

C17. Commission on Quantum Electronics

Report to the 2008 General Assembly for 2006-2008

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Activities

The mandate of the C17 Commission on Quantum Electronics encompasses activities aimed at promoting the exchange of information and views among the members of the international scientific community in the general field of quantum electronics, which includes the physics of coherent electromagnetic energy generation and transmission, the physics of interaction of coherent electromagnetic radiation with matter, and the application of quantum electronics to technology. The field is quite broad to include a large variety of interests in both scientific and technological as well as geographical sense. The membership of C17 tries to balance this diversity of interests covering basic physics to industrial applications.

In the past three years most of the work of the Commission was done by e-mail contacts, although some members of the Commission had opportunity to meet at the conferences sponsored by C17 Commission. Different interests of particular members of the Commission, however, makes it difficult to meet at one particular conference.

In years 2006-2008, some members of the Commission joined to the organization of major international conferences in quantum electronics and related area such as IQEC, EQEC, CLEO, CLEO Europe, CLEO PR, OFC, ASSP, Photonics West/East, Photonic Asia, IEEE LEOS and others. IQEC (International Quantum Electronics Conference) has been a main conference supported by C17. Recent years, IQEC meeting collocates with CLEO, CLEO Europe, and CLEO PR. These conferences are well organized and co-sponsored by several societies, such as Optical Society of America, SPIE - The Optical Engineering Society, IEEE - LEOS, and corresponding societies in EU and Pacific Rim countries. They are quite big and cover broad field on quantum electronics physics and applications. The basic research works create industrial applications quickly in this field. ISocieties in Optics and Photonics area manage large scale exhibition beside the scientific conferences. The financial balance strongly depends on the management of exhibition and registration fees are higher than IUPAP standard. Research and application activities in Asian countries are quite strong in recent years. Major conferences series are organized into three regional conferences, US, Europe and Asian/Pacific in a manner of international cooperation.

We find another trend in small conferences, for example, in the field of BEC and atom optics. Workshop-style conferences of 100-200 participants are organized for strongly focused topics. Highly concentrated discussion encourage young scientists. On the other hand young scientists do

not pay attention to attend large scale conferences. Communication between basic physics and application is a serious problem in this field.

C17 members technically supported new conferences in developing countries, for example, Photonic conferences in India, Singapore, Malaysia, and Taiwan. In these countries, photonics research and education is growing rapidly. However, these conferences are not real international.

Developments in the Field

Quantum electronics is a continuously growing field in a sense of basic research as well as applications. The member of C17 commission distribute to the broad area and provided a suitable forum for discussion of the most recent advances and the perspectives in the field.

Laser cooling and trapping technique make it possible to realize BEC on atoms, molecules and the dynamic nature of Bose-Fermion mixture is investigated intensively. The stability of optical clocks by Yb, Ca, Mg, and Sr atoms is developing higher precision new time standard. Fiber delivering of time standard by optical fiber network is demonstrated successfully.

Rapid progress of optical communication technologies and fiber network system support the backbones of total communication on the earth. Significant progress is observed in non-classical photon generation of squeezed light and entangled photon pair. Application of squeezed light to the high precision measurement improves the sensitivity. Entanglement through optical parametric processes is the base of next generation optical communication in terms of quantum cryptography.

Photonic crystals control light emission and propagation strongly. Combination of photonic crystal and quantum dot demonstrates perfectly controlled coherent light source. These devices will appear in the market for optical communication, display technology, and illumination at home.

There is a continuous progress in development of new lasers. This includes the ultra high power lasers, X-ray and VUV laser, blue and ultra-violet diode lasers, quantum cascade lasers in the infrared, organic and organo-metallic lasers, ultra-short-pulse lasers, ceramic lasers, fiber and waveguide lasers, quantum dot lasers, etc.

CEP controlled few cycle pulse lasers open new physics in ultrashort and high field physics. Sub 100 attosecond pulses are generated in XUV region. These ultrashort optical pulse is powerful tool for the snap shot of chemical reaction and bio-physical interaction of atoms and molecules. Ultrashort and ultrahigh intensity laser created new scheme of laser-plasma interaction via relativistic optics and generated monoenergetic GeV electrons by wake field acceleration. Bipolar field acceleration produces high energy proton and ions.

High power fiber laser achieved more than 50 kW. It is one of the most powerful CW lasers for industrial applications, because of the best matching to the robot technology. They changes the scope of laser processing in heavy industry like car production. Photonic bandgap fibers are the most successful application of photonic crystal technology. Ceramic lasers breaks the limit of crystalline laser in a sense of scalability, cost, and material designing technique.

Lasers find new applications in processing advanced materials contributing to laser micro-technology or laser controlled nanotechnology. Laser ablation and laser annealing are quite powerful for the laser processing.

Progress is made in medical application like optical tomography, laser therapy, multi-photon and nonlinear laser probe microscope. Ultrahigh intensity laser is a key device to produces short-lived radio isotope for PET measurement.

The permanent progress observed in the field of quantum electronics justifies the existence of the Quantum Electronics Commission in IUPAP. In terms of subject area the C17 Commission is related to the C15 & C16 Commission and the Affiliated Commission AC-1 of International Commission on Optics. The C17 Commission joins to the ICUIL WG activities. The cooperation between them should be continued.

Ken-ichi Ueda, Chair

Alexander A. Kaminskii, Vice-Chair

Sudhanshu S. Jha, Secretary