

## FORTHCOMING PAPERS

### An Invariant Imbedding Formulation of Coupled-Wave Theory

K.C. Johnson (USA)

An alternative formulation of coupled-wave theory adapted to numerical analyses is developed, using the method of invariant imbedding. Solutions of the coupled-wave equations are represented in terms of a reflectance matrix  $\rho$  and a transmission matrix  $\tau$  (rather than the transition matrix  $\Phi$  of the more classical approach).

### UV Picosecond Laser-Induced Formation of Amino Acids from Aqueous Solutions of Ammonic Salts of Dicarboxylic Acids

V.S. Letokhov, Yu.A. Matveets, V.A. Semchishen; E.V. Khoroshilova (USSR)

It is shown for the first time that the irradiation of the ammoniac-salts aqueous solutions of the dicarboxylic acids by powerful ultrashort UV pulses provokes the formation of the related amino acids. The amino-acids yield depends on the intensity and for the aspartic acid, in particular, it reaches 40% at the intensity of about 1 GW/cm<sup>2</sup>.

### Stepwise Photoionization of the Complex Organic Molecules in the Gas Phase Induced by UV Laser Radiation

G.A. Abakumov, B.I. Polyakov, A.P. Simonov, L.S. Tchuiko, V.T. Yaroslavtzev (USSR)

We measured the photoionization cross-sections of anthracene, 1,2-benzanthracene, *p*-terphenyl, and 2,5-diphenylfuran molecules excited to the singlet and triplet electronic states intermediate in the stepwise two-photon ionization process at 266 nm (all compounds) and at 355, 391, and 417 nm (anthracene).

### Single Picosecond-Pulse Generation in a Mode-Locked Oscillator and Regenerative Amplifier System

A. Penzkofer, F. Härtinger, J. Wiedmann (F.R. Germany)

A mode-locked Nd-glass laser oscillator with intra-cavity pulse selection by a Pockels cell shutter is described. A regenerative amplifier system with a saturable absorber is used to shorten the selected light pulses from the master oscillator. Pulses were shortened from 8 ps to 1 ps.

### Theory of the Synchronously Pumped Picosecond Dye Laser

J. Herrmann, U. Motschmann (DDR)

The circulation of a synchronously mode locked dye laser pulse in a linear cavity configuration containing a dye cell as an active medium and a bandwidth-limiting element is treated. The condition that the pulse shape reproduces after each cavity round-trip provides a nonlinear integro-differential equation for the steady-state pulse shape. For the solution of this equation an approximate method, not limited to small pulse energies, is given and the pulse duration, intensity, energy, asymmetry of the pulse shape, stable regions and other interesting parameters are discussed.

### Application of a cw Helium Neon Laser for Measurement of Gaseous Hydrogen Fluoride Concentration

J.E. Eberhardt, A.W. Pryor (Australia)

The concentration of gaseous hydrogen fluoride in air can be measured by the use of a close coincidence between the 3 p<sub>4</sub>-2 s<sub>2</sub> cascade cw helium neon laser line and the 1 R 5 hydrogen fluoride absorption line. A nearby cw HeNe laser line (3 p<sub>2</sub>-2 s<sub>2</sub>) is not absorbed by hydrogen fluoride and may be used to compensate for transmission losses in a long-path measurement system. Most of the HF  $\nu=0$  to  $\nu=1$  absorption lines lie in a region in which there is strong attenuation caused by atmospheric water vapour, but the 1 R 5 line is almost free of interference from H<sub>2</sub>O, CO<sub>2</sub> or CO.

# Vertebrate Photoreceptor Optics

Editors: J.M. Enoch, F.L. Tobey, Jr.

With contributions by numerous experts

With a Foreword by W.S. Stiles

1981. 164 figures. XV, 483 pages.  
(Springer Series in Optical Sciences, Volume 23)  
Cloth DM 98,-; approx. US\$41.70  
ISBN 3-540-10515-8

This book provides the first systematic analysis of retinal receptor optics. Physicists will find it an important source of information about the biological factors involved, and biologists are given clear explanations of the physical characteristics of waveguide properties.

