



ICFO COLLOQUIUM KERRY VAHALA 'High-Q Optical Micro-cavities: Towards Integrated Optical Time Standards and Frequency Synthesizers'

KERRY VAHALA

August 31, 2018

Friday, August 31, 2018, 12:00. ICFO Auditorium

KERRY VAHALA

Ted and Ginger Jenkins Professor of Information Science and Technology and Professor of Applied Physics, Executive Officer of the Department of Applied Physics and Materials Science, Caltech (USA)\$\$Kerry Vahala studies the physics and applications of high-Q optical microcavities. His research group has pioneered resonators that hold the record for highest optical Q on a semiconductor chip and has launched many of the research topics in the field of optical microcavities. Applications currently under study include micro-gyros with

Earth-rotation-rate sensitivity and soliton micro-combs. Vahala was involved in the early effort to develop quantum-well lasers for optical communications and he received the IEEE Sarnoff Medal for his research on quantum-well laser dynamics. He has also received an Alexander von Humboldt Award for work on ultra-high-Q optical microcavities and is a fellow of the IEEE, the IEEE Photonics Society and the Optical Society of America. Vahala is the Jenkins Professor of Information Science and Technology and Professor of Applied Physics and received his B.S., M.S., and Ph.D. degrees from Caltech. He currently serves as the Executive Officer of the Department of Applied Physics and Materials Science.

Communication systems leverage the respective strengths of optics and electronics to convey high-bandwidth signals over great distances. These systems were enabled by a revolution in low-optical-loss dielectric fiber, complex integrated circuits as well as devices that link together the optical and electrical worlds. Today, another revolution is leveraging the advantages of optics and electronics in new ways. At its center is the laser frequency comb which provides a coherent link between these two worlds. Significantly, because the link is also bidirectional, performance attributes previously unique to electronics and optics can be shared. The end result has been transformative for time keeping, frequency metrology, precision spectroscopy, microwave-generation, ranging and other technologies. Even more recently, low-optical-loss dielectrics, now in the form of high-Q optical resonators, are enabling the miniaturization of frequency combs. These new `microcombs? can be integrated with electronics and other optical components to potentially create systems on-a-chip. I will briefly overview the history and elements of frequency combs as well as the physics of the new microcombs. Application of the microcombs for spectroscopy and LIDAR will be discussed. Finally, efforts underway to develop integrated optical clocks and integrated optical frequency synthesizers using the microcomb element are described.

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