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A STUDY OF STIMULATED BRILLOUIN SCATTERING AND ITS APPLICATION TO PHASE CONJUGATE OSCILLATORS

by

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Abstract

A study of Stimulated Brillouin Scattering (SBS) and its use for correcting phase aberrations in laser oscillators is presented.

Chapter One includes a short description of Optical Phase Conjugation (OPC) and Stimulated Brillouin Scattering (SBS), and presents the research objectives of the thesis. Chapter Two details the transient theory of SBS incorporating a focusing geometry, random noise seed, and the effects of pump depletion and finite phonon lifetime.

In Chapter Three, the first experimental chapter, the phase conjugate properties of SBS are studied using a pulsed Nd:YAG laser with available energies up to 750mJ, under different operating conditions. Both long and short coherence length pumping regimes as well as different focusing geometries are investigated. For long coherence length pumping, intensity fluctuations in the SBS return beam are identified for particular focusing conditions. A region is found where no intensity fluctuations are observed. For short coherence length pumping, competing effects such as optical breakdown are studied in order to compare with results reported previously. The main emphasis of this chapter is the study of phase conjugate SBS performance with short coherence length pumping. The experiments presented in this chapter are essential for the characterization of the SBS process when incorporated within a laser oscillator. Phase conjugation of intracavity phase aberrations using an SBS oscillator is the subject of the following chapter.

In Chapter Four, phase conjugation of a Nd:YAG laser oscillator using SBS is investigated both theoretically and experimentally. A simple model is used to determine general characteristics of a resonator with an intracavity SBS cell. A series of resonator designs and modifications are presented. Time-resolved intracavity SBS reflectivity, as well as other laser beam parameters, are used to characterize the process under different experimental conditions. The final design presented incorporates an intracavity etalon in order to control the longitudinal mode content of the start-up cavity.

Finally, conclusions drawn from the work performed in this thesis are presented in Chapter Five.

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