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Book reviews

Ultrafast Phenomena V

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Editors: G. R. FLEMING and A. E. SIEGMAN

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[pp. i–xix + 554, with 427 Figs.]

The book entitled *Ultrafast Phenomena V*, edited by G. R. FLEMING and A. E. SIEGMAN, contains papers presented at the 5th Optical Society of America (OSA) Topical Meeting on Ultrafast Phenomena held in Snowmass, Colorado from June 16th to 19th, 1986. The papers comprised in this volume clearly indicate the remarkable progress made in this field since the first meeting which took place in 1978, i.e., they document the advance made both in the ultrafast optical technologies themselves and in the fundamental scientific accomplishments obtained using these technologies.

The book is divided into nine parts.

Part I, *Mode Locking and Ultrashort Pulse Generation*, contains ten papers. J.–C. DIELS, N. JAMASBI and L. SERGER, deal with the problem of passive and hybrid femtosecond operation of a linear astigmatism compensated dye laser. The authors of the second paper demonstrate that astigmatism of AR ring can be compensated by the geometry of the cavity. Furthermore, their cavity configuration enabled them to test experimentally the colliding pulse condition independently of the other parameters. In the third paper, M. YAMASHITA et al. present the results of experimental studies of the cavity mirror dispersion dependence on duration of pulse generated from a simple CPM laser. J. CHESNOY and L. FINI deal with stabilization of a CPM dye laser synchronously pumped by a frequency doubled ML YAG laser. D. KÜHLKE et al. concentrate their attention on fluctuations and chirp in colliding-pulse-mode-locked dye laser. Their paper suggests that the pulse fluctuations are significantly influenced by the variation in GVD over the bandwidth of the pulses. The following paper by F. SALIN et al. reports on experimental observations of high order solitons in a colliding-pulse-mode-locked laser. To the reviewer's best knowledge the authors succeeded in observing for the first time three solitons produced by a CPM laser. Considering the advances in the theory of mode-locking by synchronous pumping, G. H. C. NEW and J. M. CATHERALL confirm in their paper that the SCP method fails near optimum cavity tuning and explain the reasons why this does occur.

Part II, *Ultrafast Optical Generation and Measurement Techniques*, contains seventeen papers. In the first paper, J. P. HERITAGE, A. M. WEINER and R. N. THURSTON consider the Fourier transform picosecond pulse shaping and spectral phase measurement in a grating pulse-compressor. They describe a technique for synthesizing arbitrarily shaped ultrashort pulses by phase and amplitude masking in a fiber and grating pulse-compressor. D. STRICKLAND et al. undertake the problem of picosecond pulse amplification using a pulse-compression technique. Their technique is capable of being scaled to achieve extremely high peak powers. The fiber Raman amplification soliton laser (FRASL) is described by M. N. ISLAM, L. F. MOLLENAUER and R. H. SOLTEN. They have demonstrated the first device of that type which is based on synchronous pumping of a loop of fiber with about 10 ps pulses from a model-locked color center laser. The 80 fs soliton-like pulses from an optical nonlinear fiber resonator are considered in the paper by B.

ZYSSET et al. They demonstrate FWM frequency conversion and short soliton-like pulse formation in a fiber resonator. F. M. MITSCHKE and L. F. MOLLENAUER deal with the problem of the stabilized soliton laser. They describe the servo-control of the feedback from a pulse shaping fiber control output pulse width and shape. F. M. MITSCHKE, L. F. MOLLENAUER and J. P. GORDON present the results of the research concerning the soliton self frequency shift. They describe experimental proof of the existence of a continuous down shift in the optical frequency of a soliton pulse as it travels along the fiber. An active mode-locking of an InGaAsP optical-fiber ring resonator is considered by G. EISENSTEIN et al. They observed a pulse width of 36 ps corresponding to an actual width of about 17 ps. The paper by W. RUDOLPH and J.-C. DIELS is devoted to the problem of the femtosecond resolved fluorescence. D. HULIN et al. describe a new technique for resolving near-infrared luminescence on a subpicosecond time scale. In the paper concerning the measurement of optical phase with subpicosecond resolution by time domain interferometry, J. E. ROTHENBERG presents a new technique which determined the complete electric field of ultrashort pulses. J. A. VALDMANIS introduces a novel, real time (i.e., non-sampling) measurement technique that is applicable to the characterization of pico- and subpicosecond optical modulation phenomena. In the paper dealing with the beam overlap for long delay lines using active feedback, C. DOLAND, W. B. JACKSON and A. ANDERSSON describe the system which stabilizes the beam position to a few microns for a delay longer than a nanosecond. Y. H. MEYER et al. consider in their paper the ultrashort dye laser pulses using the sweeping oscillator method. Speaking concisely, they report on the progress in a technique for obtaining high power ultrashort pulses from dyes using a single nanosecond pump laser.