Springer-Verlag  
Berlin  
Heidelberg  
New York



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## Applied Physics A

Invited Paper

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## FORTHCOMING PAPERS (CONT'D)

### Radiofrequency - Induced Cross-Over Resonances

A. Jacques, P. Glorieux (France)

A new kind of Doppler-free cross-over resonances has been studied experimentally and theoretically. When counter-propagating fields interact with two overlapping absorption transitions at frequencies  $\Omega_1$  and  $\Omega_2$ , a rf induced cross over resonance (R.I.C.O.R) appears near  $(\Omega_1 + \Omega_2)/2$  when an rf field couples two of the levels involved in the main transitions. This Doppler-free signal splits into two symmetrical components when the rf Rabi flopping frequency increases either through rf field strength or detuning. Experimental results have been checked against a theory in which the susceptibility of the molecule dressed by the rf field is calculated by a perturbation expansion with respect to infrared couplings.

### The He/Cl<sub>2</sub> Laser at 258 nm

E. Schätzlein, W. Walter, R. Sauerbrey, H. Langhoff (F.R. Germany)

Lasing from e-beam pumped He/Cl<sub>2</sub> mixtures at 258 nm was investigated in a longitudinal pumping geometry. Time dependence, output powers and energies as well as the spectral composition of the laser pulses were determined for different experimental conditions. Optical gain was observed for eight transitions around 258 nm. The fine structure results from isotopic splitting and contributions from different vibrational states. No bottle-necking occurs. However, saturation and absorption by excited states limited the total output power to 6 MW and the output energies to 200 mJ. A simple kinetic model is proposed that reproduces the larger number of experimental data quite sufficiently.

### Interface Extinction and Subsurface Peaking of the Radiation Pattern of a Line Source

N. Engheta, C.H. Papas, C. Elachi (USA)

The radiation pattern of a line source lying along the plane interface of two dielectric half-spaces is calculated. It is found that the pattern at the interface has a null (interface extinction); that the pattern in the upper half-space, whose index of refraction is taken to be less than that of the lower half-space, has a single lobe with a maximum normal to the interface; and that the pattern in the lower half-space (subsurface region) has two maxima (peaks) straddling symmetrically a minimum. Interpretation of these results in terms of ray optics, Oseen's extinction theorem, and the Cerenkov effect are given.

### Optimization of the Optothermal Detector for Absorption Spectroscopy in the Low Pressure Range

C. Hartung, R. Jurgeit (DDR)

To use the sensitivity and the measurement accuracy of the optothermal detector (OT) better for linear absorption detection, a theory of the signal behaviour, worth for the most important range of application, is developed and compared with experimental data. By means of the example of CO<sub>2</sub>-laser light absorption by ammonia, containing two different nitrogen isotopes, the possibility of correcting measured values to get more exact, information of the absorption behaviour is shown. The limits of error, as well as the reproducibility of the measurements could be kept in a range of about 1%.

### Atomic Nitrogen Laser Action in a Hollow Cathode Discharge

Zhu Xu-hui, Lin Fu-Cheng (F.R. Germany)

Near-infrared laser action of nitrogen atoms was obtained in a hollow cathode discharge. Four laser lines at wavelengths of 1358.2, 939.3, 938.7, and 862.9 nm were observed in the cw mode. In addition, the laser line at 904.6 nm was observed in quasi-cw operation in the afterglow for the first time. It is supposed that resonant charge exchange between He<sup>+</sup> and N<sub>2</sub> followed by predissociation of N<sub>2</sub><sup>+</sup> is an important way of populating the upper laser levels.

## Optical Communication

### Integrated Optics

Editor: T. Tamir

Second corrected and updated edition  
1979. 99 figures, 11 tables. XV, 333 pages  
(Topics in Applied Physics, Volume 7)  
DM 43,-; approx. US \$ 25.40  
ISBN 3-540-09673-6

T. Tamir: Introduction.

H. Kogelnik: Theory of Dielectric Waveguides.

T. Tamir: Beam and Waveguide Couplers.

J.M. Hammer: Modulation and Switching of Light in Dielectric Waveguides.

