Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Coupling of Solute Vibrational Modes with a Fabry-Perot Optical Cavity Mode ADAM DUNKELBERGER[1], RYAN COMPTON[2], KENAN FEARS, BRYAN SPANN[3], JAMES LONG, BLAKE SIMPKINS, JEFFREY OWRUTSKY, Naval Research Laboratory — Electronic transitions of systems confined in optical microcavities can strongly couple to cavity modes, giving rise to new, mixed-character modes. Recent studies have demonstrated similar coherent coupling between the vibrational modes of a thin polymer film and a Fabry-Perot optical cavity mode. This coupling manifests experimentally as a splitting of the transmissive cavity mode into two dispersive branches separated by the vacuum Rabi splitting. Here we present recent experimental results for the coupling of solution-phase compounds with an optical cavity. Solutions of $W(CO)_6$, $Mo(CO)_6$, and NCS^- contained in cavities show strong coupling between the solute chromophores in the mid-infrared and cavity modes. We show that the methodology established with polymer-filled cavities is generally applicable to liquids but that the fluidity of the sample complicates the cavity construction. Varied cavity thicknesses can give rise to spatial gradients in coupling strength and difficulty in targeting a specific cavity-mode order. We also compare the transmission of the mixed vibrational-cavity modes in cavities constructed from either metallic or dielectric reflectors which impacts the cavity resonance line width.

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Date submitted: 13 Nov 2014 Electronic form version 1.4