Part III, *Electrooptic Sampling Techniques*, contains eleven separate papers. In the first paper, K. J. WEINGARTEN et al. consider the electrooptic sampling of gallium arsenide integrated circuits. R. K. JAIN et al. consider the problem of precise measurements of signal propagation characteristics in GaAs integrated circuits by picosecond electrooptic sampling. A. J. TAYLOR et al. investigate the high repetition rate electrooptic sampling with an injection laser. They describe the measurements of high-speed long wavelength photodetectors. The picosecond electrical pulses in microelectronics constitute the subject of investigations presented by P.G. MAY et al. They have demonstrated that very short pulses on aluminium micron lines can be propagated through impedance preserving tapers and through wirebonds. J. BOKOR et al. gave a paper on high speed circuit measurements using photoemission sampling. The new method described by them is a hybrid between optoelectronic sampling and *e*-beam probing. The paper written by T. F. CARRUTHERS and J. F. WELLER contains the analysis of the nonlinear responses of picosecond photodetectors to photogenerated carriers. T. KABAYASHI et al. report two new results concerning purely electrooptical short pulse generation: 0.8 picosecond pulse generation from a cw laser source by using a Fabry Perot modulator, and direct pulse compression of cw light in picosecond range. In his paper, HUANWEN ZHANG focussed his attention on the elimination of dynamic flash in a picosecond streak image tube.

Part IV, *Nonlinear Optics and Continuum Generation.* This part contains eight papers. In the first of them, A. PISKARSKAS et al. undertake the problem of the parametric chirp reversal and enhancement applied in femtosecond optics. P. B. CORKUM, C. ROLLAND and T. SRINIVASAN-RAO consider the supercontinuum generation in gases, concentrating their attention on a high order nonlinear optics phenomena. A. M. JOHNSON, R. H. STOLEN and W. M. SIMPSON discuss the observation of chirped stimulated Raman scattered light in fibers. They report the first observation of chirped SRS near generation point in a single-mode fiber. A. MUKHERJEE et al. pay their attention to the coherent multiphoton resonant interaction and harmonic generation demonstrating the possibility of controlling phased pulse sequences in the visible wavelength range. Y. CHO et al. deal with the ultrafast chaos from semiconductor lasers, reporting to have observed this chaos using a streak camera. They discuss its connection to the semiconductor laser noise caused by the feedback.

Part V, *Application to Semiconductors, Quantum Wells, and Solid State Physics.* This part contains twenty-one separate papers. In the first paper presented by F. SPAEPEN the thermodynamics and kinetics of melting, evaporation and crystallization induced by picosecond pulsed laser irradiation are discussed. The author states that the permanent surface damage observed in picosecond experiments is not due to the direct evaporation but to mechanical displacement of the liquid by the recoil pressure of the

