UCLA Department of Physics & Astronomy

COLLOQUIUM

Thursday, November 13th, 2025 at 4 p.m.
PAB 1-434

The High-Q Frontier: Nonlinear Optics in the Age of Integration

Kerry Vahala
California Institute of Technology

High-Q microresonators enable access to nonlinear optical phenomena at milliwatt power levels. Once discrete and reliant on specialized processing for loss reduction, today microresonators are fabricated in planar geometries, readily integrable, and, in some cases, produced on CMOS foundry lines. Moreover, these devices attain optical Q factors approaching 1 billion. Following a brief overview of their history and early demonstrations, this presentation will highlight recent advances in devices and systems powered by high-Q microresonator technology. Emphasis will be placed on efforts to miniaturize metrology systems to the chip scale for frequency synthesis, optical clocks, and microwave signal generation through optical frequency microcombs. In addition, the recent application of the photogalvanic effect in silicon nitride has unlocked access to second-order nonlinearities in this workhorse photonic integration platform—capabilities once restricted to non-centrosymmetric dielectrics. Applications of this effect to integrated high-coherence visible-light generation and spontaneous parametric down-conversion will also be discussed. Finally, prospects for boosting optical Q factors from current limits to values as high as 10 billion will be discussed.

Refreshments at 3:30 p.m. PAB Patio. **Undergraduates Welcome!**