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Study of LHC e-cloud instabilities using the linearised Vlasov method

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Modelling electron cloud driven instabilities using a Vlasov approach enables studying the beam stability on time scales not accessible to conventional Particle In Cell simulation methods. A linear description of electron cloud forces, including the betatron tune modulation along the bunch, is used in the Vlasov approach. This method is benchmarked against macroparticle simulations based on the same linear description of electron cloud forces. Applying high chromaticity settings is the main mitigation strategy for these instabilities. The effect of chromaticity can be taken into account using the Vlasov method. The Vlasov approach agrees with macroparticle simulations for strong electron clouds, and a stabilizing effect from positive chromaticity can be seen in both approaches. For positive chromaticity, the Vlasov approach shows the existence of weak instabilities which are not observed in the macroparticle simulations. This feature suggests the existence of damping mechanisms that are not captured by the linearized Vlasov equation.

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Footnotes

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