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Penetration depth of low-coherence enhanced backscattering photons in the sub-diffusion regime HARIHARAN SUBRAMANIAN, PRABHAKAR PRADHAN, YOUNG KIM, VADIM BACKMAN, Northwestern University, Evanston, IL 60208 — The mechanisms of photon propagation in random media in the diffusive multiple scattering regime have been previously studied using diffusion approximations. However, similar understanding in the low-order (sub-diffusion) scattering regime is not complete due to difficulties in tracking photons that undergo very few scatterings events in the medium. Recent developments in low-coherence enhanced backscattering (LEBS) overcome these difficulties and enable us to probe photons that travel very short distances and undergo only a few scattering events. We derive the analytical expression of the probability of penetration depth and most probable penetration depth of photons due to LEBS, and also performed Monte Carlo numerical simulations to support our analytical results. Our results demonstrate that, the most probable penetration depth $z_p$of photons that undergo low-order scattering events have only weak dependence on scattering mean free path $l_s$and anisotropy factor g of the medium, and strong dependence on the spatial coherence length of illumination,L_{sc}. For very small L_{sc} ($<<$ l_s), we show that the penetration depth is proportional to 1/3 power of the coherence volume, i.e. $z_p \propto \left(l_s \, \pi \, L_{sc}^2\right)^{1/3}$. Important implications of our results and its application in biological media are also discussed.

Prabhakar Pradhan
Northwestern University

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