Testing the effect of quadrupolar impedance with Vlasov approach developed for e-cloud

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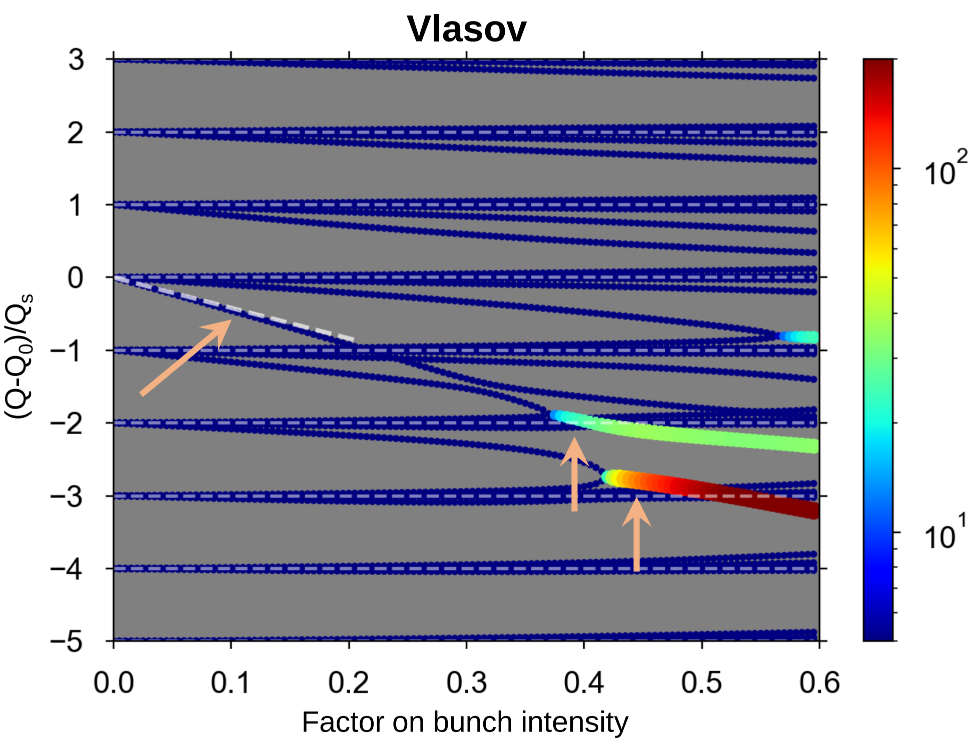
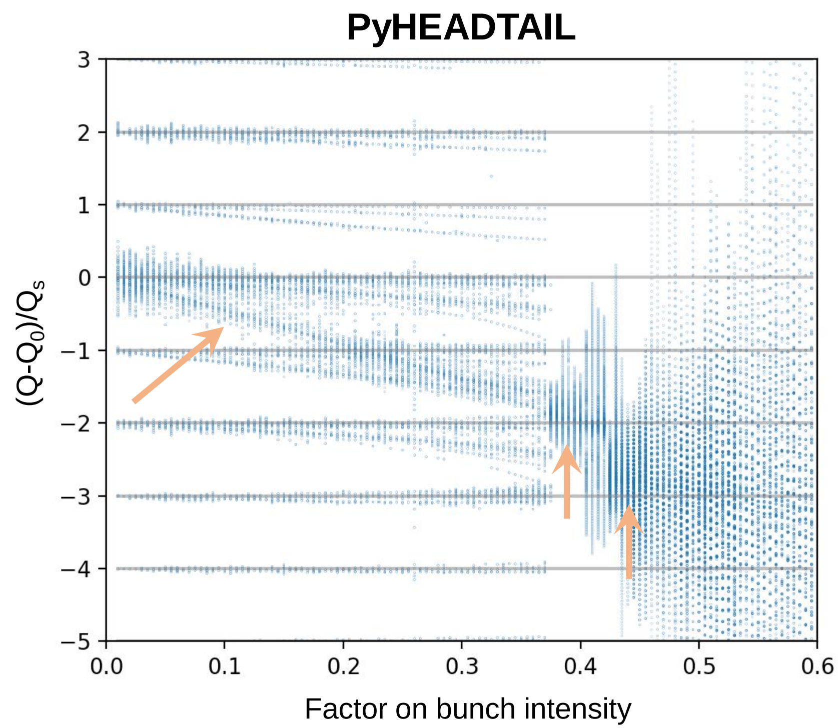
Many thanks to:
N.. Biancacci, L. Mether, E. Métral, N. Mounet, G. Rumolo, L. Sabato, C. Zannini

