CLEO/QELS 2000 will deliver up-to-the-minute information on research and applications in the fields of lasers and electro-optics May 7th through the 12th. One of the largest shows of its kind, it typically draws over 7,000 attendees every year.

**CLEO: Highlights of the technical program**

The technical program at CLEO will provide an update and review of laser and electro-optic disciplines, device development, systems engineering and applications, with an emphasis on applied physics, engineering, and uses of lasers and electro-optics. Thirteen subcommittees, composed of leading individual contributors in every facet of laser, electro-optic, and quantum electronic technology, have shaped and organized the program to provide an overview of the latest developments in these rapidly developing fields.

A generalized trend throughout the area of high-field lasers is a tendency for "big science" to move to a smaller scale; in other words, many experiments that until recently could only be carried out in large national labs can now be reproduced in smaller, academic-scale facilities. There has been significant expansion in the use of semiconductor-based planar detectors (MQW-devices) for applications in ultrasound detection and imaging through turbid media. Optical time division multiplexing, especially the drive to extend wavelength bands and create all-optical regeneration of signals, is drawing increased attention. $\chi^{(2)}$ non-linear frequency conversion devices based on micro-structured semiconductors are under development. Applications of parametric devices to spectroscopy are emerging. Applications of $\chi^{(2)}$ non-linear materials are being extended to deep UV and IR. The use of 200um films to generate mid-IR radiation from near-IR pump lasers appears to hold great promise.

Flip-chip hybridization of high performance detectors to CMOS readouts with pixel-based amplification is yielding substantial reductions in read noise. These advances suggest that low-light level imaging will shift to hybrids comprising CMOS readouts and silicon. There are applications for both wide bandgap detectors for UV and small bandgap detectors for the near- and mid-IR spectral regions.

A particularly exciting area of biomedical research is the use of optics to investigate single biological molecules and cells. This theme will be highlighted in the session "Optical Methods for Molecular and Cellular Biology." Here, results are being generated by exploiting the specificity of molecular biological techniques together with the opportunities provided by optics to perform noninvasive measurements and diagnosis. Biological moieties use geometry and chemical bonding to achieve specificity for large molecules that elude traditional spectroscopy, but optics often provides a better, noninvasive readout technique.

Another theme is the shift of biomedical optical techniques from *in vitro* applications in the research laborato-
ry to in vivo and clinical applications. Now, techniques such as photon migration, fluorescence and multiphoton microscopy and optical coherence tomography are being performed in both living systems and clinical studies. In the future, the migration of biomedical optics to clinical settings will have a tremendous impact on health care.

To meet the exploding demand for capacity, communications systems are pushing toward wider bandwidth. Some of the trends are increasing transmission bandwidth in fibers, increasing number of wavelengths in dense wavelength division multiplex (DWDM) systems and increasing time division multiplex (TDM) data rates.

QELS: Highlights of the technical program
From the record number of papers submitted, it’s clear that QELS 2000 is the premiere showcase for an extremely active scientific field. The program co-chairs, Hyatt Gibbs and Dave Wineland, have produced an impressive technical program organized around six themes, each overseen by a subcommittee.

Besides the ambitious technical program, the agenda has been enhanced with the addition of special symposia on high-order correlation effects in condensed matter (organized by Daniel Chemla and Lu Sham), quantum entanglement and quantum information (organized by Leo Hollberg) and quantum interference and slow light (organized by Paul Berman).

Coulomb correlations are responsible for collective effects that appear in various condensed matter areas: Quantum Hall-effect, superconductivity, colossal magneto-resistance and Bose-Einstein condensation. The properties of transition metal oxides, semiconductors, polymers and metals are all influenced by Coulomb correlations. Understanding high-order correlation effects is at the cutting edge of condensed-matter research.

Research is expanding into new areas of quantum information, quantum entanglement and quantum control. Work in the area of quantum computing is also progressing rapidly.

Design of nonlinear materials, interaction between solitons, cavity solitons, space-time structures and quantum coherence effects are among the topics examined. Highlights include papers on a systematic approach to fabricating new materials for data storage, micro fabrication and biomedical imaging, a new form of high power light propagation that offers possibilities for chemical/biological detection in the atmosphere, and a novel form of light pulse propagation that offers new possibilities for communications.

Microcavity application of photonics and gap structures, along with enhanced nonlinear optical effects, will also be explored at QELS. Important technical advances include: applications to telecommunications and integrated optics of a new type of optical fiber; new geometry on semiconductor material for potential integrated optics applications; and interpretation of the eye function using photonic bandgap concepts.

A great deal of work will be reported on the spectroscopy of semiconductor quantum dots. Much of the excitement is in our increasing ability to probe individual quantum dots using near-field optical microscopy and other creative high-resolution techniques.

Quantum theory and information theory are finding a common ground in the emerging field of quantum information and slow light, or QIS. Basic elements of this field, including the concepts of quantum-entanglement, quantum teleportation and quantum computation, are highlighted in invited and contributed papers.

CLEO/QELS Plenary Sessions
The plenary sessions will take place on Tuesday, May 9. This year’s dynamic sessions will reflect the emerging forces and significant fundamental achievements taking place in the laser/electro-optic industry.

The CLEO plenary session will address the shifting landscape of communications, now a major area of application for electro-optics. Steve Joiner (Hewlett-Packard Labs) will examine the use of multiple parallel channels for shorter distance data communication in his talk, “Communication Links: Where Will VCSELs Contribute?” Linn F. Mollenauer (Lucent Technologies, Bell Labs) will tackle long distance telecommunications in his presentation, “Advanced Dispersion Maps for Dense WDM.”

The QELS plenary speaker, Daniel Kleppner (MIT) is the first person to achieve Bose-Einstein condens-
tions with hydrogen. His presentation is entitled "Ultra-cold Hydrogen: BEC and QED."

Also on Tuesday, there will be two memorial symposia: one for Arthur Schawlow (CLEO) and one for Dan Walls (QELS). The symposia will honor two giants whose contributions shaped the laser and electro-optics fields. Arthur Schawlow contributed enormously to laser science and to innovative new types of spectroscopy. Co-inventor of the laser, he received the Nobel Prize for his "contributions to the development of laser spectroscopy." Dan Walls, a noted pioneer in theoretical quantum optics, made major contributions to the field—from photon anti-bunching to squeezed states of light and the theory of atomic Bose-Einstein condensation.

Commemorative talks by distinguished individuals include: Charles H. Townes (University of California, Berkeley); Boris Stoicheff (University of Toronto); Linn F. Mollenauer (Lucent Technologies, Bell Labs); Theodor Hansch (University of Munich, Germany); Crispin Gardiner (Victoria University, Wellington, New Zealand); Roy Glauber (Harvard University); Howard Carmichael (University of Oregon); Gerard J. Milburn (University of Queensland, Australia); Jeff Kimble (California Institute of Technology); and Peter A. Zoller (University of Innsbruck, Austria).

**The Lasers and Electro-Optics Applications Program (LEAP)**

The Lasers and Electro-Optics Applications Program (LEAP), on Wednesday, March 10, is designed to create a stronger dialogue between the CLEO laser-research community and commercial users of the technology.

Milton Chang (Chairman, New Focus, Inc.), leads a forum on key issues related to business strategy, management techniques, startups, and the current business environment of the optics and photonics industry. A group of outstanding speakers will join the forum, including:

- Andy Bechtolsheim (Cisco Systems, Inc.), "High Speed Optics in Networking"