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Temporal Instability of Acoustic Wave in a Semiconductor Plasma Medium under Momentum Mismatched Condition

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Received: June 10, 2019
Revised: September 6, 2019
Accepted: December 4, 2019

Temporal instability of acoustic wave is investigated in an infinite semiconductor plasma using classical hydrodynamic approach. We consider a homogeneous semiconductor placed in an external magnetic field. Dispersion and gain characteristics of acoustic wave generated in a piezoelectric semiconductor plasma medium with momentum mismatched situation are examined. Numerical analysis of qualitative nature of the four available modes infers that an endurable momentum mismatch modifies the spectra of acoustic wave significantly. Influence of pump field and doping profile on the dispersion and gain characteristics of all possible modes in the medium has been studied and reported. The result infers that the pump field and carrier density play significant roles as control parameters for the favourable propagation and gain characteristics of the acoustic wave in the medium. Presence of momentum mismatch is found to enhance the phase speed of highly unstable modes. These results may pave way to generate squeezed states, useful in optical communication system having operational wavelengths compatible with the spatial scales under consideration.

Keywords: temporal effects, plasma instability, piezoelectric semiconductor, momentum mismatched condition, propagation characteristics, gain profile of acoustic wave.