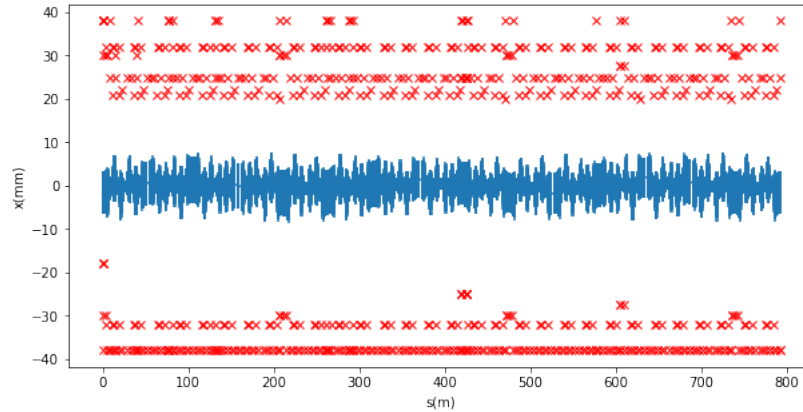


Figure 4. RMS closed orbit envelope for the whole ring

For example, at the injection point, the envelope range in Ref. [1] is about ± 5 mm (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].

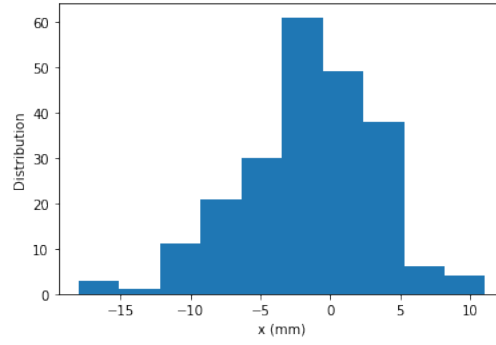


Figure 5. Distribution of closed orbit at the injection point, i.e., $s = 0$ m. The standard deviation is about 4.85 mm, which is comparable with the result (about 5 mm) in Ref. [1].

Reference:

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