Dipolar impedance alone

Studied case:

- $4\,\sigma_t$ = 1.3 ns, reference intensity 1.2 x 10^{11} p/b
- BB resonator (f_r = 2 GHz, R_s=75 MΩ)
- Synchrotron tune Q_s = 4.9 x 10^{-3}





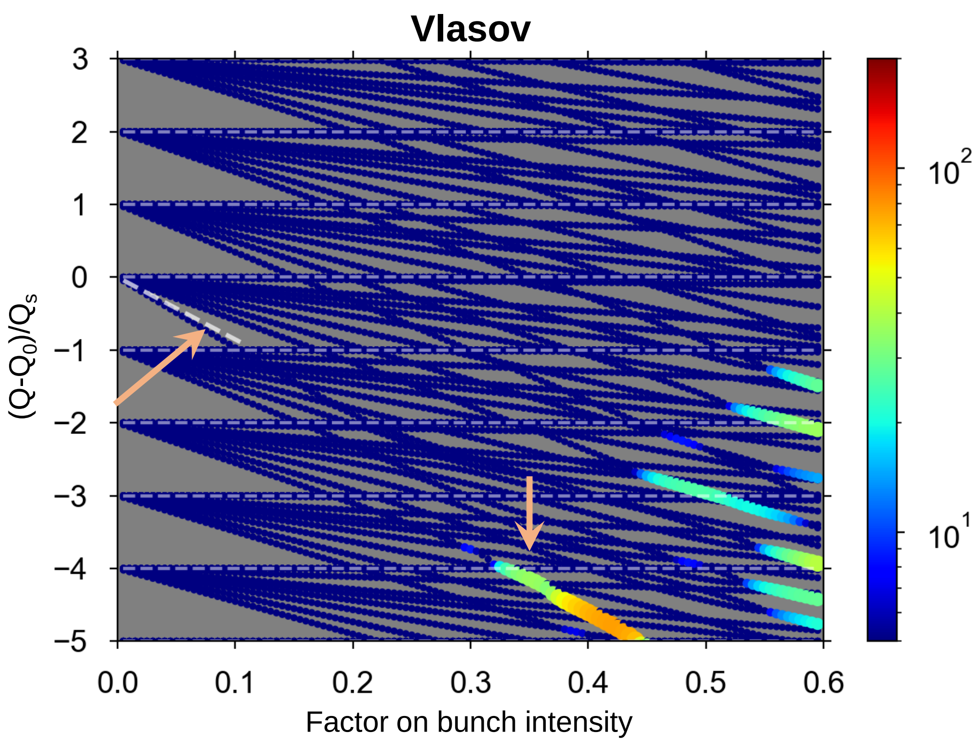
The dashed line is the expected rigid-bunch tune shift estimated as:

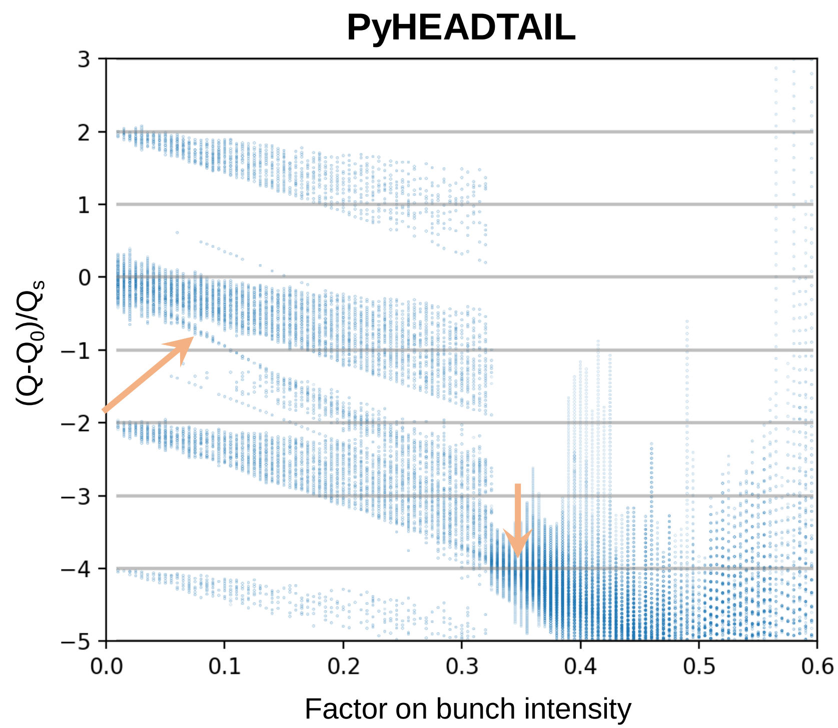
$$\overline{Q} - Q_{x0} = \frac{M_{00,00} + \tilde{M}_{00,00}}{\omega_0}$$

