**Grand Ballroom, 3F, River Wing**

**08:30-08:45**

**Opening Ceremony**

**08:45–10:05**

**M1A • Plenary Session I**

**Presider: Ping Perry Shum, Southern Univ. of Science and Technology, China**

**M1A.1 • 08:45**

**The Free-Electron Laser Based on a Laser Accelarator**, Ruxin Li[1]; [1]*Shanghai Tech Univ., China.* Free electron lasers (FELs) are capable of generating intense and coherent radiation at X-ray spectral region and have become indispensable tools for various applications. Several X-ray FEL facilities have been successfully operated which rely on the state-of-the-art radio-frequency accelerators with enormous size and cost. Great interest has been drawn to the development of more compact and economical accelerators. The laser wakefield accelerator (LWFA) is an attractive approach for its capability of sustaining accelerating gradient three orders of magnitude higher than that of radio-frequency accelerators and is regarded as a revolutionary solution for driving future compact FELs. However, the realization of such kind of compact FELs still remains a challenge due to the relatively poor beam quality of electrons based on an LWFA. Here we show the experimental demonstration of the undulator radiation amplification in the exponential gain regime using LWFA-based electron beams, typically centered at the wavelength of 27 nm. Our results constitute the first unambiguous proof-of-principle demonstration of the free electron lasing with an LWFA and pave the approach towards LWFA-based compact FELs with broad interests.

**M1A.2 • 09:25**

**Emerging Optical and Photonic Technologies for Communications and Beyond**, Xiang Liu[1]; [1] *Huawei Hong Kong Research Center, China.* The journey leading to the era of the 5th generation mobile and fixed networks, 5G and F5G, has witnessed ground-breaking innovations in optical communications and photonics. For the journey ahead, we are facing two grand technical challenges, the communication capacity limit imposed by the Shannon theorem and the slowing down of the Moore's law. To address the impact of the Shannon capacity limit, the optical communications community is exploring innovative network architectures, system designs, photonic integrated circuits, and better integration of photonic and electrical circuits to continue reducing the cost and energy consumption per bit. To address the impact of the noticeable slowing down of the Moore's law, the photonics community is exploring innovative algorithms, software, application-specific designs, advanced fabrication processes, and new material platforms via a holistic approach. In parallel, the communications and photonics communities are also broadening the application space of the optical and photonic technologies to new fields such as 3D sensing for consumer devices, head-up display, light detection and ranging for autonomous driving, distributed fiber-optic sensing, and optical computing. In this talk, we review emerging optical and photonic technologies for meeting the ever-increasing demands of communications, as well as addressing new applications beyond communications.

**10:35–11:55**

**M3A • Plenary Session II**

**Presider: Daoxin Dai, Zhejiang Univ., China**

**M3A.1 • 10:35**

**Explorations of Topological Photonics in Synthetic Dimensions**, Shanhui Fan[1]; [1]*Stanford Univ., USA.* The demonstrations of non-trivial topological effects in photonics have greatly enriched the study of fundamental optical physics, and may lead to optical devices that are robust against disorders and perturbations. The initial explorations of topological photonics have largely been restricted in the study of effects in real physical space, where non-trivial topology arises in complex photonic structures. In recent years, there have been emerging interests in exploring synthetic dimensions, which provides far more versatile platforms for exploring topological photonics. In this talk, we review some of our recent theoretical and experimental efforts in exploring frequency synthetic dimensions. When a ring resonator undergoes dynamic refractive index modulation, the modes of in the resonator can couple to form a synthetic lattice along the frequency dimension. In this system, the Hamiltonian of the system is controlled by the modulation format, which provides tremendous flexibilities for exploring novel physics. We show that a band structure along the synthetic dimension can be characterized by a time-domain measurement. Using such band structure spectroscopy technique, we experimentally demonstrate a wide range of topological effects, including synthetic magnetic field for photons in Hermitian systems, as well as band winding and band braiding in non-Hermitian systems.

**M3A.2 • 11:15**

**Photonic Chip based Frequency Combs**, Tobias J . Kippenberg[1]; [1]*Ecole Polytechnique Federale de Lausanne, Switzerland.* The development of optical frequency combs1, and notably self-referencing, has revolutionized precision measurements over the past decade, and enabled counting of the cycles of light. Frequency combs, have enabled dramatic advances in timekeeping, metrology and spectroscopy. In 2007, it was discovered that such combs can also be generated using an optical microresonator2 using parametric frequency conversion. Importantly, such Kerr combs also enable to generate dissipative temporal solitons (DKS)3,4, which are formally solutions to a driven dissipative nonlinear Schrödinger equation, termed Lugiato-Lefever equation – first derived to describe spatial self-organization phenomena5. DKS have unlocked the full potential of Kerr combs enabling a deterministic route to broadband, and coherent optical frequency combs, whose bandwidth can be enhanced using soliton broadening phenomena, such as Soliton Cherenkov Radiation6. Such Solitons Kerr combs on a chip have enabled to realize counting of the cycles of light, realize dual comb spectrometers on a chip, enabled dual comb based ultrafast ranging7, massively parallel coherent communication8, and offered a novel approach to massively parallel FCMW LiDAR9. Recent advances based on the photonic damascene process10 enable ultra low loss nonlinear photonic circuits based on silicon nitride (Si3N4), have enabled ultra-low losses, and direct integration with on chip pump lasers11.