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Probing minimal scattering events in enhanced backscattering of light using low-coherence induced dephasing YOUNG KIM, PRABHAKAR PRADHAN, MIN KIM, HARIHARAN SUBRAMANIAN, YANG LIU, VADIM BACKMAN, Northwestern University — We report the first experimental evidence that the minimum number of scattering events in enhanced backscattering (EBS, also known as coherent backscattering) of light is double scattering in discrete random media, which has been hypothesized since the first observation of EBS of light. We exploit low spatial coherence illumination to dephase time-reversed partial waves outside its finite coherence area, which virtually creates a controllable coherence volume and isolates the minimal number of scattering events from higher order scattering in EBS. In addition, EBS under low spatial coherence illumination possesses unique advantageous features compared to conventional EBS: (i) The spatial coherence length of illumination can be made to be the shortest length scale (except particle sizes) in weakly scattering media such as biological tissue. (ii) A large number of the independent coherence areas provide statistical information about the optical properties of random media in a single measurement, without configuration or ensemble averaging. (iii) LEBS allows varying the spatial coherence length of illumination to control the dephasing rate externally and LEBS does not require complicated sample preparations. Thus, these characteristics of LEBS will facilitate investigations of EBS in weakly scattering random media including biological tissue.

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