Colloquium

Scaling Light, Integrating Matter, Imaging the Nanoscale & Reprogramming Enzymes to Catalyze Non-native Reactions

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Scaling Light, Integrating Matter, Imaging the NanoscaleModern photonic technologies increasingly rely on the ability to control, manipulate, and process light within compact and scalable integrated platforms. At the same time, advances in functional and quantum materials are expanding the range of optical phenomena that can be engineered on chip, enabling new approaches to light generation, detection, nonlinear interactions, and radiation sensing. As photonic circuits grow from a few elements to hundreds or thousands of reconfigurable degrees of freedom, they open new opportunities in imaging, sensing, computing, and quantum technologies.In this talk, I will describe how my group at ISTA aims to build next-generation optoelectronic platforms by combining scalable photonics, functional materials, and advanced characterization. I will first discuss programmable integrated photonic systems that manipulate partially coherent light on chip, enabling new measurement modalities that would be difficult to realize in free space. I will then turn to the integration of emerging materials into nanophotonic devices, with a focus on radiation-sensitive materials that can reshape how X-rays are converted into optical information. These platforms point toward nanophotonic scintillators, metasurface-enhanced radiation detectors, and quantum-optical approaches to high-energy imaging.Finally, I will discuss the microscopy tools we are developing to characterize these increasingly complex nanophotonic and nanomaterial systems. More broadly, our goal is to establish integrated photonics as a scalable physical platform for revealing, controlling, and exploiting light-matter interactions across optical, quantum, and high-energy regimes._____Reprogramming Enzymes to Catalyze Non-native ReactionsEnzymes are Nature's catalysts, evolved to construct and degrade molecules with remarkable efficiency and selectivity. Although their activities have been shaped by natural selection to fulfill specific biological functions, many enzymes retain promiscuous catalytic activities toward non-native substrates and reactions. By leveraging fundamental concepts such as catalytic promiscuity and directed evolution, we repurpose and engineer these enzymes for applications in synthetic chemistry and bioremediation, enabling the degradation of emerging environmental contaminants while simultaneously expanding the accessible chemical space and introducing new reactions to the synthetic chemist's toolkit.

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ISTA | Central Building | Raiffeisen Lecture Hall

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