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Title: Polariton-Induced Modifications to Relaxation and Transport in Supercooled Liquids

Abstract: Strong coupling between confined optical modes in microcavities and molecular vibrational transitions lead to the formation hybrid light-matter states known as polaritons. This talk presents how such optical microcavities modify relaxation dynamics in supercooled liquids—the metastable liquid state below freezing temperature [1]. The inherently collective nature of glassy dynamics in supercooled liquids makes them ideal for testing our understanding of polariton-induced phenomena. Using cavity molecular dynamics simulations, which treat both the cavity mode and molecular system classically, we examine how vibrational strong coupling (VSC) influences relaxation in the dimer version of the Kob-Andersen model of supercooled liquids. Our results reveal two key findings: polariton formation in an all-classical setting and maximum modification in relaxation times at an optimal coupling strength, as measured by the intermediate scattering function. The latter finding challenges our conventional intuition that kinetic properties should change monotonically with coupling strength. The talk concludes with future directions on this new interface between polaritonics and glassy dynamics of supercooled liquids, with potential implications for controlling material transport properties through light-matter interactions.

[1] Muhammad R. Hasyim, Arianna Damiani, Norah M. Hoffmann, *in preparation* (2025).