CONFERENCE ON LASERS AND ELECTRO-OPTICS/EUROPE
EUROPEAN QUANTUM ELECTRONICS CONFERENCE

An Overwhelming Response

The 1462 technical papers submitted for presentation at this year's joint CLEO/Europe-EQEC conference (RAI Congress Centre, Amsterdam; 28 August - 2 Sept. 1994) promise a comprehensive overview of major developments in many topics. The EQEC part of this back-to-back event that mirrors the North American CLEO/International Quantum Electronics Conference is organized by the EPS Quantum Electronics and Optics Division. It received 641 submissions, so this first meeting bringing together the entire community of scientists and engineers working in lasers, electro-optics, quantum electronics, and related fields should be a great success. The Division's programme sub-committee chairs summarize the highlights.

Laser Spectroscopy

Some 20% of the EQEC submissions cover laser spectroscopy as it is a loose framework at the heart of laser applications. Highlights will be precision spectroscopic measurements (M. Inguscio *et al.*, Florence; W. Hogervorst *et al.*, Amsterdam) bringing us closer to an improved comparison of theory and experiment. The same precision is used by E. Hinds *et al.* (New Haven to probe subtle phenomena such Casimir effects (radiative corrections in a confined space). Optical lattices of laser-cooled atoms remain prominent (650 nK has been achieved by a group from Gaithersburg), but the laser cooling and coherence of simple atoms (hydrogen and helium) is brought to the fore (J.T.M. Walraven, Amsterdam; C. Cohen-Tannoudji *et al.*, Paris) since new techniques for cooling to lower temperatures are sought. While measurements with atom interferometers have proved more elusive, groups from MIT (C.R. Ekstrom *et al.*) and the University of Constance (T. Pfau) will report that progress is being made. Spectroscopy of a single atom or molecule embedded in a substance offers many opportunities, hence the interest in detecting the electron-spin resonance of Cs atoms implanted in solid He (T.W. Hänsch *et al.*, Munich). Last but by no means least, J.P. Woerdman & M. Kristensen (Leiden) will discuss whether the environment of Rb atoms in Xe behaves as a large quasimolecule whose effect on polarized light can be controlled with a magnetic field (the Faraday effect). The laser cooling of ions is represented by a report of quantum jumps of a single In ion stored in a trap (H. Walther *et al.*, Garching).

Nonlinear Optical Phenomena

Judging from the submissions to the sessions on nonlinear optical phenomena, the field now resembles nonlinear science in general, with interests not simply in frequency conversion but also in nonlinear dynamics and wave phenomena. This perhaps explains why the area dominates the joint conference with over 200 submissions. Spontaneous optical patterns feature strongly, with a good balance between theory and experiment. Highlights are optical patterns in a liquid crystal cell with one feedback mirror (M. Tamburrini *et al.*, Rome) and a review by G.-L. Oppo (Stratchclyde). Nonlinear dynamics in optical systems includes chaos in systems with different degrees of freedom using a T-shaped cavity (E. Göbel *et al.*, Marburg). Chaos in fibres, another topical area, includes work on synchronously driven fibre resonators (F. Mitschke *et al.*, Hannover) and chaos control in fibre lasers (P. Glorieux, Lille) that points to the CLEO-Europe sessions on the applications of chaos. Stable, nonlinear states have a longer history, and more obvious applications; EQEC will cover the well-established main themes (optical bistability, nonlinear propagation, solitons). Classical nonlinear optics is highlighted by talks on quasi-phase matching for frequency conversion, second-order processes, four-wave mixing, and special materials, notably chiral media which yield stereochemical information about biomolecules (N.I. Koroteev *et al.*, Moscow) and measurements on glasses with semiconductor crystallites (G.P. Banfi *et al.*, Pavia) questioning the validity of theories claiming that electron confinement affects nonlinearity.