evaporating atoms. D. van der LINDE et al. present the paper on the superheating during ultrafast laser heating of semiconductors. J. A. KASH and J. C. TSANG studied the non-equilibrium carriers in GaAs concentrating on the subject of the secondary emission during the first two picoseconds. W. Z. LIN et al. studied the ultrafast carrier dynamics in GaAs and $Al_xGa_{1-x}As$ describing in their paper the femtosecond absorption recovery dynamics using pulses 35 fs generated by a colliding pulse mode-locked ring dye laser. D. HULIN et al. deal with the subpicosecond optical non-linearities in GaAs multiple-quantum-well structures. K. BOHNERT et al. carried out and discussed the time-resolved photoluminescence measurements in $Al_xGa_{1-x}As$ under intense picosecond excitation. The main conclusion of these measurements is that for alloy compositions near the direct-indirect gap crossover, emission from direct and indirect conduction band valleys is observed to occur simultaneously. The ultrafast dynamics in GaAlAs diode laser amplifier is discussed by M. S. STIX, M. P. KESLER and E. P. IPPEN who present the results of experimental and theoretical investigations on this subject. C. H. YANG and S. A. LYON consider in their paper the problem of fast energy relaxation of hot electrons in bulk GaAs and multi-quantum wells presenting the results of measurements of hot electron distribution and relaxation rate constants obtained using a new quasi-steady-state hot luminescence technique. T. KOBAYASHI et al. investigate the picosecond photoluminescence and energy-loss rates in GaAs quantum wells under high-density excitation. In the subsequent paper the broad tuning of the photoluminescence energy and life-time by the quantum-confined Stark effect is studied by H. J. POLLAND et al. They demonstrate that the quantum-confined Stark effect leads to a drastic decrease of the oscillation strength of the $n = 1$ transitions accompanied by a red shift of the luminescence. M. C. DOWNER and C. V. SHANK report new experimental results regarding Auger heating of silicon-on-sapphire by femtosecond optical pulses. Considering the femtosecond spectroscopy of hot carriers in germanium P. H. FAUCHET et al. show that the large variations in transmission and in reflecting recorded after intense femtosecond excitation of Ge can be attributed to the cooling of hot carriers. The problem of detection of higher order Fourier components of index gratings in picosecond transient grating experiment is undertaken by E. O. GÖBEL and H. SAITO. They demonstrate that simultaneous detection of different diffraction orders in these kinds of experiments provides information on the instantaneous spatial shape of the index (or absorption) grating. Transient thermoreflectance studies of thermal transport in compositionally modulated metal films were carried out by G. L. EESLEY, C. A. PADDOCK and B. M. CLEMENS. In the next paper H. ELSAYED-ALI et al. report on the time-resolved observations of electron-phonon relaxation during femtosecond laser heating of copper. They have directly measured the electron-phonon relaxation time in copper as a function of pump laser fluence and probe photon energy. The femtosecond carrier relaxation in semiconductor-doped glasses has been studied by M. C. NUSS, W. ZINTH and W. KAISER. They point out that the absorption changes observed for three semiconductor-doped glasses investigated in their paper can be well explained within the framework of bulk semiconductor physics. The problem of the high-contrast ultrafast phase conjugation in semiconductor-doped glass has been studied by D. COTTER who for the first time succeeded in proving that the phase-conjugate reflectivity is time-resolved and the contribution precisely identified. The author found out that the nonlinearity is entirely electronic in origin and that there is no detectable thermal contribution to that. W. H. KNOX, L. F. MOLLENAUER and R. L. FORK present the paper on the femtosecond vibrational relaxation of the F_2^+ center in LiF. The energy is dissipated in a time less than four phonon periods and, therefore, the relaxation cannot be described within the frame of a classical cascade model. M. C. NUSS and D. H. AUSTON investigate the propagation of coherent phonon polaritons in $LiTaO_3$ measured by FIR-Cherenkov-pulses. They suggest that the individual oscillation cycles of the TO phonon in $LiTaO_3$ could be resolved in time by using the femtosecond Cherenkov radiation.

