THEORETICAL STUDY OF MULTI-MODE OPTICALLY PUMPED NH₃ FIR LASER*

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Abstract

The two or multi-mode optically pumped NH₃ FIR laser had been studied theoretically. The NH₃ molecular gas was assumed to be a three-level system and obeyed the time-dependent behavior of the density matrix equations. Considering the situation of playing the two or multi-mode optical pumping and the FIR laser field were same polarized. The gain coefficient and the output FIR power of the system could be calculated by using the iteration method.

It had been predicted that the two or multiple longitudinal mode optically pumped NH₃ FIR laser could have a greater output power or higher lasing efficiency than single mode pumped FIR laser under suitable selected operating parameters of laser.

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I. Introduction

So far the optically pumped molecular gas lasers was a universally applicable and important FIR source for the research works on the SMMW and FIR technique. This kind of laser source could be able to supply thousands discrete laser lines with wavelength from short mm to 30μm, and laser power density up to several hundreds mW for CW laser and peak power up with several kW even MW for pulse operating laser. Thus the applicability of the optically pumped FIR laser should go a step further to be strengthened.

Although optically pumped FIR lasers possess many advantages, in general case, they induced output with single FIR laser line when they were pumped by means of single longitudinal mode operation of a CO₂ lasers. However, one of the defects of optical pumping laser was that, it worked in rather low efficiency. Usually, the single longitudinal mode was required for optically pumped FIR laser, so the total efficiency of CO₂ laser itself would be much decreased.

Scientists always resorted to every possible means to get stronger output with single line of FIR laser, such as to control some operating conditions of optically pumped FIR laser, to improve tuning and gain characteristics or tried to pump the molecular gas system using two or multiple