2-9: Label-free imaging on waveguide platform with enhanced resolution and contrast

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Chip-based Evanescent Light Scattering (cELS) utilizes the multiple modes of a high-index contrast optical waveguide for near-field illumination of unlabeled samples, thereby repositioning the highest spatial frequencies of the sample into the far-field. The multiple modes scattering off the sample with different phase differences is engineered to have random spatial distributions within the integration time of the camera, mitigating the coherent speckle noise. This enables label-free superior-contrast imaging of weakly scattering nanosized specimens such as extra-cellular vesicles (EVs) and liposomes, dynamics of living HeLa cells etc. We demonstrate a multi-moded straight waveguide as a partially coherent light source. For isotropic super-resolution, spatially incoherent light engineered via multiple-arms waveguide chip and intensity-fluctuation based algorithms are used. The proof-of-concept results are demonstrated on 100 nm polystyrene beads and resolution improvement of close to 2× is shown. cELS also realizes (2-10)× more contrast as opposed to conventional imaging techniques.

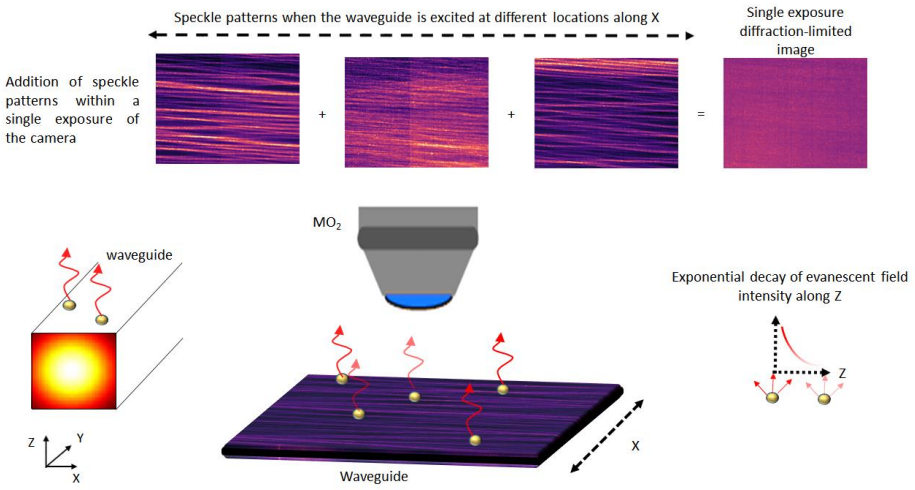

Figure: Schematic representation of an optical waveguide supporting several guided modes and a few scattering objects that convert the evanescent waves into scattering waves. The addition of speckle patterns at the camera plane helps suppress the speckle noise. A waveguide transmitting power via a fundamental mode of the structure is also shown alongside.