F. Zernike: Fabrication and Measurement of Passive Components

E. Garmire: Semiconductor Components for Monolithic Applications.

T. Tamir: Recent Advances in Integrated Optics.

Additional References with Titles. - Subject Index.

### Semiconductor Devices for Optical Communication

Editor: H. Kressel

1980. 186 figures, 6 tables. XIV, 289 pages  
(Topics in Applied Physics, Volume 39)  
Cloth DM 98,-; approx. US \$ 57.90  
ISBN 3-540-09636-1

H. Kressel: Introduction.

H. Kressel, M. Ettenberg, J.P. Wittke, I. Ladany: Laser Diodes and LEDs for Fiber Optical Communication.

D.P. Schinke, R.G. Smith, A.R. Hartman: Photodetectors.

R.G. Smith, S.D. Personick: Receiver Design for Optical Fiber Communication Systems.

P.W. Shumate, Jr., M. DiDomenico, Jr.: Lightwave Transmitters

M.K. Barnoski: Fiber Couplers.

G. Arnold, P. Russer, K. Petermann: Modulation of Laser Diodes.

J.K. Butler: The Effect of Junction Heating on Laser Linearity and Harmonic Distortion.

J.H. Mullins: An Illustrative Optical Communication System.

B. SALEH

## Photoelectron Statistics

With Applications to Spectroscopy and Optical Communication

1978. 85 figures, 8 tables. XV, 441 pages  
(Springer Series in Optical Sciences, Volume 6)  
Cloth DM 74.80; approx. US \$ 44.20  
ISBN 3-540-08295-6

Tools From Mathematical Statistics: Statistical Description of Random Variables and Stochastic Processes. Point Processes. - Theory: The Optical Field: A Stochastic Vector Field or, Classical Theory of Optical Coherence. Photoelectron Events: A Doubly Stochastic Poisson Process or Theory of Photoelectron Statistics. - Applications: Applications to Optical Communication. Applications to Spectroscopy.

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Heidelberg  
New York



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## FORTHCOMING PAPERS (CONT'D)

### A Magnetically Stabilized Coaxial Laser Discharge

C.E. Capjack, H.J.J. Seguin, D. Antoniuk, V.A. Seguin

A new magnetic discharge stabilization technique for coaxial laser systems is described. The approach utilizes crossed electric and magnetic fields to create and maintain a large and rapidly rotating plasma volume which does not experience glow-to-arc transitions. Very high cw specific discharge power loadings have been achieved even without the benefit of external gas cooling or circulation.

Performance is insensitive to gas composition and pressure such that high power coaxial discharges have been run in CO<sub>2</sub> laser gas mixtures up to several hundred torr. Stable cw discharges have also been obtained in mixtures containing several torr of SF<sub>6</sub>.

The technique appears to be readily scalable to give very large excited volumes in systems with comparatively small overall physical dimensions.

### A Repetitively Pulsed Sealed - TE CO<sub>2</sub> Laser Using an Oxygen Tolerant Discharge Scheme

P.E. Dyer, P. Monk

A repetitively pulsed ( $\leq 40$  Hz) TE CO<sub>2</sub> laser using an oxygen tolerant discharge scheme is described. Long lived ( $> 10^5$  shots) stable discharges at high pump energy density ( $\sim 200 \text{ Jxl}^{-1} \text{ atm}^{-1}$ ) have been achieved both with and without the use of additive cases.

### Subpicosecond Pulse Generation in Synchronously Pumped and Hybrid Ring Dye Lasers

P.G. May, W. Sibbett, J.R. Taylor

Subpicosecond pulse generation has been examined in synchronously pumped mode-locked ring dye laser systems. These include hybrid and composite absorber/gain media arrangements as well as a simple synchronous cavity. The shortest pulses recorded were 0.3 ps for the hybrid system, and this has been shown to be critically dependent on the positioning of the absorber jet in the centre of the cavity to better than 50  $\mu\text{m}$ . Stable operation for subpicosecond pulse generation has been achieved in the ring configurations with greater wavelength tunability and higher average power conversion efficiency than with conventional cavity arrangements.

