An efficient numerical program for studying light scattering at the nanoscale

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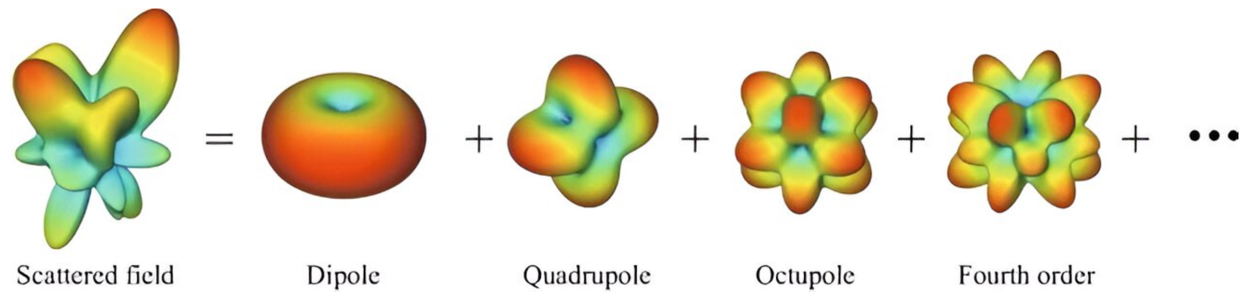

Credit: *Frontiers of Optoelectronics* (2023). DOI: 10.1007/s12200-023-00102-2

When light encounters a particle, it interacts with the particle instead of just passing through smoothly. The light waves can get scattered in different directions because of the light-matter interactions.

Things become even more intriguing at the nanoscale, where the size of the particles is comparable to the wavelength of light. This size matching leads to some special effects. For example, you might observe colors changing or specific patterns forming as the light scatters in various ways.

Multipole decomposition is a powerful tool widely used for analyzing light scattering, both by a single nanoparticle and by periodic arrays of nanostructures. This tool allows us to explore the physics behind unusual light behaviors like directional scattering, perfect reflection and transmission, anapole effects, and more. Additionally, we can use this tool to design novel nanophotonic devices such as metasurfaces and plasmonic arrays for light manipulation.

Beyond symmetric scatterers like spheres or cylinders, there are typically no analytical solutions for the electromagnetic multipoles of irregular scatterers. Therefore, efficient numerical implementations of multipole decomposition are highly desirable.

Researchers led by Prof. Yuntian Chen at Huazhong University of Science and Technology (HUST), China, aim to enhance the performance of the multipole decomposition program. Numerical integration plays a crucial role in multipole decomposition and can be carried out using surface or volume integral techniques. The researchers have introduced Lebedev and Gaussian quadrature methods into the program, significantly improving the accuracy and efficiency of calculating integrals.

They validated this improvement through several demonstrations, including dielectric nanospheres, symmetric particles, and anisotropic nanospheres. The user friendly numerical program is publicly accessible on GitHub and beneficial for researchers working on nanophotonics. The work, titled "Efficient and accurate numerical-projection of electromagnetic multipoles for scattering objects," was published in *Frontiers of Optoelectronics* on December 29, 2023.

More information: Wenfei Guo et al, Efficient and accurate numerical-projection of electromagnetic multipoles for scattering objects, *Frontiers of Optoelectronics* (2023). DOI: 10.1007/s12200-023-00102-2

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