Effect of Statistics of Speckle Fields on Topological States of Light

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My talk has two parts. In the first part, I shall talk about how to generate light speckles with certain statistics. Optical speckle fields with both non-Rayleigh statistics and non-diffracting characteristics in propagation are an important light source for many applications. However, tailoring either non-Rayleigh statistical speckles or non-diffracting speckles are only investigated independently in previous studies. Here, we report the first observation of optical speckles that remain diffraction-free over a long axial distance while keeping non-Rayleigh statistics simultaneously. We further show the enhancement of Anderson localization of light with the non-Rayleigh non-diffracting speckles. In the second part, I shall talk about how the speckle fields affect the edge states of light in a photonic crystal with different cutting boundary conditions. We find that the edge states with non-trivial topology are robust to the random fluctuation induced by the speckle field. We also find that all the edge states become stable when the non-Rayleigh property of the speckle field becomes strong. The work presented here provides a versatile framework for customizing optical fields with desired speckle patterns for applications in the fields of solid-state physics, cold atoms, and optical imaging.