

ANALYTICAL CHARACTERIZATION OF THE SATURATED STATES FOR A SINGLE-PASS FREE ELECTRON LASER IN PRESENCE OF HIGHER HARMONICS

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Abstract

The generation of higher harmonics in Single-Pass Free Electron Laser (FEL) represents a challenging frontier and would enable in perspective to produce narrowband radiation at high frequency. For this reason, the development of theoretical frameworks that are able to capture the peculiar characteristics of the amplification process are needed. Using a statistical approach based on the Vlasov equation associated to the Colson-Bonifacio model, we predict the saturation level for the first two harmonics of the wave, as function of the initial conditions and of the coupling parameters. In particular, we identify a phase transition towards a regime where only the third harmonic is amplified. By exploiting the analogy between the physics of FEL and Travelling Wave Tube, we suggest to make use of the latter device to test our predictions.

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