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On the numerical dispersion and the spectral fidelity of the Particle-In-Cell method[1] CHENGKUN HUANG, M.D. MEYERS[2], Y. ZENG, S. YI, B.J. ALBRIGHT, Los Alamos Natl Lab — The Particle-In-Cell (PIC) method is widely used in plasma modeling. However, the PIC method exhibits grid type numerical instabilities, including the finite grid instability and the numerical Cherenkov instability that can render unphysical simulation results or disrupt the simulation. A faithful numerical dispersion of the electromagnetic PIC algorithm is obtained and analyzed to obtain the insight about the numerical instabilities inherent in such a computation model [1]. Using this dispersion, we investigate how the finite grid instability arises from the interaction of the numerical modes admitted in the system and their aliases. Compared with the gridless model [2, 3], we show that the lack of spectral fidelity relative to the real system due to the aliasing effect is a major cause of the numerical instabilities in the PIC model.

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