Erratum: Reply to "Comment on 'Fast-slow mode coupling instability for coasting beams in the presence of detuning impedance'" [Phys. Rev. Accel. Beams 24, 078002 (2021)]

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An error was found in Fig. 1 of this paper for the number of segments $N_{\mathrm{seg}} > 1$. The kick distribution scheme was leading to the same one-turn-map as a single kick scheme: this was inadvertently left from previous studies investigating the dependence of the fast-slow mode coupling instability on the lattice phase advance.

The authors reviewed and implemented the uniform kick distribution scheme assigning each impedance kick to a specific s location along the accelerator circumference C. Given a number of segments N_{seg}, the kick location is located at $s \in \{C/N_{\mathrm{seg}}, 2C/N_{\mathrm{seg}}, \ldots, C\}$ and scaled in amplitude by $1/N_{\mathrm{seg}}$. Figure 1 below shows the updated results for $N_{\mathrm{seg}} = 1, 2,$ and 10. The fast-slow mode coupling instability is observed for the case of a single kick ($N_{\mathrm{seg}} = 1$), while, already for two equally spaced kicks, the effect of coupling is not visible and the classical result without coupling is obtained, which is due to the particular phase advance between the two kicks.

Indeed, Fig. 2 shows the rise-time dependence on the phase advance $\Delta\varphi$ between two kicks while varying $\Delta\varphi \in \{0, 2\pi\}$ for the intensity of 5×10^{13} p+. The fast-slow mode coupling effect is enhanced or reduced depending on the phase advance between the two kicks. In particular, for $\Delta\varphi = 0$, we recover the same result as for a single lumped kick; for $\Delta\varphi = 0.2$, there is no coupling since, for a fractional tune of 0.4, the particles experience two kicks in opposite phase as also shown in Fig. 1 (note the periodicity of 0.5 in Fig. 2). The effect of coupling between fast and slow coasting beam modes vanishes for a distributed impedance, in agreement with [1].

These observations suggest that the effect could also be modeled considering the effect of a complex detuning close to the half-integer as suggested in [2]: the complex tune shift of the impedance sampled at the fast and slow waves frequency

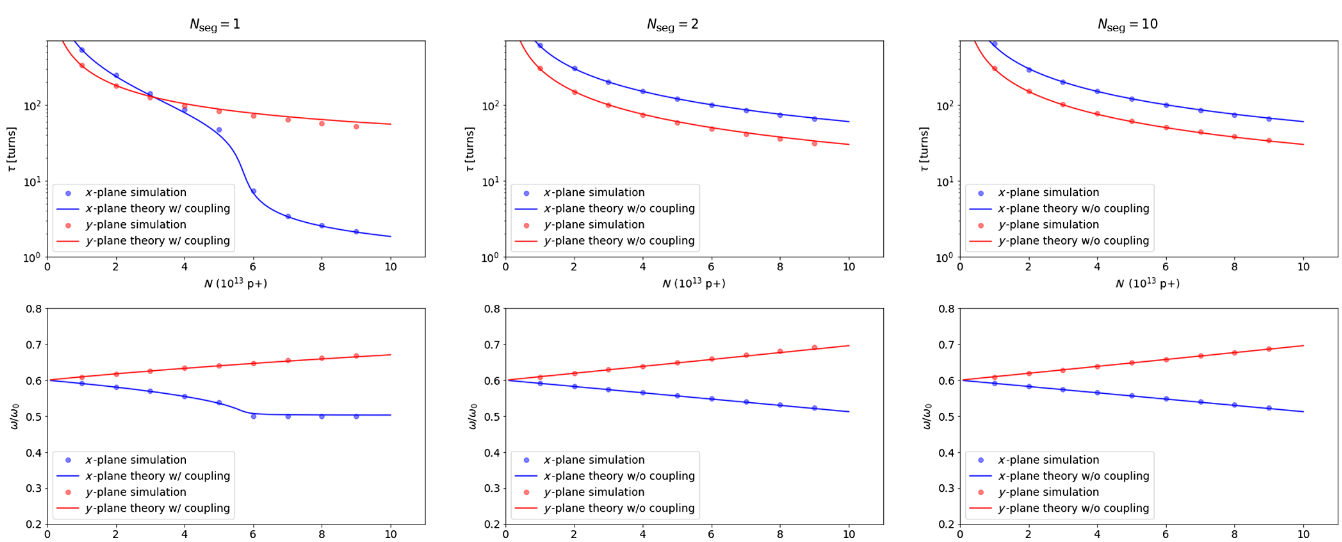

FIG. 1. Updated comparison between tracking simulations and theory with coupling (for $N_{\mathrm{seg}} = 1$) and without coupling (for $N_{\mathrm{seg}} = 2$ and $N_{\mathrm{seg}} = 10$ with equally spaced kicks). The rise time versus beam intensity is shown at the top, while the real part of the tune shift versus beam intensity is shown at the bottom.