Part VI, *Chemical Reaction Dynamics*. This part of the book contains twenty two individual papers. In the first paper by J. T. HYNES there are presented the theoretical perspectives on solution of reaction dynamics for cages, crossings and correlations. The theoretical overview of the solvent dynamic influence on radial recombination, activated barrier crossing and time dependent fluorescence is presented in a detailed and formally complete manner. P. F. BARBARA and V. NAGARAJAN present studies on the dynamic solvent effect on small barrier isomerization describing ultrafast measurements on two elementary processes in solution, namely, rotation about a single bond and intramolecular charge separation. M. MARONCELLI et al. undertook the problem of experiments and simulation concerning the

solution dynamics in polar liquids. C. RULLIÈRE, A. DECLÉMY and Ph. KOTTIS investigate the time-dependent fluorescence shift in alcoholic solvents having in view a non-Debye behaviour related to hydrogen bonds. They have studied strong solute-solvent interactions on a picosecond time scale via time-resolved emission from electronically excited species in solution. R. J. HARRISON et al. consider the detection of the inverted region in photo-induced intramolecular electron transfer. D. F. KELLEY and N. A. ABUL HAJ study the geminate recombination and relaxation of condensed phase molecular halogens. T. W. SCOTT and S. N. LIU concentrate their research on the subject of cage recombination and unimolecular β—scission reactions of sulfur centred free radicals, dealing in their paper with the recombination reactions of large organic free radicals in complex hydrocarbon liquids. The influence of friction and deuteration on stilbene isomerization is analysed by S. H. COURTNEY et al. The paper on photoionization studies of substituted stilbenes (4,4′-dihydroxystilbene and 4,4′-dimethyoxystilbene) is presented by D. M. ZEGLIŃSKI and D. H. WALDECK. D. BEN-AMOTZ and C. B. HARRIS present the results of their picosecond studies of barrierless torsional diffusion. They state that the various apparent anomalies in the internal conversion dynamics of TPM dyes can be explained by allowing for a temperature dependent equilibrium torsional distribution of the phenyl rings. The subject of the time-resolved fluorescence spectra of ethidium bromide is very concisely described by J. H. SOMMER et al. J. C. MIALOCQ and J. C. STEPHENSON present a paper on the picosecond laser investigations of the collisionless UV photodissociation of energetic materials elucidating the fast process in the initiation of explosive decomposition of energetic materials in view of controlling their sensitivity and effectiveness. G. ARJAVALINGAM, T. F. HEINZ and J. H. GOLOWNIA dealt with the subject of time-resolved measurement of laser-induced desorption of a molecular monolayer performed on a picosecond scale. According to the suggestion of the authors the fast response observed in the SH signal can be interpreted either as arising from molecules leaving the surface with a very high translational temperature or from the surface photofragmentation process.

Part VII. *Dynamics of Biological Processes.* This section contains sixteen papers. M. BECKER et al. consider the picosecond electron transfer and stimulated emission in reaction centres of Rodobacter sphaeroides and Chloroflexus aurantiacus. W. ZINT, J. DOBLER and W. KEISER consider the femtosecond spectroscopy of the primary events of bacterial photosynthesis concentrating their attention on photosynthetic units such as bacterior and bacterial reaction centres. S. R. MEECH, A. J. HOFF and D. A. WIERSMA report on their research results concerning an accumulated photon echo study of subpicosecond processes in photosynthetic reaction centres. M. R. WASILEWSKI, M. D. TIEDE and H. A. FRANK deal with the ultrafast electron and energy transfer in reaction center and antenna proteins from photosynthesis bacteria. J. BRETON et al. report on their results concerning the femtosecond spectroscopy of excitation energy transfer and initial charge separation in the reaction center of the photosynthetic bacterium Rhodopseudomonas sphaeroides. The femtosecond-pulse spectroscopy of primary photoprocesses in reaction centres of Rhodopseudomonas sphaeroides R-26 is described by C. V. CHEKALIN, Yu. A. MATVEETS and A. P. YARTSEV. The picosecond conformational intermediates in the bacteriorhodopsin photocycle are described by G. H. ATKINSON et al. The problem of the electron transfer and rapid restricted motion in homologous azurins constitute the subject of the next paper presented by J. W. PETRICH, J. W. LONGWORTH and G. R. FLEMING. T. KOBAYASHI, H. OHTANI and M. TSUDA present the paper on primary processes in vision (hypsorhodopsine) concluding that the primary processes of the photoreaction of octopus rhodopsin at physiological temperature are the thermal formation of both hypsorhodopsin and bathorhodopsin. The reactivity and dynamics of hemoproteins in the femtosecond and picosecond time domains are considered by D. HOUDE et al. B. F. CAMPBELL and J. M. FRIEDMAN considered the picosecond Raman hole burning as a probe of conformational heterogeneity with application of this effect to the oxyhemoglobin. Ultrafast studies of nitrosylmyoglobin were performed and presented by K. A. JONGEWARD, J. C. MARSTERS and D. MAGDE, E. R. HENRY, W. A. EEATON and R. M. HOCHSTRASSER studied molecular dynamics of vibrational cooling in optically excited hemoproteins.

