THEOS
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The Many-Body Problem of Electromagnetic Waves in Complex Photonic Media

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Abstract: In this talk, I will discuss the vector multiple scattering theory of classical waves for the rigorous description of photon transport and localization in complex photonic media with arbitrary refractive index fluctuations (i.e., periodic, random, deterministic aperiodic). In particular, by focusing on the problem of discrete scatterers, I will introduce the dyadic operator notation and derive the vector Lippman-Schwinger volume integral equation. I will then present the diagrammatic expansion technique leading to the definition of the all-important dyadic transition operator (i.e., T-matrix) for the solution of general multiple scattering problems. Within this formalism, Dyson's and Bethe-Salpeter equations for the propagation of the mean field and its second moment are obtained within classical electrodynamics. A self-consistent derivation of the Foldy-Lax multiple scattering equations will be illustrated and numerical approaches discussed for their efficient solutions.

The similarities between multiple scattering theories of photons and electrons in inhomogeneous complex media will be emphasized, as well as deep-rooted connections with the integral equation-based methods of computational electromagnetics.