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Quantum Optics

The central themes of the quantum optics sessions are connected with the manipulation and transformation of states of atoms and light through nonlinear interactions. Cavity quantum electro-dynamics in which atom-field interactions are enhanced through confining the atomic sources in high-impedance cavities will be highlighted in invited talks (J.M. Raimond, Paris; H. Walther, Garching) while A.S. Parkins (Constance), P. Zoller (Colorado), H.J. Kimble (Pasadena) *et al.* will describe how quantum states can be "engineered" by adiabatically transferring atomic coherence to quantum fields. Reducing quantum noise to below the standard quantum limit continues to be of interest, especially now that quantum non-demolition has shown potential for information processing. Recent work on monitoring single quantum trajectories conditioned by the history of

past observations will be reviewed by the pioneers (H.J. Carmichael, Eugene; K. Mølmer, Aarhus) as it is proving to be invaluable in modelling laser cooling. P. Mandel (Brussels) will summarise achievements in exploiting coherent effects (*e.g.*, interference of atomic states induced by intense classical fields) to suppress losses while preserving laser gain. Finally, phenomena at the single quantum level form the basis of secure optical communication. In testing quantum behaviour over long distances, P.R. Tapster *et al.* (Malvern) will report that two-photon interference can be observed in fibre interferometers separated by up to 4.3 km of fibre.

Optical Interactions with Matter

A session on ultrafast dynamics in semiconductors will cover coherent spontaneous radiation of ballistic electrons in superlattices (hot-electron luminescence) that can be employed to characterise these types of structures (Yu.A. Malov & D.F. Zaretsky, Moscow), as well as spin-splitting of quantum wells in magnetic fields using time-resolved spectroscopy to overcome inhomogeneous broadening due to well-depth fluctuations (I. Bar-Joseph, Rehovot). Other topics are resonant optical instabilities in evaporation induced by laser radiation (N.E. Kask & S.V. Michurin, Moscow) and the inverse Faraday effect. J.-Y. Marzin (Paris) will show how the high-resolution spectroscopy of self-organized quantum dots giving small recombination linewidths opens up new opportunities. Nonlinear spectroscopy can probe spatial correlation in polymers (J. Knoester *et al.*, Groningen) and time-resolved spectroscopy is invaluable for studying X-ray microplasma sources (D. von der Linde, Essen) and the technically very important shallow donors in GaAs (T.O. Klaassen *et al.*, Delft). The manipulation of light fields will feature work on trapping with phase holograms, wavefront dislocations from optical damage in photonic crystals, and the simulation (U. Janicke & M. Wilkens, Constance) of near-field atom optics which may have important applications in atom lithography.

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Physics of Coherent Light Sources

Novel designs for laser cavities continue to be developed, while carrier dyamics in quantum-well semiconductor lasers is now known to involve both classical transport and quantum mechanical capture (G. Eisenstein, Haifa; M. Priesel, Copenhagen). G. Huber (Hamburg) will review new sources for tuneable solid-state lasers in the near-infrared, and even in the visible with direct, internal upconversion. New dopants allow emission from fibre lasers in the near-infrared, and new excitation schemes being proposed are based on coherent coupling of atomic levels, and on relativistic effects of ionization in strong laser fields.

Ultrafast Phenomena

Several sessions provide a glimpse of the changes taking place in the rapidly growing field of ultrafast phenomena, where the physics and applications of femtosecond technology are displacing technical developments. Among the many topics covered are laser-generated X-ray plasma sources with reports on the feasibility of high-brightness soft X-ray sources, and on spectra from alumina targets struck with state-of-the-art 100 TW pulses of 260 fs duration (C. Sauteret *et al.*, Limeil). Ultrafast phenomena associated with quantum wells, exciton dynamics and superlattices provide much interest, especially in fundamental studies of electron wave packets in atoms (H.B. van den Heuvell, Amsterdam); polarization selection rules for quantum beating; bi-excitons and exciton bleaching in GaAs quantum wells; excitons and carriers in multiple quantum wells (R.H.M. Groenweld *et al.*, Nijmegen); and lattice vibrations and Bloch oscillations with the emphasis on THz radiation emission (H. Kurz, Aachen) for semiconductor dipole antenna. Invited talks will highlight interactions in plasma (R. Falcone, Berkeley), solvent dynamics in solutions (D.A. Wiersma, Groningen), coherent solid-state phenomena (De Korsy, Aachen), hole relaxation in semiconductors (T. Elsaesser, Berlin), and high-sensitivity phase spectroscopy to measure, for instance, the spin structure of Sm atoms in a beam (J.-C. Diels, Albuquerque).

Lasers in Chemistry and Biology

The applications of lasers in biology and chemistry are obviously widespread. From a more fundamental viewpoint, today's possibilities are beautifully demonstrated by work on small-molecule dynamics, notably wave packets in light-harvesting pigments using femotsecond spectroscopy (T. Pullerits *et al.*, Umea & Sheffield), high-resolution quantum beat spectroscopy (J.R. Huber, Zurich) and the measurement of molecular properties by relating the behaviour of a single molecule to its environment (R. Rigler, Stockholm).