Part VIII, *Energy Transfer and Relocation.* This part contains eighteen individual papers. K. KEMNITZ, A. NAKASHIMA and K. YOSHIHARA consider the energy and electron transfer of absorbed dyes on molecular single crystals and other substrates. P. A. ANFINRUD, T. P. CAUSGROVE and W. S. STRUVE gave their attention to the optical pump-probe spectroscopy of dyes on surfaces, having in mind the ground-state recovery of rhodamine 640 on ZnO and fused silica. The picosecond fluorescence

spectroscopy on molecular association in Langmuir–Blodgett films in considered in the paper written by I. YAMAZAKI, N. TAMAI and T. YAMAZAKI. The fractal behaviours in two-dimensional excitation energy transfer on vesicle surfaces constitute the topic of the paper presented by T. TAMAI et al. who show that the fractal analysis is applicable to the energy transfer kinetics for dyes absorbed on vesicle surfaces. A. SEILMEIER et al. consider the transient vibrational heating of molecules after internal conversion which is one of the most important relocation processes governing the return of most organic molecules to the electronic ground state via radiationless processes after their previous electronic excitation. M. J. ROSKER et al. observed the initial relaxation of photoexcited organic dyes with unprecedented resolution. Probably for the first time they succeeded in observing the quantum beats in large molecules on a femtosecond time scale. P. SPERBER, M. WEIDNER and A. PENZKOFER refer to S_0–S_n two-photon absorption dynamics of rhodamine dyes and analyse the influence of various dye parameters on the intensity dependent transmission through the dye samples. The subject of a singlet excitation fusion in molecular solids is concisely treated in the paper by R. R. MILLARD and B. I. GREENE. The matrix effect on vibrational relaxation in molecular crystals is described by J. R. HILL et al. who used picosecond coherent Raman scattering and picosecond photon echo spectroscopies to investigate vibrational relaxation in low temperature crystals. The problem of optical damage in molecular crystals (solid state explosion) is described in the paper by D. D. DLOTT, T. J. KOSIC and J. R. HILL. They found a new constructive use for optical damage, namely, the simulation of the behaviour of energetic solid materials as rocked propellants or explosives. A. J. BAIN et al. discuss in their paper the rotational relaxation of free and solvated rotors. The ultrafast dynamics at the interface was studied by E. F. TEMLETON et al. They conclude that the major probemicelle interaction is a screened coulombic repulsive or attractive interaction, depending on the effective ionic strength experienced by the probe in the microscopic boundary level comprising charged head groups and counter ions.

