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Chip-scale optical frequency combs: Advances in precision metrology

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Optical frequency comb, a Nobel Prize awarded research, is a new time and frequency standard with unprecedented precision. It has been the cornerstone for breakthroughs in ultrastable time keeping, astrophysical spectrography, attosecond sciences, high-precision navigation, high-capacity coherent communication, and high-speed nonlinear spectro-imaging. Recently, continuous-wave pumped microresonators emerge as promising alternatives to the current benchmark femtosecond laser platform. These photonic frequency combs are unique in their compact footprints and offer the potential for monolithic electronic and feedback integration, thereby expanding the already remarkable applications of optical frequency combs. In this talk, I will present my recent work on photonic frequency combs. I will first report the generation of stable 74-fs optical pulses from a Si_3N_4 microring resonator via numerical modeling and analytic theory, the connection between the microresonator parameters and the ultrashort pulse qualities. I will also report a low-phase-noise photonic frequency comb with 18 GHz comb spacing, compatible with high-speed silicon optoelectronics. I will describe the strategy to fully stabilize the photonic frequency comb and achieve a chip-scale optical frequency synthesizer with a relative uncertainty of 2.7×10^{-16}. Finally, I will cover the future endeavour towards chip-scale precision metrology.

Biography

Shu-Wei Huang is an Assistant Research Professor at the University of California, Los Angeles, with research interests in ultrafast lasers, nanophotonics, THz technologies, and nonlinear spectro-imaging. He has received his BS degree from National Taiwan University (2005) and his PhD degree from Massachusetts Institute of Technology (2012), both in Electrical Engineering. He was awarded the 2012 Jin-Au Kong Outstanding Doctoral Thesis Prize for breaking the single-cycle barrier in high-energy coherent light sources. In 2015, he received the Air Force Young Investigator Grant for his investigations in microresonator-based optical frequency comb. Currently, he serves as the Webinar Co-chair of OSA's Nonlinear Optics Technical Group.

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