Physikalisches Kolloquium und SFB Kolloquium

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Simulation of light scattering by arbitrarily shaped particles with the discrete dipole approximation

Light scattering by small particles is widely used in remote sensing of various objects ranging from metal nanoparticles and macromolecules to atmospheric aerosols and interstellar dust, being in some cases the only available approach to characterize their geometric or optical properties. Moreover, the structure of electromagnetic near-fields of particles is also of major importance for other phenomena, such as surface-enhanced Raman scattering or electron-energy-loss spectroscopy. All these applications require accurate light-scattering simulations, which is not trivial for particles of arbitrary shape and internal structure with sizes comparable to or larger than the wavelength. The discrete dipole approximation (DDA) is one of the general methods to handle such problems and nowadays is freely available in mature parallelized open-source codes. In this talk, I will provide a short introduction to this method, including both the underlying physics and important computational aspects, and will describe two of the recent developments of the DDA. The first addresses the rigorous and fast description of particles near the plane substrate as realized in essentially all scenarios using deposited particles. While the configuration is very common in many applications (especially nanoparticles), all previous implementations were much slower than the free-space DDA, motivating the practitioners to either ignore the substrate or use some hard-to-control approximations. The second development is the DDA with rectangular cuboid dipoles (volume discretization elements). Such formulation is relevant for very oblate or prolate particles with at least one dimension much smaller than the wavelength, e.g. a graphene sheet.

Einlader: Thomas Fennel