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**Enhancing vibrational selectivity and 2D IR spectroscopies with mid-IR pulse shaping**

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We report on the capabilities of a new pulse shaper that operates directly in the mid-infrared. This shaper can adjust the phase and amplitudes of 500 frequency elements to generate complex time-domain pulses. In this talk, experiments will be reported using this shaper to coherently control the vibrational excitations of condensed phase molecules with adaptive learning feedback control. We will also report how this shaper can be used to collect two-dimensional infrared (2D IR) spectra by programming the pulse sequences. 2D IR spectroscopy via pulse shaping is extremely rapid, highly accurate, and more flexible than traditional means for collecting spectra. Taken together, mid-IR pulse shaping allows for new experiments in ground state coherent control and probing vibrations with unprecedented accuracy using new multidimensional spectroscopies.