

Giant amplification in degenerate band edge slow-wave structures interacting with an electron beam

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We propose a new amplification regime based on a synchronous operation of four degenerate electromagnetic (EM) modes in a slow-wave structure and the electron beam, referred to as super synchronization. These four EM modes arise in a Fabry-Pérot cavity when degenerate band edge (DBE) condition is satisfied. The modes interact constructively with the electron beam resulting in superior amplification. In particular, much larger gains are achieved for smaller beam currents compared to conventional structures based on synchronization with only a single EM mode. We demonstrate giant gain scaling with respect to the length of the slow-wave structure compared to conventional Pierce type single mode traveling wave tube amplifiers. We construct a coupled transmission line model for a loaded waveguide slow-wave structure exhibiting a DBE, and investigate the phenomenon of giant gain via super synchronization using the Pierce model generalized to multimode interaction. © 2016 AIP Publishing LLC. [<http://dx.doi.org/10.1063/1.4942791>]