

# MARISSA WEICHMAN

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10:30 AM – 11:30AM

Steele 006

## “New Experimental Platforms for Molecular Polaritonics”

**Abstract:** Polaritons are hybrid light-matter states with unusual properties that arise from strong interactions between a molecular ensemble and the confined electromagnetic field of an optical cavity. Cavity-coupled molecules appear to demonstrate energetics, reactivity, and photophysics distinct from their free-space counterparts, but the mechanisms and scope of these phenomena remain open questions. I will discuss new experimental platforms that the Weichman Lab is developing to investigate molecular reaction dynamics under strong cavity coupling.

While polaritons are now well-established in solution-phase and solid-state systems, they had not been previously reported in isolated gas-phase molecules, where attaining sufficiently strong light-matter interactions is a challenge. We access the strong coupling regime in an intracavity cryogenic buffer gas cell optimized for the preparation of simultaneously cold and dense ensembles and report a proof-of-principle demonstration in gas-phase methane. We strongly cavity-couple individual rovibrational transitions and probe a range of coupling strengths and detuning's. In ongoing work, we are harnessing this infrastructure as a testbed for fundamental studies of polariton physics and chemistry.

We are also searching for signatures of cavity-altered dynamics in benchmark condensed-phase systems. We use ultrafast transient absorption to examine intracavity dynamics in benchmark systems with the goal of better understanding exactly how and when reactive trajectories may be influenced by strong light-matter interactions.

**Bio:** Marissa Weichman obtained her B.S. in chemistry from the California Institute of Technology in 2012, where she performed undergraduate research with Prof. Mitchio Okumura. She pursued a Ph.D. in chemistry at the University of California, Berkeley where she developed high-resolution anion photoelectron imaging spectroscopy as an NSF graduate research fellow in Prof. Dan Neumark's group. Marissa completed her Ph.D. in 2017 and was awarded the 2018 Justin Jankunas Doctoral Dissertation Award in Chemical Physics from the American Physical Society for her thesis work. Marissa then joined Dr. Jun Ye's group as a NIST/NRC postdoctoral research fellow at JILA/CU Boulder, working on precision cavity-enhanced frequency comb spectroscopy of large molecules. Since 2020, Marissa has been an assistant professor of Chemistry at Princeton University. Her lab uses fundamental chemical physics and spectroscopy to probe the behavior of complex molecular systems and explore new ways to steer molecular processes using light. Her group's work has been recognized with a Department of Energy Early Career award, NSF CAREER award, Packard Foundation fellowship, Presidential Early Career Award for Scientists and Engineers, and a Cottrell Scholar Award.