"Bridging Chiroptics and Spintronics with Strong Light-Matter Coupling"

Physical Chemistry Seminar

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Abstract: Chiroptics involves the preferential interaction of matter with light of a select circular polarization. Such polarization is a direct manifestation of the photonic spin state. As such, there is an intricate relationship between chiroptics and the transduction between photonic spin and matter-based polarizations. This relationship becomes particularly relevant for spintronics, where such polarizations involve select electronic spin states, with ramifications for quantum information applications and spin chemistry. In this talk, I will discuss how strong light–matter coupling opens new opportunities for transducing spin polarization between optical modes and matter through the formation of chiral polaritons – hybrid light–matter excitations. I will present challenges arising when producing chiral polaritons by means of conventional Fabry–Pérot cavities, and highlight how a chiroptical phenomenon called "apparent circular dichroism" could provide a practical means of realizing polaritons involving desirable spin polarizations.

BioSketch:

Roel Tempelaar is an Assistant Professor of Chemistry at Northwestern University. Roel is a theoretical chemist whose interests lie at the intersection of chemistry, physics, and materials science. His research group seeks to advance the fundamental theories of mixed quantum–classical dynamics, tensor network states, and chirality, with applications to quantum materials, spin chemistry, and strong light–matter coupling phenomena. Roel did his undergraduate studies in Physics at the University of Groningen, the Netherlands, and in 2015 he received a PhD with distinction Cum Laude at the same university. He then pursued his postdoctoral studies, working with David Reichman at Columbia University, until starting his independent career at Northwestern University in 2020. He was a 2016 recipient of the Rubicon Fellowship by the Dutch Research Council, and received an NSF CAREER award in 2022.

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