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Intrabunch motion in the presence of mode coupling

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The intrabunch motion for independent longitudinal or transverse beam oscillation modes has been explained analytically for impedance driven bunched-beam coherent instabilities already several decades ago by Laclare and they have been observed in many measurements and simulations. These oscillation patterns do not depend on the bunch intensity, they are head/tail symmetric and they exhibit a number of nodes equal to the radial mode number. However, in many measurements and simulations of transverse beam instabilities (due to impedance only, impedance and beam-beam, impedance and space charge, or electron cloud), asymmetric patterns are observed depending on the bunch intensity. The latter can be described theoretically considering the interaction between several modes, i.e. mode coupling, which explains why and how different kinds of asymmetric intrabunch signals can be observed. In this paper, the intrabunch motion in the presence of mode coupling is explained first without maths and then with maths, considering the case of a bunch interacting with a transverse impedance, using the GALACTIC Vlasov solver.

Footnotes

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