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Lecture I: Mechanical effects of light spin and orbital angular momentum in liquid crystals

It is generally known that there is no definite way to uniquely separate the total angular momentum density of an electromagnetic field in its spin (SAM) and orbital (OAM) parts in vacuum. A more physical approach would be to try to distinguish the SAM and OAM densities of the field looking at the different mechanical effects they may locally induce in matter. Liquid crystal are ideal materials to this purpose. In fact, they are fluids with internal local orientation degrees of freedom and they are sensible to the small forces induced by the optical fields. We may expect, therefore, that the OAM part of the total angular momentum density of the field would act on the local center of mass of the fluid element, while the SAM part would act on its internal orientation. In this lecture we will show that this program can be accomplished by using an unique Lagrangian to describe both the optical field and the liquid crystal, provided we add the further condition that the SAM and OAM densities are separately divergence free (i.e. conserved) in the limit of an homogeneous and isotropic medium. The theory is carried out with no use of the paraxial approximation.

Lecture II: Manipulation of the OAM of a paraxial optical beam with linear optics devices.

In this lecture, some methods of linear optics are reviewed to manipulate the OAM of a paraxial beam together with its polarization. In particular, some schemes are presented to generate LG and/or HG-like beams form TEM_{00} beams by manipulating only the beam polarization, to sort the beam OAM into different polarizations, to have OAM controlled c-NOT operation on the beam polarization, etc.