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Modelling of Sub-Wavelength Effects in a FEL Oscillator

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Previous studies of FEL oscillators typically use averaged simulation codes which cannot model sub-wavelength effects, such as Coherent Spontaneous Emission from the electron pulse. In this paper, the unaveraged FEL simulation code Puffin is used with the optics code Optical Propagation Code to model the FEL in three dimensions, enabling sub-wavelength effects to be modelled at the FEL interaction and cavity length scales. The parameters used are very similar to those of the IR-FEL of [1].
Results show that CSE does drive the FEL interaction during the start-up phase in the cavity. Further, cavity detuning effects at the sub-wavelength scale can have an effect upon the FEL output from start-up through to the steady state output.
While the effects are demonstrated here at the fundamental level, it can be expected that they may be reduced due to limitations such as electron beam and/or cavity length jitter at the wavelength scale. Such effects will need to be further investigated.

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