On the beneficial/detrimental effect of the detuning impedance for the TMCI

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- See our recent paper with GiovanniR and XavierB (https://cds.cern.ch/record/2714848/files/CERN-ACC-NOTE-2020-0019.pdf)
  - "Short-bunch" regime vs. "long-bunch" regime
  - Comparison with respect to the symmetric case OR the driving impedance (which is also modified in the asymmetric case)?

“Short-bunch” regime (2-particle or 2-mode)

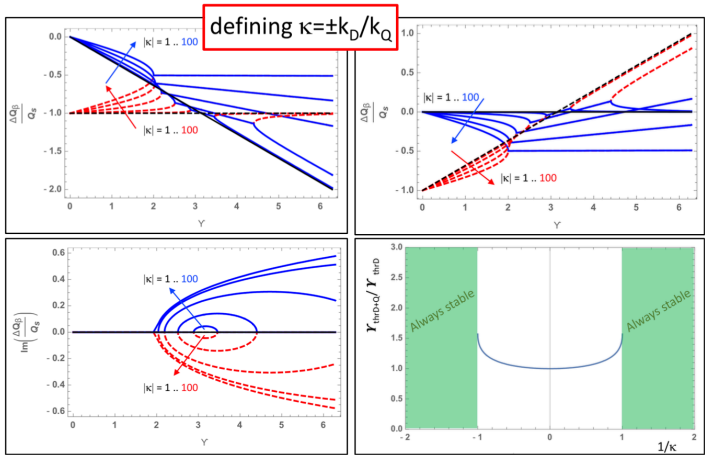


Figure 2: Summary of the results obtained by extending the two-particle model, discussed in the past with dipolar (D) wake only, to include also the quadrupolar (Q) wake.

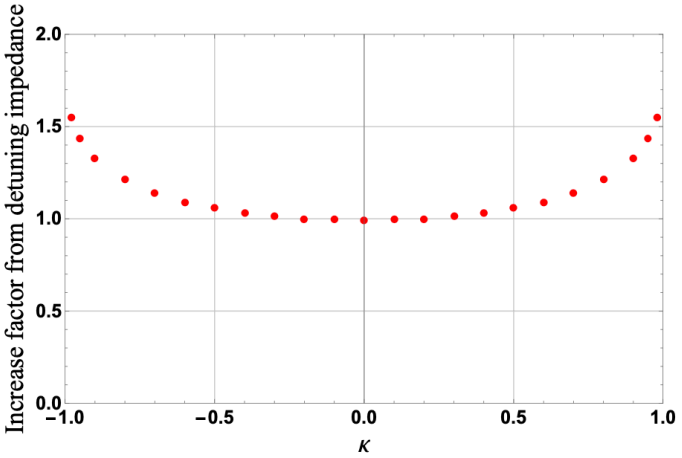


Figure 3: Similar result as the one obtained with the two-particle model (see Fig. 2) but using the simplified circulant-matrix formalism discussed above.

⇒ Beneficial effect of the detuning impedance wrt to the driving impedance (and therefore also wrt e.g. flat vs. round chamber, as the driving impedance is lower)

