Playing Hide-and-Seek in the Nanoworld –

Structured Light-Matter Interactions for Ultra-Precise Particle Localization

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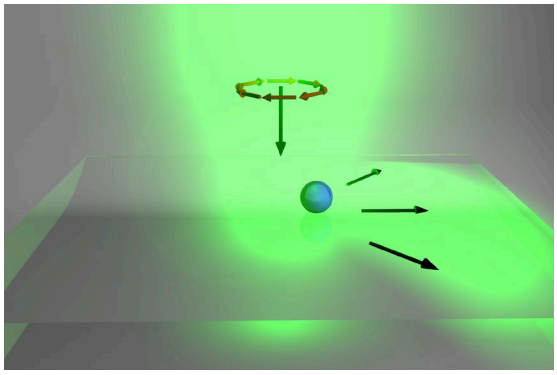

Over the last decade, structured light has become an important tool in the field of nano-optics, nano-photonics and beyond [1]. Especially when confined spatially, electromagnetic fields exhibit complex three-dimensional distributions. These tailored fields can be utilized to excite individual nanoparticles, giving rise to a variety of different applications, ranging from single-particle spectroscopy [2], nanoscale traffic control [3-5], nano-metrology [6-8] and beyond. In the context of nano-metrology, we have recently introduced a scheme based on structured light-nanoparticle interactions, resulting in controlled directional scattering [6-8]. We take advantage of directional interference of dipolar emission of a nanoparticle, a phenomenon similar to the so-called Kerker scattering (or Huygens dipole) [9-11]. However, in contrast to conventional Kerker scattering that gives rise to pronounced forward or backward signals [10,11], the excitation with three-dimensional fields can result in a lateral directionality or *transverse* Kerker scattering [5-8] (see Fig.). The strength of this directionality is directly linked to the position of a nanoparticle with respect to the highly confined excitation field. Hence, it can act as a ruler to measure the particle position via the far-field scattering. By using this technique, the position of a nanoparticle can be experimentally retrieved on a sub-Angstrom length-scale [7]. The scheme paves the way for the development of novel nano-metrology schemes, precise and fast stabilization of positioning stages, nano-scale light-routing, and more.

In this presentation, we will introduce the general concept of transverse Kerker based localization. Furthermore, we will discuss current activities aiming for hi-speed tracking, first steps towards the localization of arbitrarily shaped nanoparticles as well as the utilization of a novel detector platform for nano-metrology.

References:

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