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Book review

Laser Spectroscopy V

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[pp. i–xi + 495, with 319 Figs.]

This volume contains a collection of the papers presented at the Fifth International Conference on Laser Spectroscopy (VICOLS) held at Jasper Park Lodge, Canada on June 29–July 3, 1981. The conference gathered 230 scientists from 19 countries who presented a number of interesting papers covering many new developments in the rapidly growing field of lasers and their applications.

It is, of course, impossible to present here in a condensed form the contents of the book consisting of more than eighty extended abstracts of varying form and length and the reviewer will not attempt to do so. A somewhat arbitrary selection of those papers and topics which seemed the most fascinating will be given instead.

The contributions in the book have been grouped into eleven parts and the volume is opened by the paper of WALTHER on *Progress and Perspectives in Laser Spectroscopy*. The author surveys there mainly the methods of high-resolution laser spectroscopy including saturation spectroscopy and the quantum beat method. Part I entitled *Fundamental Applications of Laser Spectroscopy* brings, among others, two interesting contributions by MAISCHBERGER et al. and by DREVER et al. on the use of laser interferometry for attempts at detecting gravitational waves whose existence is predicted by general relativity theory. Both groups: the German one and the Anglo-American one describe in detail their work on the construction of ultra sensitive interferometers for monitoring changes in apparent distance of two or three test masses due to gravitational waves. The task calls for ingenious engineering with respect to, e.g., eliminating all sources of noise both from the outside and from the system itself (e.g., the frequency stability of the laser).

Part II brings several papers on *Laser Spectroscopic Applications*. Here, the most fascinating contribution seems to be that of HURST et al. on *Resonance Ionization Spectroscopy: Counting Noble Gas Atoms*. The authors describe their recent work on detection of individual atoms. An exciting concept is presented of constructing an apparatus which would work as the "Maxwell's sorting demon", i.e., which could recognize and count single atoms of noble gases, for example, atoms of the radioisotope ^{39}Ar. The suggested basis of operation of the "Maxwell's demon" is that of selective ionizing atoms with a UV laser, separation of ions with a quadrupole mass filter, implanting them into a CuBe target and detecting secondary electrons emitted from the activated CuBe surface.

Part III entitled *Double Resonance* contains a few contributions on the use of various double resonance schemes for obtaining information on excited states of simple molecules as D_2CO, CF_4, Li_2, Na_2, Cs_2 and Li^+ ions. In the subsequent Part *Collision-Induced Phenomena* one should note at least one interesting paper by DABKIEWICZ et al. on the new technique of Doppler-free saturation spectroscopy which is acronymed POLINEX (Polarization Intermodulated Excitation). The new method is related both to polarization spectroscopy and to intermodulated fluorescence spectroscopy and consists in studying the nonlinear interaction of two laser beams in an absorbing medium by modulating the polarization of one or both beams. When the combined absorption depends on the relative polarization of the two beams,

an intermodulation is observed in the total rate of excitation. The authors show examples of the use of the POLINEX method, e.g., for the $1s_5$–$2p_2$ transition in Ne, and for saturation spectra of metastable atoms in hollow cathode discharges.

In the fifth Part *Nonlinear Processes* there is an interesting paper by BREWER et al. entitled *New Phenomena in Coherent Optical Transients*. The new phenomena being discussed are the oscillatory free induction decay, the stimulated photon echo effect and the molecular spin-rotation effect. The paper by BYER et al. on the use of a supersonic jet to record high resolution CARS spectra of simple molecules should also be mentioned.

The subsequent Part on Rydberg states brings several short papers presented during the panel discussion of the subject. More interesting papers are those included in the VIIth Part *Methods of Studying Unstable Species*. One should note here a short paper by OKA which presents the first spectroscopic evidence of the existence of a H_3^+ ion: the simplest polyatomic system in which two electrons keep three protons in an equilateral triangle configuration. As the author states, this ion is a beautiful jewel of nature left for the laser spectroscopist.

The subsequent Part deals with *Cooling, Trapping and Control of Ions, Atoms and Molecules*. A few papers, among them those by DEHMELT and by LETOKHOV and MINOGIN describe the techniques of radiative cooling capable of reducing an ion temperature down to 10 mK. The progress in cooling atoms is not so spectacular yet. Experiments in which a single Ba^+ ion is visualised after localizing it to a region of the diameter of ca. 200 nm are given in the paper by DEHMELT.

Part IX entitled *Surface and Solid State* contains at least two interesting contributions dealing with new experimental techniques. The first of these, by BJORKLUND et al. describes the technique of FM (frequency modulated) spectroscopy. The technique is shown to be suitable for both absorption and excitation spectroscopy. An interesting suggestion is made of the viability of using the phenomenon of photochemical hole burning in a solid, e.g., an alkali halide crystal containing color centers. The information storage density, limited to ca. 10^8 bits/cm^2 for a planar geometry may be further enlarged by introducing a *third dimension* in the storage system, the additional dimension being the frequency at which a hole is burned in the inhomogeneously broadened absorption profile. The ultimate storage density of 10^{11} bits/cm^2 is thus possible. Another paper one should note is that by PATEL et al. reviewing the basis of the photoacoustic spectroscopy and, especially, its modification being given an acronym PULPIT (PUlsed Laser Piezoelectric Transducer). The acronym describes quite well the experimental arrangement advocated by the authors for studying wery weak absorption (even less than 10^{-7} cm^{-1}) in condensed media. Two papers should also be mentioned which deal with surface enhancement of nonlinear processes (as e.g., the surface enhanced Raman scattering – SERS).

Parts X *Vacuum Ultraviolet* and XI *Progress in New Laser Sources* are mainly concerned with the achievements in creation of new sources of coherent light.

This short trip into a range of topics covered by the papers which form the book was meant to give some flavor of the field. Certainly, the book suffers from some shortcomings which are impossible to avoid in editing a collection of extended abstracts. The amount of background information given by various authors in their papers is often insufficient for an average reader to fully comprehend the message carried by the article without resorting to a tedious task of looking through the references. Even so, this book seems to be a must for any laser spectroscopist involved in the problems of high resolution spectroscopy and provides a good survey of the hot topics in the field for a reader from the outside.

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Forthcoming meetings

This is to inform you that IMECO TC2 will hold its
12th Symposium in the field of Photon Detectors

in

Varna, Bulgaria, between 22—24 May, 1986

Main topics of the meeting are:

Properties of all kinds of optical detectors,
Application of optical detectors in
- metrology
- biology and medicine
- mechanical measurements
- robotics
- fibre optics
- optical instruments