Part IX, *Coherent Spectroscopic Techniques*. That part of the book contains eleven different papers. J. ETCHEPARE et al. consider the phase grating approach to susceptibility tensors determined in isotropic media. S. MUKAMEL, Z. DENG and R. F. LORING considered the nonlinear response function for four-wave mixing and applied its to coherent Raman lineshapes in polyatomics and to the optical Anderson transition. P. N. PRASAD et al. consider the third order nonlinear optical interactions in thin films of organic polymers investigated by picosecond and subpicosecond four-wave mixing. The picosecond Raman-induced phase conjugation (RIPC) spectroscopy is described in the paper by R. DORSINVILLE, P. DELFYETT and R. R. ALFANO who demonstrate, for the first time, the use of RIPC technique in the picosecond regime. They obtained the picosecond RIPC spectra of several liquids and solids and by delaying one of the interacting beams relative to the other. Pump and probe beams were able to determine with picosecond resolution the intensities of the phase conjugate beams at the Stokes frequencies as a function of time. The direct measurement of wave-vector-dependent polariton energy velocity and dephasing in NH_4Cl were performed and presented in the paper prepared by G. M. GALLE, F. VALLÉE and C. FLYTZANIS. They have shown that it is possible to create and follow the temporal and spatial evolution of a picosecond pulse of propagating Raman active photopolaritons. M. R. FARRAR et al. present their findings regarding the impulsive stimulated Rayleigh, Brillouin and Raman scattering, and in particular experiments and theory of light scattering spectroscopy in the time domain. The ultrafast transient spectroscopy with broadband non-transform limited light sources problem was considered by T. YAJIMA and N. MORITA who concluded that this light is widely applicable to investigation of a variety of ultrafast phenomena. T. KABAYASHI, T. HATTORI and A. TERASAKI gave their attention to the picosecond dephasing time measurement by CSRA using temporarily incoherent nanosecond laser with short correlation time. P. MUKHERJEE and H. S. KWOK present in the last paper of this part the results of their studies of the anomalous pulse duration dependence of the quasi-continuum absorption spectrum providing new dynamical information on the relatively featureless envelops of the absorption spectra.

In conclusion of this informative note, it has to be emphasized that the material gathered in the book is, on one hand, extremely interesting and valuable but, on the other hand, equally difficult to read without deep knowledge of the very specialized laser theory and technology problems. The book indicates the surprisingly quick progress made in this technology. It is a pity that no panel discussion gave the pointers for future progress. Certainly, it has to be expected. The applications of ultrafast techniques to

widely separated fields of science and engineering, presented in this book, make it a valuable vedemecum of information to those scientists who already are familiar with their practical and potential possibilities. It seems clear, however, that in the application field a close collaboration with highly specialized physicists will be unavoidable.

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Laser Spectroscopy VIII

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Eds.: W. PERSSON and S. SVANBERG

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[pp. i–xx + 476 with 315 Figs.]

Following the tradition, the book has a form of conference proceedings. The Eight International Conference on Laser Spectroscopy, *EICOLS '87*, was held in Åre, Sweden, June 22-26, 1987.

Over 140 contributions have been arranged into 12 topical groups. As usual, a wide range of interests is presented. Parts I–VI contain results of fundamental studies. The headlines of these chapters might be informative to the potential reader:

I *Applications of Laser Spectroscopy to Basic Physics*
II *Laser Cooling, Trapping, and Manipulation of Atoms and Ions*
III *Quantum Jumps*
IV *Quantum Optics, Squeezed States, and Chaos*
V *Atomic Spectroscopy*
VI *Molecular Spectroscopy*

The other part reports more applications and developments of the laser spectroscopy. It is also worth to mention the chapters' titles:

VII *Clusters, Surfaces and Solids*
VIII *Miscellaneous Laser Spectroscopy Experiments*
IX *Laser Spectroscopic Diagnostics*
X *Spectroscopic Techniques*

XI *Spectroscopic Sources*
XII *VUV Spectroscopy*

The volume starts with four contributions dealing with the determination of the Rydberg constant. This constant introduces the largest uncertainty (~ 2.5 MHz $= 8 \times 10^{-5}$ cm^{-1}) in tests of quantum electrodynamics (QED), whereas fine splittings of couplings anticipated in the QED calculations are as small as 4 kHz ($\sim 1.2 \times 10^{-6}$ cm^{-1}). The figure 109 737.3157 cm^{-1} for the Rydberg constant seems to be above suspicion. Nevertheless, the experiments performed in Stanford and Yale (USA), Paris (France), and Oxford (UK) result in some discrepancies: the limit values .315 73(5) (UK) versus .315 692(60) (France) for decimal parts of the Rydberg constant are reported. However, it is worth to mention that these observations are the most accurate measurements ever performed in history. At this point it is perhaps interesting to refer the reader to the review *Towards the Ultimate Laser Resolution* by J. L. HALL et al. (Part X) that demonstrates a possibility of producing a laser linewidth of 50 miliHerz ($\sim 2 \times 10^{-12}$ cm^{-1})!

