Speckle decorrelation and contrast variation in disordered medium with $\chi^{(2)}$ – nonlinearity

Rabisankar Samanta[1,*], Romain Pierrat[2], Rémi Carminati[2] and Sushil Mujumdar[1]

[1] Nano-optics and Mesoscopic Optics Laboratory, Tata Institute of Fundamental Research, 1 Homi Bhabha Road, Mumbai, 400 005, India

[2] Institut Langevin, ESPCI Paris, PSL University, CNRS, 1 rue Jussieu, 75005 Paris, France

[*]Email: rabisankar.samanta@tifr.res.in

When coherent light propagates in a disordered medium, speckle patterns are formed as an interference-effect. Despite the randomness in the intensity pattern, a lot of information can be extracted from the speckle pattern. Under the application of ultra-intense laser pulses, disordered medium with $\chi^{(2)}$ - nonlinearity generates speckle patterns of both the fundamental harmonic (FH) and second harmonic (SH) light. Here, we study the speckle decorrelation in the FH and SH light while varying the input power of FH. We observe that the speckle displays strong correlations at low input power and it decreases with the increase in the input power [1]. The statistical distributions of the correlation coefficients translate from sharp-peaked distributions at low power to wide flat distributions at higher power. A faster decay in the average correlation is seen in the SH than in the FH. We propose that the decorrelation is due to the displacement of the particles of the medium induced by the radiation pressure of the ultra-intense laser. Our argument is supported by an analytical model and numerical computations and also speckle contrast measurements [2]. We show that as the input power increases, the speckle contrast of the FH decreases due to the temporal averaging. Interestingly, an opposite behavior is seen for SH light as it depends on the generation probability. We hope our studies will support in understanding further interesting phenomena in disordered medium with $\chi^{(2)}$ - nonlinearity.

References:

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