LETHARGY IN AN OPTICALLY GUIDED FEL AMPLIFIER

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Abstract

Lethargy (i.e., electron pulse slippage) in an optically guided FEL amplifier configuration is analyzed. The FEL operates in the exponential regime and the optical beam is guided by the electron beam throughout the wiggler with a filling factor that is nearly constant, resulting in high efficiency. Since the velocity of the electrons is smaller than the group velocity of the optical pulse, the electron bunch gradually slips behind the optical pulse, terminating the interaction. As a result the wiggler length must be limited which, in turn, limits the gain per pass. In a low|-|power oscillator configuration the slippage distance is equal to the number of wiggler periods multiplied by the optical wavelength. Here, we obtain an expression for the slippage distance in a high|-|current FEL amplifier in the exponential, optically|-|guided regime. It is shown that the slippage distance in this case is significantly less than that in the oscillator case. In the amplifier configuration slippage is reduced because the dispersion characteristics of the optical beam are modified by gain effects as well as by finite spot|-|size effects.

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