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Generating photonic hooks using dual-dielectric designs

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Near-field, sub-wavelength, and localized curved light beams, known as photonic hooks [1]–[3], discovered in 2015 [2], have become an area of interest due to their relatively simple design, compactness and potential to be used in a number of applications such as in sensing and optical trapping [2]. Recently, it has been shown how concepts to design focusing devices in the microwave and optical regimes using mesoscale particles (dimensions in the order of the operational wavelength) [4]–[10] such as two identical rectangular dielectric particles to make a diffraction-limited focus [11] can be exploited to produce photonic hooks by breaking the symmetry of these systems. This asymmetry can be introduced using several techniques such as asymmetric illumination (oblique incidence) or by changing the shape and dimensions of the particle [1].

Inspired by the interesting applications photonic hooks offer, here we show our recent efforts in designing such light beams by properly engineering two asymmetric dielectric particles in terms of their individual diffraction and scattering properties through variations of their dimensions and refractive indices to design a device which can generate a bent focus with a beam waist of less than half a wavelength when illuminated by planewave [1]. Full details will be provided during the conference demonstrating how the dual-dielectric devices are designed, and the effect of changing parameters including the refractive index, size, and separation of the particles on the resolution and curvature of the generated photonic hook. These results may open new avenues in optical trapping [12], sensing, and focusing applications.

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