High-speed infrared laser absorption imaging of state populations and multiple temperatures for entry studies

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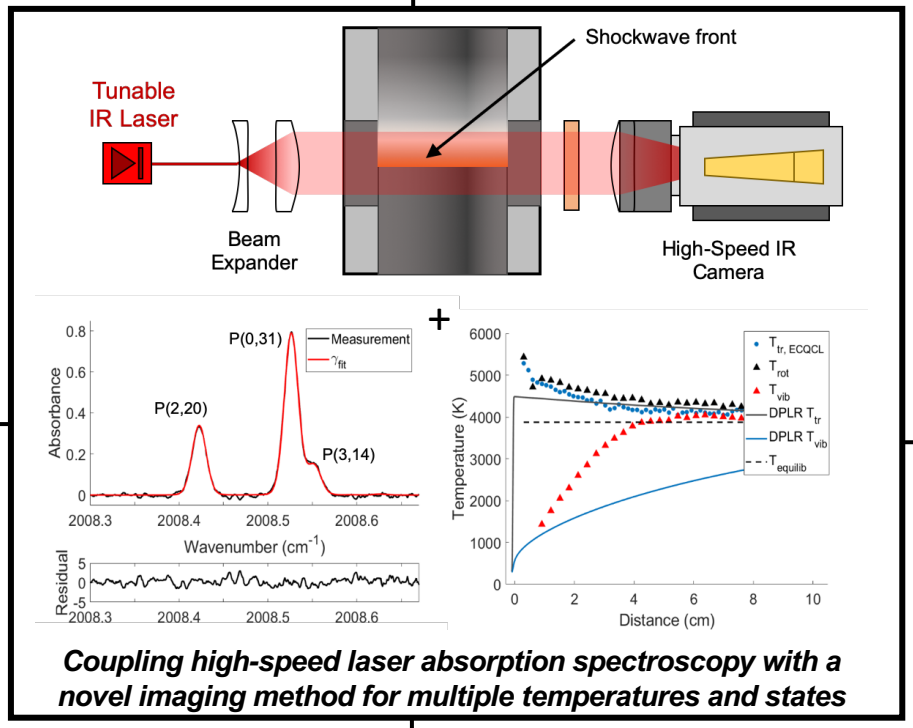
Research Objectives

- Advance laser absorption imaging of molecular and atomic gas properties in entry aerothermal test facilities
- Increase accessible state-populations and spatial resolution
  - Starting TRL: 1—laser absorption imaging of steady-state or slow transients, limited species
  - Ending TRL: 3—near MHz imaging of multiple temperatures / state populations of CO, CO_2, NO, and O at entry conditions



Coupling high-speed laser absorption spectroscopy with a novel imaging method for multiple temperatures and states

Approach

- Target species relevant to: Earth, Mars, and Venus entry (CO, NO, CO_2, O)
- Investigate spectroscopy of excited vibrational levels for CO, NO, and CO_2 at high temperatures
- Enhance measurement rates for multi-wavelength laser absorption imaging
- Assess limits of capability by imaging shock and boundary layers in UCLA high-enthalpy shock tube

Potential Impact

- Comprehensive datasets of gas parameters and state populations during entry non-equilibrium
- Portable diagnostic system capable of deployment in many entry aerothermal facilities
- Improved models of radiative heat transfer during entry
- Reductions in thermal protection system mass
- Increased payload mass for NASA missions