Exciting Nanoparticles: Plasmonics in a trap

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Optical trapping of metal nanoparticles is an emerging area and promises to become a remarkable tool for various applications. We investigate the interplay of the forces acting upon gold nanoparticles when exposed to laser light close to their plasmonic resonance. In particular we exploit the plasmon resonance for the first time to trap a nanoparticle within the dark core of a Laguerre-Gaussian (LG) light field. The trapping wavelength is below the resonance of the particles where they experience a repulsive optical force. Optical beamshaping facilitates the creation of single ringed Laguerre-Gaussian (LG) laser beams that offer the advantage of such annular fields. This trapping geometry opens up new avenues for optical manipulation of metal nanoparticles beyond the single beam tweezers. In addition to the confinement of 100nm gold spheres we observed rotation of the particles due to orbital angular momentum transfer from the LG beam onto the particles. We interpret our data with a theoretical framework based upon the Maxwell stress tensor formulation to calculate the total forces upon nanoparticles near the particle plasmon resonance. The presented geometry may have several advantages for advanced manipulation of metal nanoparticles, potentially avoiding strong heating.