“Long-bunch” regime

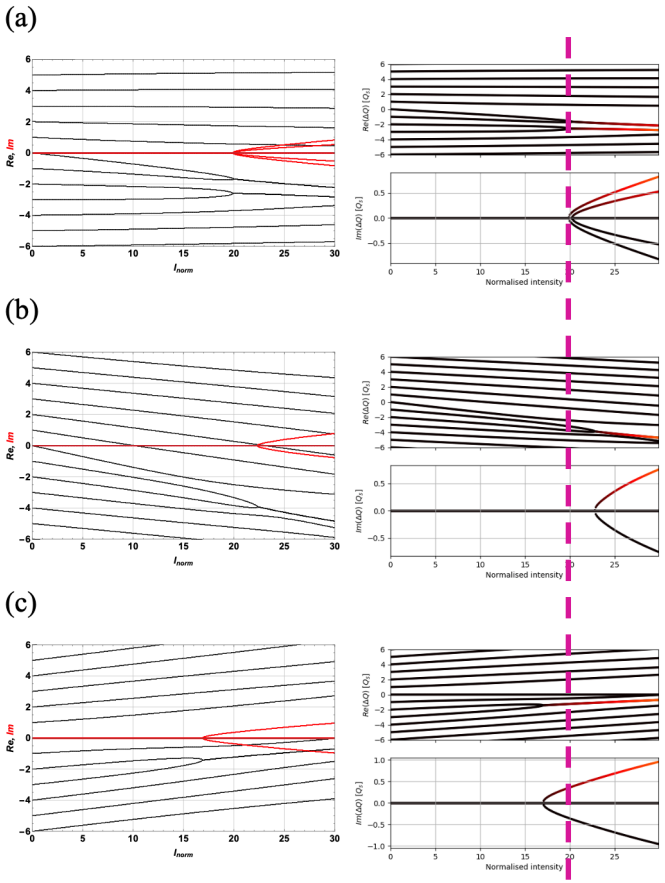


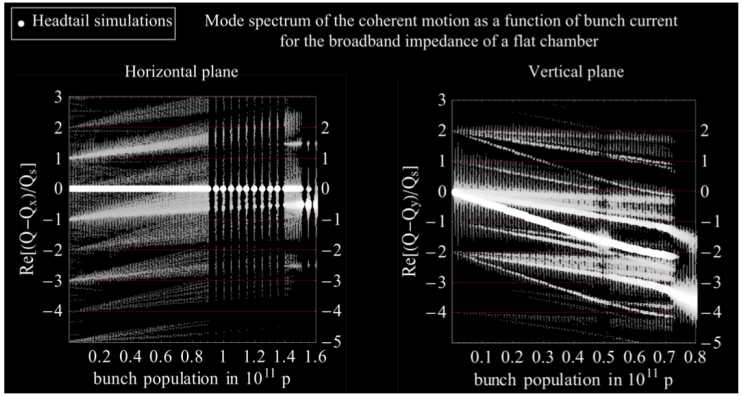
Figure 6: Comparison between theory (left) and the BimBim code (right) for the case of a broad-band resonator impedance with $f_r\,\tau_b = 2.8$: (a) $\kappa = 0$; (b) $\kappa = -1$; (c) $\kappa = +1$.

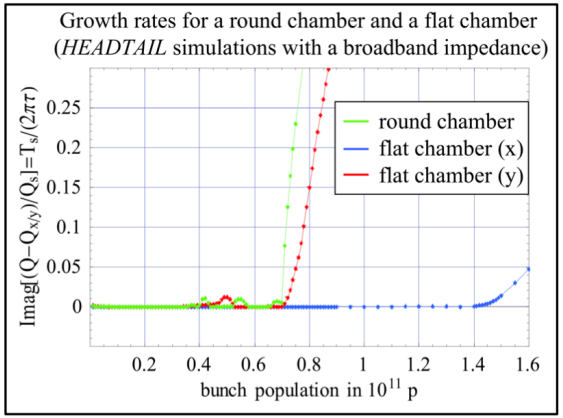
⇒ Detrimental effect of the detuning impedance wrt to the driving impedance for the horizontal plane ($\kappa = +1$)

⇒ But beneficial effect of the detuning impedance / asymmetry wrt symmetric case (as the driving impedance is much smaller)!

One should be careful when comparing the different κ −cases, as for each case I_{norm} is normalised by the dipolar impedance (which includes a Yokoya dipolar factor [13]): 1 for round ($\kappa = 0$), $\pi^2/24$ for flat x ($\kappa = 1$) and $\pi^2/12$ for flat y ($\kappa = -1/2$). Applying this to the

It could also be seen on the first HEADTAIL simulations by BenoitS





- Intensity threshold for round chamber: ~ 0.7E11
- Intensity threshold for flat chamber in x: ~ 1.4E11, i.e. ~ 2 times higher
  - Beneficial effect of the asymmetry
  - But (slight) detrimental effect of the detuning impedance wrt to the driving impedance as the gain from the driving impedance only would have been $24/\pi^2 \approx 2.4$

Conclusion

- One has to be careful when we mention the beneficial or detrimental effect of the detuning impedance, depending on what we compare it to!