Dipolar + positive quadrupolar

Studied case:

- 4 σ_t = 1.3 ns, reference intensity 1.2 x 10^{11} p/b
- BB resonator (f_r = 2 GHz, R_s=75 MΩ)
- Synchrotron tune Q_s = 4.9 x 10^{-3}





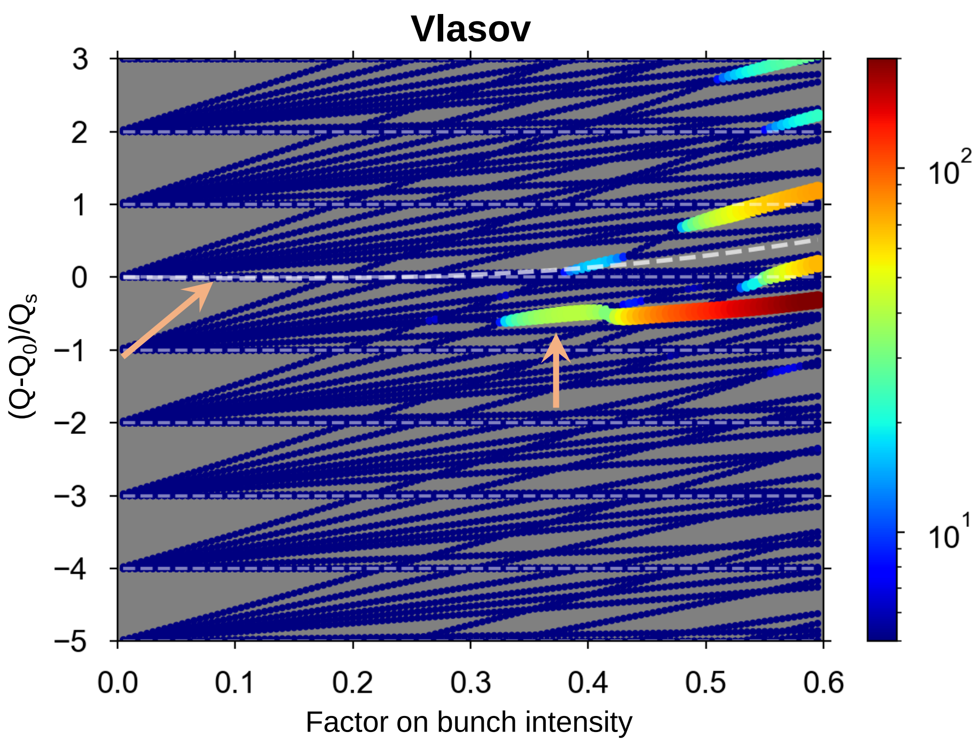
The dashed line is the expected rigid-bunch tune shift estimated as:

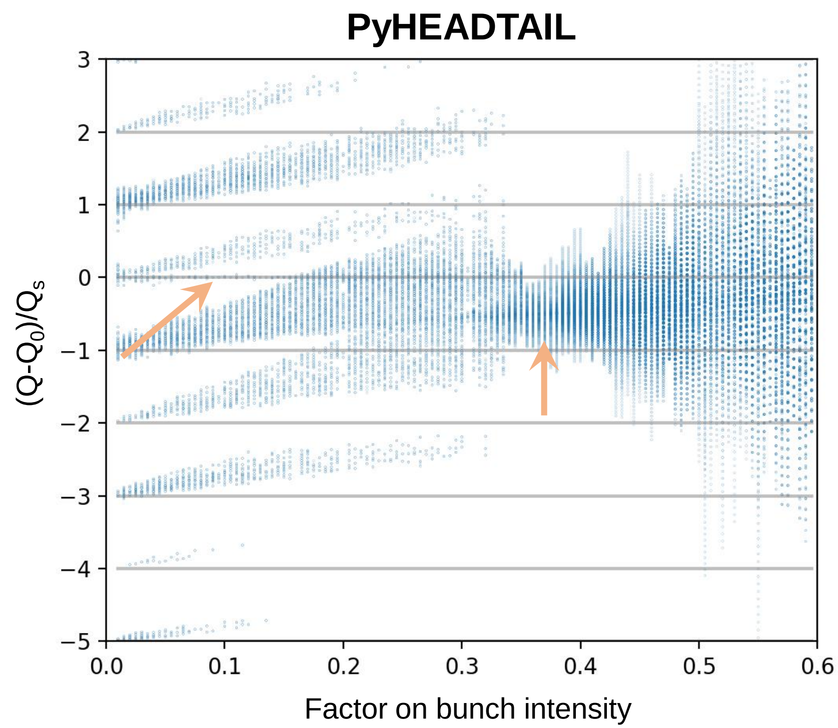
$$\overline{Q} - Q_{x0} = \frac{M_{00,00} + \tilde{M}_{00,00}}{\omega_0}$$