No simple statement is possible to summarize the book's content. Perhaps as a substitute of such a synthetic opinion following remarks would be in order. There is still increasing tendency to look for applications of laser spectroscopy in fundamental and applied research. Only scarcely one can find a contribution concerned with theoretical aspects of the laser physics. The techniques that use very short pulses (subpicosecond regime) become increasingly popular, resulting in new experimental developments and perspectives. The words "... the optoelectronic technique detects the electric field and not the intensity. This feature makes the technique sensitive to changes in phase and amplitude of the interfering spectral components ..." as cited from the communication *Spectroscopy with ultrashort electrical pulses* by D. GRISCHKOWSKY et al., IBM, would serve as a representative statement. Methods like those are very promising in sampling of the time-resolved dynamical behaviour of quantum systems in non-equilibrium states.

An appealing experiment on this topic has been reported by Th. SAUTER et al., FRG, in the contribution entitled *Quantum jumps and related phenomena of single ions and small ion clouds.* The progress in methods of cooling and storage by laser beams allowed the authors to detect the $^2P_{1/2} \leftarrow {}^2S_{1/2}$ fluorescence of a cold single Ba^+ ion. Occasionally this fluorescence has disappeared for an additional red-line laser beam drawn up the ion to a "dark" state switching, therefore, off the radiative transition. Similar effect has been demonstrated for three Ba^+ ions. As the authors mentioned, serious consequences for quantum mechanics arise from the experiment. Namely, the continuous time evolution of a quantum state, as it results from the Schrödinger equation, is broken in the act of a single instantaneous transition. And such a transition has been really detected! Additionally, Schrödinger's opinion "we never experiment with just one electron or atom ..." looses its validity, at least, for the last word.

On the other hand, an increasing number of applications (in comparison with the former conferences) of laser spectroscopy in the macroscopic word can be observed. For example, coherent anti-Stokes Raman spectroscopy (CARS) yields a precise tool for probing combustion processes.

Another advantage of the laser beam reveals itself in use of a lidar (or optical radar) in detection of the trace constituents (for example, metals, ozone) in remote parts of the atmosphere.

Being one of the newest and comprehensive reviews of modern spectroscopy, the book is warmly recommended for several reasons: a collection of up-to-date experimental facts, a nice review of developments in laser technology, a guide to current achievements of laser spectroscopy.

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Video Microscopy

S. INOUÉ

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[pp. i–xxvi + 584, with 317 Figs. and 2 Colourplates, and about 650 References]

One of the most fascinating achievements in light microscopy during the past decade is Video Enhanced Contrast (VEC) microscopy, in short Video Microscopy. This new and highly useful method was initiated in 1981 by S. INOUÉ (affiliated with Marine Biological Laboratory, Woods Hole, Mass., and University of Pennsylvania, Philadelphia, and Universal Imaging Corporation, Falmouth, Mass., USA), and R. D. ALLEN (the late, 1986, who was affiliated with Dartmouth College, Hanover, New Hampshire, USA). It uses a high-resolution video camera (mainly a Hamamatsu CCTV camera) attached to a light microscope, a digital image processor, and various computer assisted accessories. The image contrast of a specimen under study is enhanced by applying an offset to the video signal and increasing the gain. Optical mottle or noise of the background (empty microscope field of view) is stored in a frame memory by an electronic processor and continuously substracted from incoming actual image of the specimen. Moreover, electronic noise is reduced by averaging the images over a selected number of frames and the image contrast can be further enhanced by digital gain expansion. This general principle is discussed in detail by S. INOUÉ in his fascinating book, whose highly practical matters can be very useful for all microscopists who desire to explore applications of the video technique even in a way "do-it-yourself".

