Inducing magnetic ring currents in non-magnetic aromatic molecules: a finding from the 25 T Split-Florida Helix

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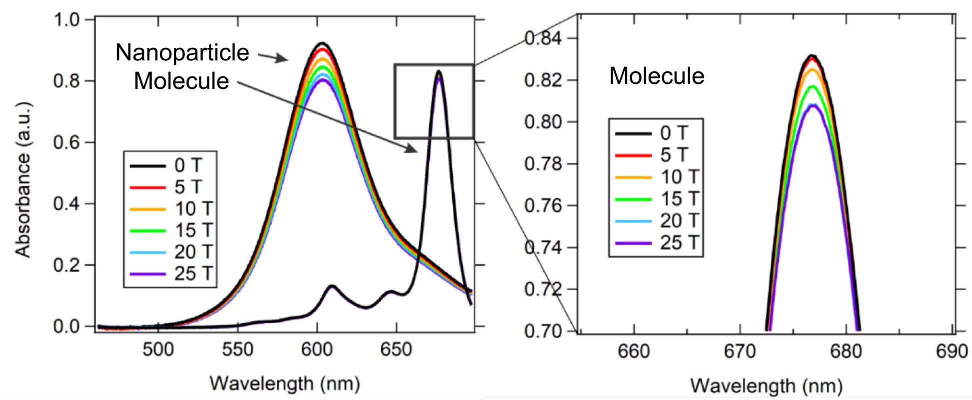
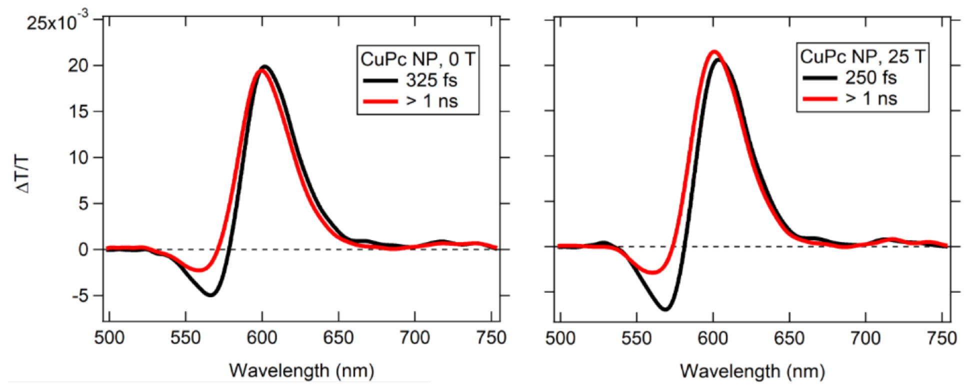
High-field magnets are powerful scientific tools to investigate and manipulate the properties of next-generation quantum materials. Many organic chemical systems studied to date have intrinsic magnetism, leading to the straightforward Zeeman interactions in applied magnetic fields that are utilized in NMR spectroscopy. *Recently, MagLab users have observed magnetic-field-induced effects in the photophysics of non-magnetic organic molecules, thereby expanding the scope of candidate materials that may be considered for multifunctional devices.*

Experiments in the MagLab's unique 25 T Split-Florida Helix Magnet confirmed theoretical predictions by this collaboration that a strong magnetic field applied to organic aromatic molecules will affect their optoelectronic properties. The Split-Florida Helix magnet enables ultrafast (femtosecond) optical spectroscopy on liquid samples positioned in the center of the magnet. *Aromatic ring currents of several nanoamperes induced by the applied fields were shown to modulate not only the light absorbing properties of the model aromatic chromophore, but also their subsequent ultrafast dynamics after light absorption*, as shown in the figure.

Magnetic field sensitivity was also demonstrated to be enhanced by molecular aggregation in certain packing arrangements, analogous to constructing a solenoid from a quantum molecules. Understanding how magnetic fields affect the electronic properties of aromatic molecules broadens our understanding of fundamental molecular magneto-science.



High magnetic fields of 25T modulate by more than 10% the absorption properties of nanoparticles comprised of aromatic molecules.



The subpicosecond intersystem crossing rate in nanoparticles of aromatic molecules is also modulated by 25T magnetic fields.

Facilities and instrumentation used: MagLab's 25 T Split-Florida Helix Magnet, MagLab's Ultrafast (Femtosecond) Optics Facilities

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