Nanophotonics of Thermal Radiation and Optical Interactions

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Advances in nanofabrication over the past few decades have enabled and encouraged the study of material structures with features at the scale or smaller than the electromagnetic wavelength. These engineered materials can exhibit a wide range of unusual optical behaviors, allowing unprecedented control over the propagation and behavior of light, e.g. allowing us to slow and confine light at the nanometer scale. I will give an overview of recent developments in our understanding of the ways in which thermal radiation (the familiar glow of hot objects), quantum fluctuation and optical interactions (the forces and interactions of light waves induced by quantum and material effects), and more generally, our ability to localize and control photons, can be dramatically modified in nanostructured media, e.g. enabling us to design materials that radiate millions of times more energy than blackbodies or efficiently convert light from infrared to visible or ultraviolet wavelengths.

Biography

Alejandro Rodriguez is an Assistant Professor of Electrical Engineering at Princeton University, working in the areas of nanophotonics, nonlinear optics, and fluctuation electromagnetic phenomena. He received both his B.A and Ph.D in Physics from MIT in 2006 and 2010, and was a postdoctoral fellow at Harvard University until 2013, during which time he co-developed some of the first methods for computing fluctuation interactions in complex environments and made significant contributions to the understanding of ways of tailoring thermal radiation and Casimir forces in nanostructured media. Recent contributions include the first fundamental limits to radiative heat transport at the nanoscale (generalizing the famous Stefan–Boltzmann law to the near field) and inverse designs of photonic structures exhibiting complex and exotic spectral and nonlinear properties. He is a recipient of the NSF Early CAREER Award, was elected a National Academy of Sciences Kavli Fellow, and was also named a DOE Fredrick A. Howes Scholar in Computational Science. When not playing with photons, he enjoys salsa dancing, playing video games, and listening to afro-Cuban music.