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Title:

Ultrafast spectroscopy with frequency combs: enabling new measurements of dilute species in molecular beams

Abstract:

Initially developed as a tool for metrology, frequency combs are widely used for precision spectroscopy but their utility for ultrafast spectroscopy is just beginning to be explored. Exploiting the properties of frequency combs, we are improving the sensitivity, spectral resolution, and broadband detection of ultrafast spectroscopies. One such technique we are developing, cavity-enhanced transient absorption spectroscopy, uses fiber-laser frequency combs coupled to external enhancement cavities to increase the sensitivity of ultrafast transient absorption spectroscopy. A home-built fiber-laser frequency comb system provides a stable source of ultrafast pulses. The external enhancement cavities increase both the laser power and effective absorption path length, thus improving the signal by several orders of magnitude over traditional transient absorption spectroscopy. Altogether the sensitivity is more than four orders-of-magnitude better than the previous best transient absorption techniques, which allows for the study dilute samples in molecular beams on the femtosecond timescale with transient absorption spectroscopy for the first time. The second technique discussed will be the application of cavity-enhancement and frequency-comb techniques, including dual-comb spectroscopy, to two-dimensional spectroscopy. Initial results and current progress towards ultrafast two-dimensional spectroscopy of dilute species in molecular beams will be presented.

Short Bio:

I did my undergraduate degree in chemistry at Macalester College, in St. Paul, MN. I did my PhD in chemical physics at the University of Colorado, Boulder and JILA where I worked for David Nesbitt, doing high-resolution spectroscopy of small hydrocarbon radicals. While there I was in an interdisciplinary NSF-IGERT program called the Optical Science and Engineering Program (OSEP) to focus on optics. I did a post-doc at Stony Brook University in the physics department with Thomas Allison. He had also just left JILA for a faculty position and I helped him start up his new lab. In 2016 I started as an Assistant Professor in Chemistry at the University of Georgia. I was recently named a 2021 UGA Innovation Fellow.