3-7 PARAMETRIC AMPLIFICATION, OSCILLATION AND MIXING IN NONLINEAR BACKWARD SCATTERING

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Investigations in optical parametric interactions have so far been mostly concerned with forward-traveling-wave (FTW) scattering processes. Similar interactions involving backward-traveling waves (BTW) are apparently less well known, despite the fact that BTW parametric amplification and oscillation have been observed in parametric diodes in the microwave range and in stimulated Brillouin scattering in the optical range. Some of the results of our recent work on BTW amplification and oscillation have been published. We have since made substantial progress in this direction and would like to report further findings on the concept of conversion efficiency, the inherent theoretical limitations of this parameter and its asymptotic behavior at high conversion and high gain. Some new results will also be presented in the case of parametric mixing. This new method of analysis has also been applied to the case of interactions involving only forward traveling waves. Some of the conclusions and experimental verification in photon-phonon studies will also be included in the talk.

The effects of variations in pump excitation and interaction length on the stability of amplification, oscillation threshold, overall gain, conversion efficiency, signal depletion prove to be very useful as means of studying the performance of such devices and can potentially be generalized to the study of multiple elementary scattering processes.

Our study so far has also established inherent nonlinear factors that may ultimately limit the effectiveness of laser induced interactions. This lies in the significant finding of a drastic decrease in laser penetration into a medium with increasing laser power as a result of nonlinear interactions.