

Fiber Sagnac interferometer for sensing magnetochiral birefringence: first tests on iron-alkynyl-helicenes

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Magnetochiral (Mch) interaction leads to a small scalar contribution of the optical index of a chiral molecule on the direction of an external magnetic field. Mch-dichroism was first detected in Eu-complexes¹ and, since then, in various compounds such as, e.g., chiral ferromagnets or aggregates. Conversely, observation of Mch-birefringence (MchB) was only reported by two groups, using passive² or active interferometers.³ However, for both setups, the response was polarization-dependent and required the availability of the two enantiomers of the compound under study, in order to compensate the circular anisotropies inherent to chiral samples.

Recently, we have developed a home-made fiber Sagnac interferometer⁴ dedicated to the measurement of directional phase shifts $\Delta\phi$. It works at 6500 cm^{-1} and is optimized to be insensitive to circular anisotropies and to residual absorption. It can thus characterize MchB of samples i) for which the two enantiomers are not available and ii) of poor transmission. The detection floor is $\Delta\phi_{\text{lim}} = 500\text{ nrad.Hz}^{-1/2}$, only limited by the source intensity noise. We point out that, in order to reach this sensitivity, the so-called systematic effects have to be carefully circumvented.

Here, we present this setup and focus on its use to probe the MchB of iron-alkynyl-helicenes. These molecules display giant chiroptical properties and have been shown to invert their optical rotation at $1.5\text{ }\mu\text{m}$ upon oxidation.⁵ They are thus good candidates for investigating redox-triggered magnetochiral switching. Our samples consist in 0.5 ml of ethynyl-helicene mono or bis Fe^{II} complexes (CH_2Cl_2 , $C \approx 15\text{ mg/ml}$).

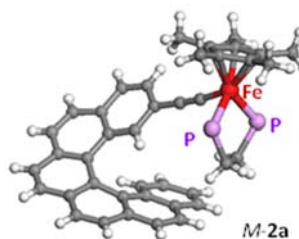


Fig.1: Fe^{II} complex

Up-to-now, we have not detected any directional phase shift. This yields a 3σ -limit on the Mch-index of $6 \cdot 10^{-13}\text{ T}^{-1}$ at $1.55\text{ }\mu\text{m}$ for the helicenes tested. To increase the signal, we plan to probe MchB closer to the UV bands. A second-generation setup is now under test. It will work at 12000 cm^{-1} and should provide a better sensitivity due to lower intensity source and compactness. Finally, the potential detection of other chiroptical effects using our fiber interferometer will be discussed.

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