Unpolarized Light Revisited: Classical Randomness and Coherent Quantum Decomposition

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For nearly a century, unpolarized light has been assumed to be random. However, recent experimental and theoretical advances show that light scattered from coherent sources through a turbid tissue-like medium, though appearing unpolarized, retains a hidden, structured polarization organization. Using a reformulated Wolf decomposition and quantum optical formalism, we demonstrate that such light consists of coherent LCP–RCP photon pairs with stable phase relationships, fundamentally distinct from the truly random polarization of incoherent sources like sunlight. These findings suggest that macroscopic quantum entanglement can survive multiple scattering events in biological tissues—offering a new quantum perspective on biomedical polarimetry. This work bridges classical and quantum optics, reframing conventional light–tissue interactions as potential quantum measurements, and opening pathways toward quantum-enhanced diagnostics based on naturally occurring coherent scattering in biological systems.