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Mesoscopic light transport properties of a single biological cell : Early detection of cancer PRABHAKAR PRADHAN, YANG LIU, YOUNG KIM, XU LI, RAMESH K. WALI, HEMANT K. ROY, VADIM BACKMAN, Northwestern University, Evanston, IL 60208 — The progression of carcinogenesis involves morphological changes in the internal structure of a biological cell. These changes are reflected in the fluctuations of refractive index within the cell at scales ranging from a few nanometers to microns. We demonstrate that these fluctuations of refractive index can be measured by our newly developed technique – partial wave spectroscopic microscopy, and can be quantified using the mesoscopic transport theory of light. Our experimental and numerical results show that the statistics of the light reflection coefficient, the statistics of the localization length and the statistics of the refractive index fluctuation agree well with the mesoscopic light transport theory. Furthermore, our results show that we can detect the progress of carcinogenesis in a single biological cell earlier than any existing technique. We conclude that biological cells are nature made interesting disordered mesoscopic systems, and the changes in the statistics of fluctuations of refractive index in a single cell are highly diagnostic for noninvasive early detection of cancer using mesoscopic theory.

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