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Modeling of the amplified optical stochastic cooling experiment at IOTA

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Optical Stochastic Cooling (OSC), a beam cooling technique based on Stochastic Cooling, is in the early stages of experimental development. It uses radiation produced by the beam in an undulator magnet (the pickup) to correct the momentum deviation of particles downstream in another undulator (the kicker). The OSC mechanism was recently demonstrated at Fermilab's IOTA ring using a passive configuration. However, the cooling rate of OSC can be dramatically increased by first amplifying the undulator radiation before applying the corrective kick. In collaboration with the IOTA experiment, we developed a computational model of the OSC mechanism. This paper presents beam-dynamics simulations of the amplified-OSC configuration. We implement a model of intrabeam scattering and study the effects on beam equilibrium and diffusion rate as a function of bunch charge. Finally, we investigate the phase-space dynamics with various coupling configurations between the transverse and longitudinal planes.

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