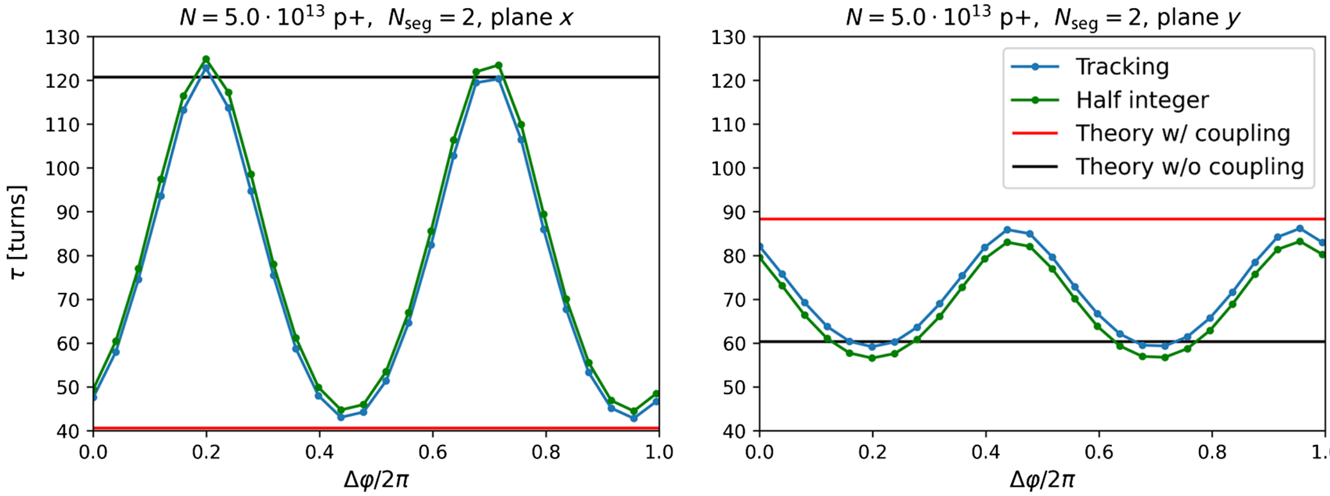

FIG. 2. Rise-time dependency on the phase advance between two kicks in the lattice for the horizontal (left) and vertical plane (right).

described in [3] is applied as a perturbation to the lattice one turn map [4]. The corresponding unstable mode rise time is plotted in Fig. 2 in green, showing very good agreement with the tracking simulations and confirming the mechanism as an intensity-dependent single-particle effect.

For a larger number of kicks, e.g., $N_{\rm seg} = 10$, the effect of the phase advance averages to zero, effectively suppressing the coupling as shown in Fig. 1. Nevertheless, specific machine working point and phase advance arrangements could, in principle, enhance/reduce the fast-slow mode coupling instability. For example, the dependence on the machine working point was extensively studied in [5] for a single kick.

In summary, the authors agree with the comment presented in [1] and highlight that the results and conclusions presented in [3] are still valid as related to a localized impedance kick or to specific arrangements of the phase advance between a larger number of kicks.

[1] A. Burov and V. Lebedev, Comment on "fast-slow mode coupling instability for coasting beams in the presence of detuning impedance", Phys. Rev. Accel. Beams **24**, 078001 (2021).

[2] X. Buffat, Half integer resonance, in *Proceedings of ABP-CEI Meeting, CERN, Geneva, Switzerland, 2021*, https://indico.cern.ch/event/1042401/contributions/4379212/attachments/2274970/3864485/2021-05-07_halfInteger.pdf.

[3] N. Biancacci, E. Métral, and M. Migliorati, Fast-slow mode coupling instability for coasting beams in the presence of detuning impedance, Phys. Rev. Accel. Beams **23**, 124402 (2020).

[4] N. Biancacci, E. Métral, and M. Migliorati, Fast-slow mode coupling instability for coasting beams vs. half-integer resonance, in *Proceedings of ABP-CEI Meeting, CERN, Geneva, Switzerland, 2022*, https://indico.cern.ch/event/1132018/contributions/4750265/attachments/2401229/4106524/FastSlowModeCouplingVsHalfIntegerResonance_EM_03-03-2022.pdf.

[5] N. Biancacci, E. Métral, and M. Migliorati, Effect of segmentation on the fast-slow coasting beam mode coupling instability, in *Proceedings of ABP-CEI Meeting, CERN, Geneva, Switzerland, 2022*, https://indico.cern.ch/event/1132018/contributions/4750265/attachments/2401229/4106716/CE\I_segmentation_03032022_NB.pdf.