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Phase portrait dynamics of emittance-dominated beams in solenoids

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Solenoid serves as a single magnetic lens and is used at the different stages of the beam formation with the effectiveness depending from the beam energy. It may change the shape of the initial phase volume of the beam, that may be especially important in some cases of laser-based acceleration because of more specific emittance formation in comparison with the phase volumes of the beams from conventional accelerators. In this report the analytic approach is applied to study the peculiarities of the beam phase volume transformation and manipulation in solenoidal magnetic field for the case of the emittance-dominated long-pulse beam. The modified KV-model used allows to obtain the beam envelope equations. The model is based on the specific kinetic distribution function which depends on the particle motion integrals and represents an accurate solution of the Vlasov equation. The transfer of rms emittances caused by the coupling of the particle oscillations is investigated for the case of elliptical beam cross-section and with approximation of uniform space charge distribution. The factors affecting the transfer are studied. The possibility of the beam emittance manipulation is discussed.

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