CMQT
CENTER FOR MOLECULAR
QUANTUM TRANSDUCTION

Fifth Annual CMQT Symposium

April 23 & 24, 2026 | Northwestern University

Justin R. Caram

Dr. Justin R. Caram is an associate professor in the department of chemistry and biochemistry at the University of California, Los Angeles. Following a PhD at the University of Chicago, and research as the Bob Silbey memorial postdoctoral fellow at MIT, he joined UCLA as an assistant professor in 2017. He has been recognized by several national awards including an NSF Career grant, a Sloan, Dreyfus and Cottrell fellowships, a PHYS division lectureship and the Richard Van Duyne award for early career experimentalists.

His research program focuses on developing new materials and methods for studying photophysics. He is particularly fascinated by extremes in excitonic behavior, including ultranarrow linewidths, superradiance and unusually redshifted chromophores.

Atomic Physics in a Beaker?

A prerequisite for realizing quantum advantage in sensing and computing is the fiduciary preparation of specific (and non-thermal) quantum states. This is often at odds with chemical environments which rapidly destroy coherence and limit the scope of quantum operations. However, if one could retain "quantum" properties in a small molecular moiety while it lives in a messy thermally fluctuating environment, we could greatly increase the scope of qubit-based technology. I will introduce atom-like molecular sensors (ALMS) which are lanthanide-based analogs to atomic vapor cells. I will demonstrate that this material retains extraordinarily narrow linewidths in liquid phase, a property which can be leveraged for magnetic field sensing and state preparation. We will then show that one can use optical tools to manipulate these electronic qubits, demonstrating single-qubit gates. Finally, we will show that one can access ground state population control via polarization manipulation, suggesting a path toward quantum memory. We hope to show how physical (in)organic chemical intuition can be combined with principled approaches to quantum technology.