Video enhancement was originally used by S. INOUÉ with polarized-light microscopy and with differential interference contrast microscopy (Nomarski DIC system) by R. D. ALLEN. This enabled the cell organells of size below the limit of resolving power of the light microscope to be observed on a monitor screen, with a final magnification of 7000 × or even more. The useful magnification is in this instance five times higher than in conventional light microscopy. The VEC technique can therefore be qualified as a direct bridge between light microscopy and electron microscopy. Today, this technique is particularly used for dynamic studies of living cells, for visualization of individual colloidal gold particles in living cells (the diameter of those particles is equal to tens, say 20 to 50 nanometers, as usually in immuno-gold microscopy), for the study of structure and dynamics of the cytoskeleton, for examining the transport and motility of cytoplasms with membrane systems and cell organelles, for studying the growth, interactions and division of cells and mitosis, as well as for analysing the influence of experimental substances on cell structures and their kinetics. Video microscopy is also very useful in the semiconductor industry and materials sciences, especially for differentiation of object phases with minimum reflection differences, for studying the surface structure of transparent substrate material, for displaying striae in glass and small differences in refractive index in optical fibres. However, the most spectacular applications of the VEC method are in biology and biomedicine.

The *Video Microscopy* starts with a list of 28 Tables and another list of firms cited in the text (about 80 firms). The are followed by four chapters that can be qualified as an introductory part of the book. They contain a brief review of the invention of TV, its early applications, and the present state of video microscopy, a glossary of terms commonly used in video and microscopy, some elementary and practical operations and manipulations with TV cameras attached to a microscope, and a review of the major features of human vision that relate to the design and use of TV as well as the light microscope.

Then Chapter 5 deals with the essentials of microscope image formation and the basic adjustments and special care of the light microscope needed to produce high-quality images using the video technique.

The true VEC microscopy begins with Chapter 6 at page 149 and follows through the next six chapters, which deal with the video signals and their transmission from the TV camera to the monitor

(Chapter 6); the video imaging devices, cameras, and monitors (Chapter 7); the video recorders, their operation, choice, and care, including video tape recorders and optical disc recorders, some with capabilities for time-lapse, freeze-frame, and high-speed operations (Chapter 8); the techniques suitable for video processing and analyses using the analog video equipment (Chapter 9); the principles and applications of digital image processing and analysis (Chapter 10, which is given by R. J. WALTER and M. W. BERNS); the applications of VEC method, classified according to modes of contrast generation in light microscopy (phase contrast, DIC, fluorescence, darkfield, polarization, and other techniques), and image quantification by video (photometry, densitometry, morphometry, sorting, tracking), including scanning light microscopes, tomography, and three-dimensional reconstruction (Chapter 11). The final Chapter 12 is devoted to the presentation of video data by publication of video micrographs, optical copying with video, copying and editing onto videotape, video projection, video-to-film transfer, including the stereo video display.

The final chapter is followed by a short postscript and four appendices. The first Appendix (by G. W. ELLIS) deals with spatial filtration for video line removal, the second discusses the modulation transfer function analysis in video microscopy (this is given by E. W. HANSEN), the next is added by S. INOUÉ as an introduction to biological polarization microscopy, including the rectified optics, and the last Appendix is an addendum on digital image processors. A detailed subject index brings this book to an end.

S. INOUÉ has stated in his *Preface* that the organization of the book may appear somewhat unusual. He "tried to develop the subject in a spiral fashion, interweaving the practical and the basics, hoping to help those who actually make use of video microscopy". The reviewer thinks that this is a good help.

It is worth noting that the equipment for video microscopy is commercially available from several firms, from which the most known are Hamamatsu, Japan, Universal Imaging Corporation (Ted Inoué, President), 600 North Jackson Street, Media, PA 19063, USA, Ernst Leitz Wetzlar GmbH, West Germany, and Carl Zeiss Oberkochen, West Germany. The Hamamatsu system is called Photonic Microscope System, Universal Imaging Co. offers Images-1/AT system, E. Leitz Wetzlar – the Microvid system, and C. Zeiss Obekochen – the ACE Microscope System.

For all these systems the book *Video Microscopy* by S. INOUÉ is a fundamental reference.

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