Dipolar + negative quadrupolar

Studied case:

- $4\,\sigma_t$ = 1.3 ns, reference intensity 1.2 x 10^{11} p/b
- BB resonator (f_r = 2 GHz, R_s=75 MΩ)
- Synchrotron tune Q_s = 4.9 x 10^{-3}





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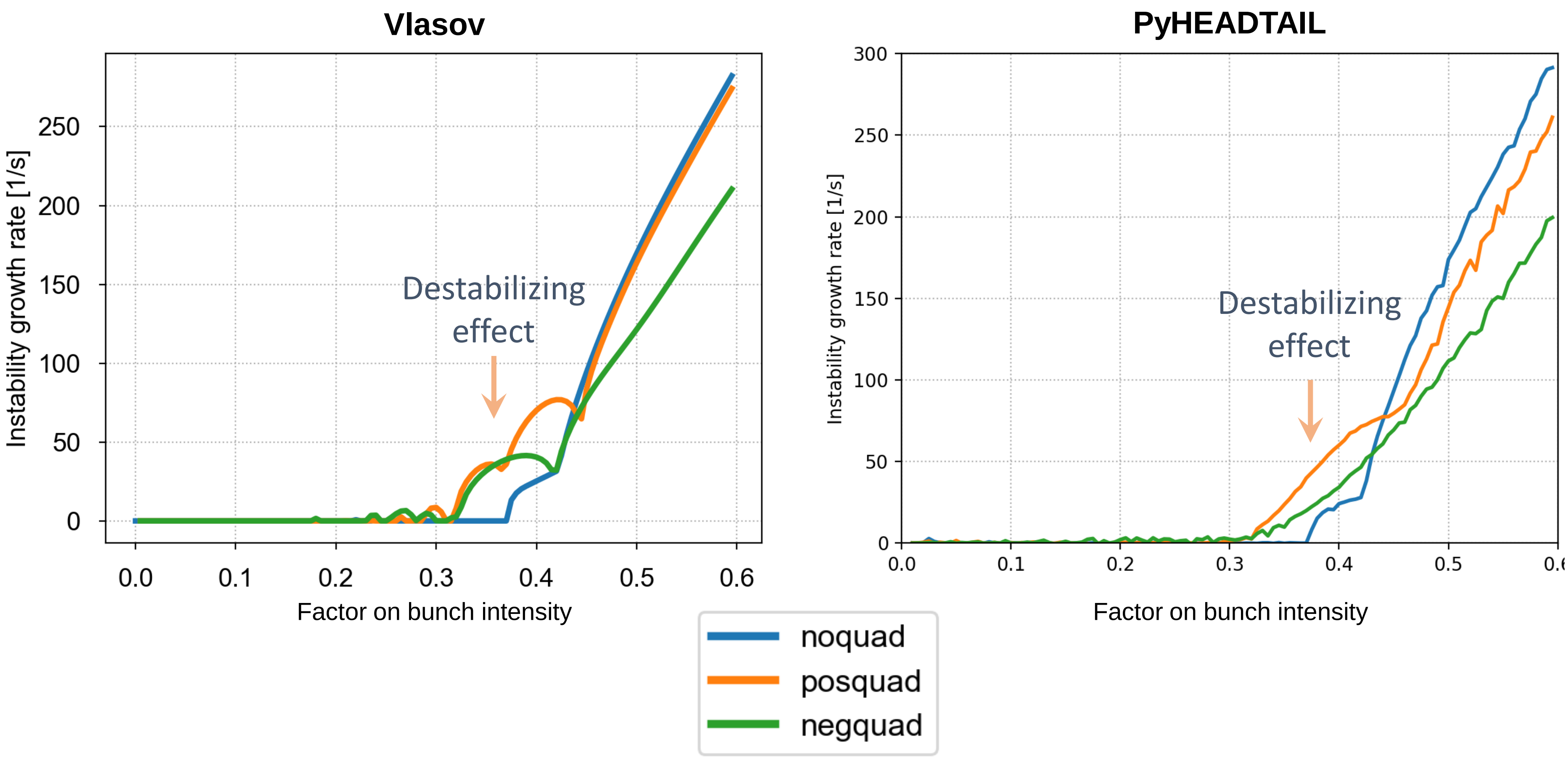
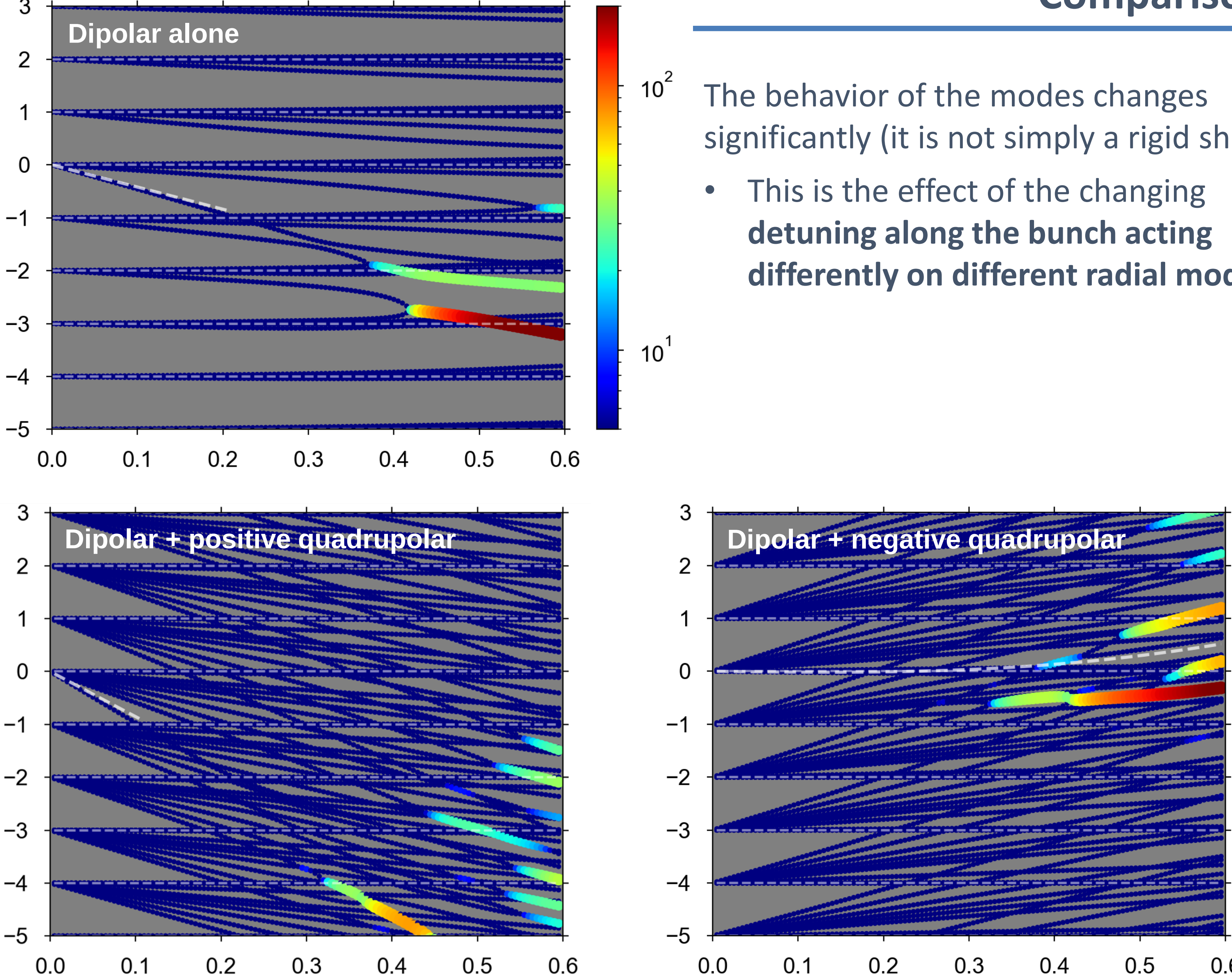
Instability risetimes



Comparison



The behavior of the modes changes significantly (it is not simply a rigid shift)

- This is the effect of the changing **detuning along the bunch acting differently on different radial modes**

- The new Vlasov solver **agrees well with PyHEADTAIL** for the case of dipolar and quadrupolar impedances

- The **quadrupolar impedance introduces complex changes in the behavior of the modes:** different shifts for different radial modes as result of the detuning along the bunch
- This **can affect the instability threshold** and have a destabilizing effect in a certain range of intensity

Thanks for your attention!