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General references and further reading

- A non-mathematical account of laser saturation spectroscopy is given in the article by
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 A comprehensive review of mode selection techniques in lasers is given by
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Tunable dye lasers and atomic spectroscopy

14.1. Introduction

In the previous three chapters we have discussed the properties of gas lasers and have shown how they can be designed for single frequency oscillation, and also how the output frequency may be tuned continuously over the bandwidth of the Doppler-broadened gain curve. Unfortunately this tuning range is relatively narrow and the application of these gas lasers to atomic and molecular spectroscopy is restricted to studies of the laser transitions themselves, or to accidental coincidences with molecular absorption lines. It would therefore seem that the new and powerful technique of saturated absorption spectroscopy was also of relatively limited applicability.

Fortunately, in the past decade, several different types of narrow-bandwidth widely tunable lasers have been developed and of these the organic dye laser has played the most prominent role in atomic and molecular spectroscopy. These dye lasers provide tunable coherent radiation throughout the wavelength range from the near ultraviolet to the near infrared, and moreover, by optical harmonic and laser difference frequency generation, the accessible spectral region can be extended into the vacuum ultraviolet and the far infrared.

This new device has led to a rapid growth in the nonlinear spectroscopy of atoms and molecules. In addition the narrow spectral bandwidth and great intensity per unit spectral range of these dye lasers have made it possible to extend the range of classic spectroscopic techniques such as absorption and fluorescence spectroscopy. Even the more precise spectroscopic methods such as the Hanle effect, the optical double resonance, and the optical pumping techniques have all benefitted from the increasing availability of tunable dye lasers. Selective step-wise excitation using dye