雷射光與物質的腔內非線性交互作用

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摘要

本論文係探討雷射二極體激發式固態雷射共振腔內之雷射光與物質的非線性交互作用。 除了第一章的簡介與文末的未來工作，將主要內容分為 A、B 兩部分共五章。 第一部分主要探討，作為光激發固態雷射之飽和吸收體或增益介質的半導體中之有吸收的非線性效應。 以 InAs/GaAs、InGaAs/GaAs、InGaAsP/InP、AlGaInAs/InP 為材料的量子點與量子井結構半導體，被使用在摻鈦被動式 Q 開關與鎖模脈衝雷射以及光驅動半導體雷射中。 第二部分則處理無吸收的非線性效應運用在可應用的雷射與波函數的研究。 題材包含人眼安全雷射、拉曼雷射、以及在具有隨機缺陷之非線性晶體中的非共線二階諧波產生。 論文中許多主題均可以是獨立的研究題目，也各有其關鍵的研究成果與貢獻。 但隨著實驗的進展，有許多有趣的現象與物理開始出現在原本不同的實驗系統。 其實的物理深處本是相通相容的，藉由不同的實驗系統，更能從不同的角度去看到物理的面貌。 而這裡所要談的，就是從研發並了解現今可實現的雷射系統與非線性效應開始，作為深入探討這些交互作用的基石。

Intracavity Nonlinear Interactions of Laser Light and Matter

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ABSTRACT

The author demonstrates the study of nonlinear interactions of laser light and matter inside cavities of diode pumped solid-state lasers. Besides introduction and future works, the author put main text in five chapters divided into two parts. In Part A, we are concerned with nonlinear effects with absorption in semiconductor which used as a saturable absorber or a gain medium in solid-state laser. Quantum-dot and quantum-well structures based on InAs/GaAs, InGaAs/GaAs, InGaAsP/InP, and AlGaInAs/InP were utilized in Nd-doped passively pulsed lasers and optical pumped semiconductor lasers. In Part B, we deal with interactions without absorption for applicable laser and the study of wave function. The discussion includes eye-safe lasers, Raman lasers, and noncollinear second harmonic generation in nonlinear crystal with random defects. All physics should be connected or sing in tune if we could have deeper understanding. Through researching and developing novel laser technologies in various experiment systems, we may see the face of physics from various viewpoints. What the author present here is the research on intracavity nonlinear interactions of laser light and matter, from studying existing feasible laser systems and nonlinear effects to be the groundwork of thorough understanding hereafter.