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Near field studies for nonspherical dielectric particles with Waterman's T-matrix method and a least square T-matrix method

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Waterman's T-matrix method has been established as a powerful technique to calculate light scattering properties of nonspherical dielectric particles. In contrast to the scattering quantities, that are defined in the far field, the scattering field will be examined in the near field region inside the smallest circumscribing sphere of the particle, in this talk. To prove the quality of the solution, the validity of the boundary condition for the tangential components of the electrical and magnetic fields is used. This is an independent criterion, that has to be fulfilled by all valid solutions. For this, in addition, the internal field has to be calculated. It was found, that for spheroids with increasing eccentricity the scattering field, at least numerically, diverges at the surface. This occurs at points with distances to the origin smaller than the circumscribing sphere, although the far field converges stably in this case.

To avoid these divergences, a new T-matrix method was developed. It uses the same expansion of the internal and the scattering fields, but it determines the expansion coefficients in a way, that the boundary conditions of the electrical and the magnetic fields will be fulfilled in a least square sense. In this talk, it is numerically shown, that the resulting approximations of the internal and the scattering fields converge and that the boundary conditions will be fulfilled.

Convergence analyses show, that Waterman's method should be used if scattering quantities in the far field have to be calculated. The convergence region of the least square method is limited compared to the region, in which Waterman's method works. But, if we are interested in the field near the surface and inside the smallest circumscribing sphere, the least square method should be used. An example, where the least square method has to be used is the multi particle scattering of nonspherical particles. If one particle lies inside the circumscribing sphere around a second particle, the least square method should be used.