David A. B. Miller

In a career in optics spanning more than 45 years, David Miller has made many key contributions in original scientific and engineering research, in education, and in professional service. His research spans semiconductor and quantum well optoelectronics; optics in digital systems, information processing, and communications; fundamentals of optics and waves; and complex and controllable photonic circuits. His work has been cited more than 50,000 times, with an h-index of 114. In over 300 papers and over 75 patents, he has collaborations with over 400 people, and also has over 40 single-author papers throughout his career with over 12,000 total citations. He has contributed extensively to the community in conference leadership and in other professional society activities, including being a society president (IEEE Lasers and Electro-Optics (now Photonics) Society). He has served on Boards for various societies, companies, and university and government bodies. His educational activities outside his university duties include over 40 short courses and lecturing at over 20 summer schools, the textbook *Quantum Mechanics for Scientists and Engineers* (Cambridge, 2008), and freely available online quantum mechanics classes taken by over 70,000 students throughout the world.

He holds a B. Sc. from St. Andrews University and a Ph.D. from Heriot-Watt University, both in Physics. He is the W. M. Keck Professor of Electrical Engineering, and Professor by Courtesy of Applied Physics at Stanford University. Before Stanford, he was with Bell Laboratories from 1981 to 1996, as a department head from 1987. He was awarded the OSA Adolph Lomb Medal and the R. W. Wood Prize, the ICO International Prize in Optics, the IEEE Third Millennium Medal, and the 2013 Carnegie Millennium Professorship. He is also a Fellow of AAAS, APS, OSA, IEEE, the Electromagnetics Academy, the Royal Society of London and the Royal Society of Edinburgh, holds two Honorary Doctorates, and is a Member of the US National Academies of Sciences and of Engineering.

Semiconductor optics and optoelectronics: His extensive research in this field includes the discovery, explanation, naming and device application of the quantum-confined Stark effect [1] in semiconductor quantum wells, which is widely and routinely used for optical modulation in telecommunications. This is part of a large body of work in optical processes in semiconductors and quantum-confined structures [2], including ultrafast phenomena and applications in laser modelocking.

Optics in digital systems: His early work invented and demonstrated several optical logic devices, including highly functional and low energy quantum-well self-electrooptic-effect devices [3] that enabled large system demonstrations [4]. His critical analysis of this field [5,6] helped move the focus towards optical interconnect, where he established the clear physical reasons and practical motivations for the necessary application of optical interconnects for the scalability of digital processing [7,8], including key demonstrations and definitive reviews [9,10].

Fundamentals of optics and waves: His creation of the communication mode (or singular-value decomposition) approach to optics and waves generally [11,12] gives a clear counting and definition of wave channels in and out of volumes and surfaces, resolving paradoxes of apparently “infinite” numbers of channels, reveals new physical laws and limits in optics, and extends diffraction theory to arbitrary volumes and shapes. It is seeing increasing use in optics and wireless communications, including recently showing why optics needs thickness [13].

Complex and controllable photonic circuits: He introduced the idea of universal linear optical machines [14], both as a theoretical construct for fundamental optical physics in proving new laws, and showing practically how any such machine could be constructed from two-beam (e.g., Mach-Zehnder) interferometers, arguably starting the field of programmable silicon photonics [15] for applications in optics itself. His algorithms and architectures are enabling innovative self-configuring complex photonic systems for communication through arbitrary optics [16–18] and for novel analog programmable systems for information processing [18].

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