### Unidirectional Doppler-Free Gain and Generation in Optically Pumped Lasers

A.K. Popov, V.M. Shalaev (USSR)

The feasibility of obtaining anisotropic Doppler-free gain and unidirectional light in optical pumped lasers is studied. The Doppler broadening is compensated due to a pump-induced velocity-dependent light shift of an atomic transition. The gain and spectral characteristics are investigated.

### New Results on Ultrafast Coherent Excitation of Molecular Vibrations in Liquids

W. Zinth, H.-J. Pollard, A. Laubereau, W. Kaiser

Coherent Raman probe scattering experiments are performed to study dynamical processes of polyatomic liquids at 300 K. For single homogeneous transition the dephasing time  $T_2$  is readily obtained from time resolved investigations. Spectral studies show an interesting time dependent shift in scattered frequency. After the excitation the vibrating molecules are shown to relax freely with their resonance frequency. Multiple, equally spaced transitions exhibit a beating phenomenon which provides the dephasing time and the frequency interval between neighboring vibrational states. Inhomogeneously broadened systems do not allow a ready determination of the dephasing time by the present probing technique. Previous experiments on the subject have to be reconsidered.

# Nonlinear Optics

## D.C. HANNA, M.A. YURATICH, D. COTTER Nonlinear Optics of Free Atoms and Molecules

1979. 89 figs., 10 tab. IX, 351 pages.  
(Springer Series in Optical Sciences, Vol. 17)  
Cloth DM 79,-; approx. US \$46.70  
ISBN 3-540-09628-0

**Contents:** Introduction.— Theory of the Nonlinear Optical Susceptibility.— Propagation of Plane Waves in a Nonlinear Medium.— Sum Frequency and Harmonic Generation.— Stimulated Electronic Raman Scattering.— Raman-Resonant Four-Wave Processes.— Nonlinear Optical Processes in Free Molecules.— Some Miscellaneous Topics.— References.— Subject Index.

## V.S. LETOKHOV, V.P. CHEBOTAYEV Nonlinear Laser Spectroscopy

1977. 193 figs., 22 tab. XVI, 466 pages.  
(Springer Series in Optical Sciences, Vol. 4)  
Cloth DM 72,-; approx. US \$ 42.50  
ISBN 3-540-08044-9

**Contents:** Introduction.— Elements of the Theory of Resonant Interaction of a Laser Field and Gas.— Narrow Saturation Resonances on Doppler-Broadened Transition.— Narrow Resonances of Two-Photon Transitions Without Doppler Broadening.— Nonlinear Resonances on Coupled Doppler-Broadened Transitions.— Narrow Nonlinear Resonances in Spectroscopy.— Nonlinear Atomic Laser Spectroscopy.— Nonlinear Molecular Laser Spectroscopy.— Nonlinear Narrow Resonances in Quantum Electronics.— Narrow Nonlinear Resonances in Experimental Physics.

## Nonlinear Infrared Generation

Editor: Y.-R. Shen  
1977. 134 figs. XI, 279 pages.  
(Topics in Applied Physics, Vol. 16)  
Cloth DM 98,-; approx. US \$ 57.90  
ISBN 3-540-07945-9

**Contents:** Y.-R. Shen: Introduction.— R.L. Aggarwal, B. Lax: Optical Mixing of CO<sub>2</sub> Lasers in the Far-Infrared.— R.L. Byer, R.L. Herbst: Parametric Oscillation and Mixing.— V.T. Nguyen, T.J. Bridges: Difference Frequency Mixing via Spin Nonlinearities in the Far-Infrared.— J.J. Wynne, P.P. Sorokin: Optical Mixing in Atomic Vapors.— T.Y. Chang: Optical Pumping in Gases.

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