# Scattering of light with OAM from an array of particles

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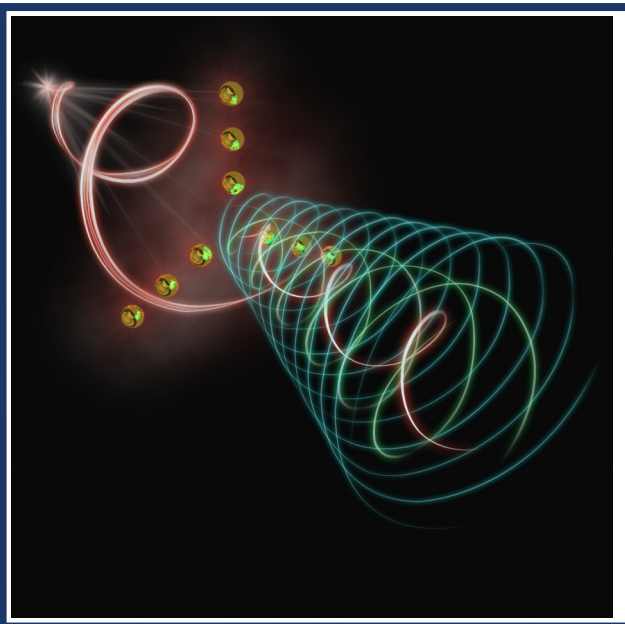
**Abstract**
Understanding the scattering properties of various media is of critical importance in many applications, from secure high-bandwidth communications to extracting information about biological and mineral particles dissolved in sea water. We demonstrate how beams carrying orbital angular momentum (OAM) can be used to detect the presence of ordered subsets of particles in otherwise disordered media.



Artists impression of a beam with OAM scattering from an array of particles, arranged in a distribution with 3-fold symmetry (with respect to the beam axis). The OAM spectrum of the scattered light contains information regarding the distribution of particles.

**Project Description**
In a recent paper [1] we show how the angular momentum of scattered light encodes information that can be used to analyse a medium. Using beams carrying orbital angular momentum, we develop a theory allowing us to detect the presence of symmetric or chiral subsets of particles in disordered media.
This is a fundamentally new method to extract information on the spatial distribution and electromagnetic response of scattering media that can be performed maintaining detectors and light sources in the same positions, a unique feature that can be extremely useful in many applications.

**Key Results**
- Using a generalized Mie theory, we have developed a theory for the scattering of light carrying OAM from dilute distributions of micro- and nanoparticles.
- The OAM spectrum of scattered fields can be used to identify the presence of subsets of particles with symmetric or chiral distributions within a disordered medium.
- The signal-to-noise ratio does not degrade as the OAM increases (for particles small wrt. the size parameters of the beam ).

[1] D. McArthur, A. M. Yao, and F. Papoff, “Scattering of light with angular momentum from an array of particles”, Phys. Rev. Research, 2, 1, 013100, 2020 https://link.aps.org/doi/10.1103/PhysRevResearch.2.013100