**High Field Magneto-Optical Studies of Liquid Crystals and Complex Fluids**

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**Introduction**

High magnetic fields are a particularly powerful technique for the study of ordered, fluid materials, such as liquid crystals. This technique can give insight into the propensity of these materials to spontaneously break their symmetry. Furthermore, high fields give the experimenter a powerful tool to control the principal axes within inherently anisotropic fluid materials. During 2015, we examined the magneto-optical response of two new classes of liquid crystal materials, the twist-bend nematic phase, and the twist-bend cholesteric phase.

**Experimental**

Using the unique capabilities of the split-helix magnet, we measured the magnetic field induced birefringence of these materials in two geometries: Faraday, in which the direction of light propagation is parallel to the field, and Voigt, in which it is perpendicular. For both cases we have devised specialized temperature-controlled magnet inserts and beam recovery optics with appropriate optical access. Additionally, we performed, for the first time, angularly resolved photon-correlation spectroscopy in the split helix, taking advantage of both directions of angular access (horizontal and vertical).

**Results and Discussion**

During one week in 2015, we examined the effect of high fields on two distinct phase transitions, the nematic-isotropic and the nematic- to twist-bend nematic. For the latter, we found that in three new materials, the field has an unprecedentedly large effect, increasing the transition temperature by up to 13K. This is thought to be caused by a field alteration of the molecular shape made possible by a highly flexible molecular architecture. External field has an even larger effect on the formation of the twist-bend phase for the materials studied in 2015, which is distinction to better known twist-bend materials.



Figure 2 Intensity of diffraction spots characteristic of twist-bend nematic phase vs magnetic field at four different temperatures



Figure 1 phase transition temperatures vs field squared

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