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Ganapathi S. Subramania
Stavroula Foteinopoulou
Editors

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Introduction

Sculpting the behavior of light in space and time into unprecedented capabilities is essential to current photonic technologies that impact our everyday lives by pushing forward the speed of information transfer and computing, or enabling new means for medical diagnostics, and sustainable energy. The advancement of nanofabrication methods enabled the realization of sophisticated structured material platforms. These platforms can facilitate the required synergy between material photonic properties and form for controlling light in ways that would have been unimaginable some decades ago. While tremendous progress has been made with passive materials, such as metals and dielectrics, the potential of photonic platforms transcends into new unexplored domains when active material and/or material with tunable or dynamic photonic properties are incorporated. Examples of such material are gain or non-linear media, phase-change materials, magneto-photonic material, as well as quantum emitters.

The Active Photonic Platforms IX conference brought together the newest developments in the fundamentals and applications of structured-material platforms for active, dynamic, and tunable control of light. New exotic types of light propagation, which could open entirely new direction in active photonics have also been featured. Several keynote, invited, and contributed talks highlighted one class of such extra-ordinary light propagation, unveiled by the growing field of topological photonics. Judicious photonic designs were reported that interfaced systems of different topological phases demonstrating unidirectional and scatter-free properties. These properties can be in some cases controllable by the light's angular momentum; so these topological photonic systems are highly promising for applications in photonic circuitry and quantum information platforms.

A new exciting emerging topic, discussed in the opening keynote presentation [paper 10345-1], is non-linear photonic platforms for neuromorphic computing. Non-linear material platforms have also been featured with two separate sessions that have reported exciting new capabilities such as order-of-magnitude non-linear enhancement with 2D materials and transition-metal dichalcogenide nanomaterials and epsilon-near-zero (ENZ) enabled enhancement of non-linearities in aluminum-doped zinc oxide (AZO).

In addition, a number of fascinating talks focused on non-Hermitian photonic systems, where a balanced interplay between gain and loss manifests itself in parity-time (PT) symmetry, and can be exploited for unidirectional propagation and lasing. For context and contrast to asymmetric propagation properties in these active systems, a few talks discussed also paradigm systems where a strong asymmetry in coupling, or reflection can be effected in an entirely passive system.

Moreover, non-classical light generation as well as lasing phenomena at the nanoscale were also a central theme of the conference. Furthermore, interesting topics presented in the conference included platforms for extra-ordinary absorption management, harnessing near-field heat transfer, as well as tunable or dynamically controlled photonics with atomically thin materials such as graphene or monolayer MoS₂.

Last but not least, for the first time we featured in the conference an emergent and rapidly growing area, that of phase-change-material Nanophotonics. There were several invited talks reporting on photonic platforms with phase-change materials, such as chalcogenides, vanadium dioxide, samarium nickelate, or Ge₂Sb₂Te₅. These fascinating presentations in these topics demonstrated dynamically controlled and/or tunable absorption, thermal emission, or radiative fluorescent decay as well as a platform for thermal homeostasis, a non-volatile type of photonic memory and a bio-inspired photonic synapse.

Our conference also ran a *Best Student Paper* competition, recognizing the best contributed presentations that were presented by a student author. We would like to thank all student contributors for their enthusiasm with which they participated in this competition presenting outstanding and interesting research! The finalist winners of this competition, were recognized with an SPIE award certificate at the "Best Student Paper Award Announcement," session on the last day of the conference. We enlist below the winners of the *Best Student Paper* competition.

First place: Paper 10345-74 "*Higher-order exceptional points in photonic systems,*" by **Hossein Hodaiei**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (United States)

Co-authors: Absar U. Hassan, Steffen Wittek, Midya Parto, Hipolito Garcia-Gracia, CREOL, The College of Optics and Photonics, Univ. of Central Florida (United States); Ramy A. H. El-Ganainy, Michigan Technological Univ. (United States); Demetrios N. Christodoulides, Mercedeh Khajavikhan, CREOL, The College of Optics and Photonics, Univ. of Central Florida (United States)

Second place: Paper 10345-18 "*Coherence and dynamics of a high- β metallo-dielectric nanolasers,*"

by **Si Hui Pan**, Univ. of California, San Diego (United States)

Co-authors: Qing Gu, The Univ. of Texas at Dallas (United States); Abdelkrim El Amili, Felipe Vallini, Univ. of California, San Diego (United States); Yeshaiahu Fainman, Univ. of California (United States)

(See also paper annotated as best student paper: second place in this volume).

Third place: Paper 10345-35 "*Tunable chiral metasurfaces based on the transfer of electromagnetic angular momentum,*"

by **Sophie Viaene**, Vrije Univ. Brussel (Belgium), Chalmers Univ. of Technology (Sweden)

Co-authors: Vincent Ginis, Jan Danckaert, Vrije Univ. Brussel (Belgium); Philippe Tassin, Chalmers Univ. of Technology (Sweden)

Active Photonic Platforms IX has brought together theorists and experimentalists to exchange state-of-the art results in this rapidly evolving area of research. As conference chairs, we would like to express our sincere thanks to all the participants of the 10345 conference who contributed with their presentations as well as manuscripts to make this conference a stimulating and vibrant event.

Ganapathi S. Subramania
Stavroula Foteinopoulou

