Breaking Lorentz Reciprocity Using Metamaterials

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In this talk, I discuss our recent research activity in electromagnetics, nano-optics and acoustics, showing how tailored *meta-atoms* and suitable arrangements of them open exciting venues to realize non-reciprocal devices for light, radio-waves and sound, largely breaking Lorentz reciprocity and realize isolation without the need of a magnetic bias. Our approaches are based on using suitably tailored mechanical motion, spatio-temporal modulation, and nonlinearities in coupled resonator systems, and have enabled magnet-free circulators and isolators for sound, microwaves, THz and optical frequencies, non-reciprocal antennas, emitters and absorbers breaking Kirchhoff's law, self-induced isolation for high-intensities triggered by nonlinearities, and a new generation of non-reciprocal topological insulators for light, sound, and static systems in mechanics. In the talk, I will also discuss the impact of these concepts from basic science to practical technology, and some of their inherent limitations stemming from thermodynamics, specifically in the context of nonlinear isolators and of the delay-bandwidth limit.

Andrea Alù is the Founding Director and Einstein Professor at the Photonics Initiative, CUNY Advanced Science Research Center. He received his Laurea (2001) and PhD (2007) from the University of Roma Tre, Italy, and, after a postdoc at the University of Pennsylvania, he joined the faculty of the University of Texas at Austin in 2009, where he was the Temple Foundation Endowed Professor until Jan. 2018. Dr. Alù is a Fellow of IEEE, OSA, SPIE and APS, and he currently serves as IEEE AP-S Distinguished Lecturer and AdCom member. He has received several scientific awards, including the ICO Prize in Optics (2016), the NSF Alan T. Waterman award (2015), the OSA Adolph Lomb Medal (2013), and the URSI Issac Koga Gold Medal (2011).