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The "Music" of Light: Optical Resonances for Fun and Profit

RAYMOND BEAUSOLEIL, Hewlett Packard Labs, 1501 Page Mill Rd., Palo Alto, CA 94304

Moore's Law has set great expectations that the performance/price ratio of commercially available semiconductor devices will continue to improve exponentially at least until the end of this decade. But the physics of the metal wires that connect the transistors on a silicon chip already places stringent limits on the performance of integrated circuits, making their continued dramatic improvement highly unlikely. In this talk, I will introduce the basic concept of an optical resonance in a microscopic dielectric cavity in the context of the same type of spatial boundary conditions that give each musical instrument its unique sound. Then I will illustrate applications of these resonances to information technology in a variety of forms and functions using examples from my own laboratory at HP, such as chip-scale optical networks, quantum bits based on spins in diamond, and ultrafast optical switches that could become the foundation for a new generation of optical computers. Our goal is to conduct advanced research that could precipitate an "optical Moore's Law" and allow exponential performance gains to continue through the end of the next decade.