Optical Micromanipulation of Birefringent Objects with Beams with Polarization Singularities

In experiments of optical micromanipulation of birefringent objects a circularly or elliptically polarized beam passes through a micron sized birefringent object. Because of the difference between two indices of refraction in the object, there is a transfer of angular momentum from the beam to the object creating optical torque and causing the object to rotate. This phenomenon has applications in micro machines and microfluids research. The focus of this project is to control the rotation of an array of birefringent objects using a beam with a polarization singularity, where the state of polarization varies across the transverse profile of the beam. Using a spatial light modulator the beam can be programmed to have different polarization profiles. When this light is focused on the grid of birefringent crystals it is predicted that each will move in a different way, and the movements can be controlled with the polarization of the beam. Currently data is being taken using calcite crystals, a material with very high birefringence. The crystals are obtained in two ways, either by crushing a larger crystals with a mortar and pestle or growing them in solution. In addition, our work with calcite shows promise for beam polarization diagnostics.