

Isabelle C. Sanders

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Education

DOCTOR OF PHILOSOPHY | 2019-2023 | UNIVERSITY OF CALIFORNIA, LOS ANGELES

- Major: Mechanical Engineering

MASTER OF SCIENCE | 2019-2021 | UNIVERSITY OF CALIFORNIA, LOS ANGELES

- Major: Aerospace Engineering

BACHELOR OF APPLIED SCIENCE | 2015-2019 | QUEEN'S UNIVERSITY

- Major: Engineering Physics
 - Minor: Mechanical Engineering
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Relevant skills

Areas: Molecular spectroscopy, optical diagnostics, reacting flows, chemical kinetics

Software: MATLAB, Python, SolidWorks, CATIA, ANSYS, LaTeX, Cantera

Professional Experience

GRADUATE RESEARCHER | UNIVERSITY OF CALIFORNIA, LOS ANGELES

2019 – 2023

Laser Spectroscopy and Gas Dynamics Laboratory

Los Angeles, CA

PI: Professor R. Mitchell Spearrin

- Designed and developed laser absorption-based diagnostic methods and experimental architectures for applications to rocket propulsion, energy, and environmental sensing
- Managed projects with academic, industry, and funding agency partners on multi-year deliverables and technical progress reports
- Worked with undergraduate and graduate students in a mentorship role to build their interest and experience while ensuring the advancement of research to meet demanding external timelines

UNDERGRADUATE RESEARCH ASSISTANT | UNIVERSITY OF TORONTO

2018 – 2019

Dunlap Institute of Astronomy and Astrophysics

Toronto, ON, Canada

PI: Professor Suresh Sivandam and Dr. Shaojie Chen

- Developed an experimental process to test the dispersive behavior of a digital micromirror device (DMD) to determine its suitability as a programmable slit-array in major ground-based telescopes for multi-object spectroscopy
- Designed an opto-mechanical assembly with visible and IR-range lasers and cameras to spatially resolve refracted light patterns on the slit-array
- Utilized OSLO ray tracing software to both predict and help explain experimental findings

MECHANICAL ENGINEERING INTERN | STANDARD BIOTOOLS (FLUIDIGM)

2016 – 2017

Mechanical Engineering Department

Markham, ON, Canada

Supervisor: Sergey Vorobiev, P.Eng.

- Designed optomechanical assemblies for next generation instrument research
- Conducted thermal and flow rate analysis on both existing and in-development instruments
- Converted parts and large device assemblies (1000+ parts) from CATIA to SolidWorks and worked extensively with SolidWorks PDM to streamline and troubleshoot the design process workflow

Select Research Projects

JPL STRATEGIC UNIVERSITY RESEARCH PARTNERSHIP

2019 – 2021

Spectroscopic Analysis of Hybrid Rocket Combustion Efficiency

- Developed an improved method to evaluate combustion efficiency for hybrid rockets by in-situ sensing of temperature and gas composition (CO, CO₂, H₂O) via novel laser absorption tomography techniques
- Designed and manufactured components for a modular hybrid rocket motor combustion facility that enabled hot fire tests up to 20 bar with different propellants, fuel-port geometries, and oxidizer injector geometries
- Studied effects of differing axial and swirl oxidizer injector geometries and fuel-port geometries by spatially quantifying the combustion progress in the radial and axial domains with laser absorption tomographic measurements
- 2D imaging of the thermochemical structure of the flow-field for varied hybrid motor geometries validated and lead to improvements of computational fluid dynamics (CFD) simulations and multi-physics reacting flow models

JPL SUBCONTRACT: WATER ISOTOPE TUNABLE LASER SPECTROMETER

2022 – 2023

Rover-Based Sensor to Measure Water Isotopic Ratios in the Lunar Regolith

- Quantified laser characteristic response parameters to enable simulations of the signal expected from varied isotopic concentrations in the collected water vapor sample gas call
- Assisting with design and analysis of a small multi-pass Herriot cell needed to provide a sufficient pathlength to detect trace concentrations of gas phase water isotopes at sub 100 mbar pressures
- Working with the electronics team to modify data management and post-processing algorithms to enable a migration from the analog electronics currently implemented on tunable laser spectrometer systems at JPL to a robust digital solution
- Collaborating with an interdisciplinary team of JPL scientists and engineers to help integrate my contributions to the laser sensing strategy into the overall device given harsh environmental conditions and strict flight readiness requirements

FEMA FIRE PREVENTION AND SAFETY GRANT

2022 – 2023

Fighting Fire Toxicity with Novel Optical Sensors

- Designing portable miniaturized laser absorption-based sensor packages to detect toxicant emissions in structural fires to help combat deaths and illnesses in firefighters associated with unknown exposure to harmful gases
- Conducting spectroscopic studies and developing sensors to target toxicants, such as Benzene and HF, where both the existing spectral databases are more limited and the existing available sensors are inadequate
- Developing wavelength modulation spectroscopy (WMS) based calibration-free, onboard signal processing methods to enable real time toxicant concentration readings at low detection limits (ppm/ppb) in harsh fire and post-fire environments

UCLA: SOLID FUEL COMBUSTION SENSING AND ANALYSIS

2021 – 2023

Laser-Based Sensing for Chemical Kinetic Studies of Solid Fuel Combustion

- Built a database of formaldehyde absorption cross-sections via experiments in the UCLA High Enthalpy Shock Tube which enabled subsequent quantitative measurements of formaldehyde formation in solid fuel decomposition and combustion studies
- Measured combustion intermediate and product species (CO, CO₂, and CH₂O) evolution via laser absorption sensors from shock-heated Methyl Methacrylate (MMA) decomposition to provide constraints to kinetic models and improve the accuracy of PMMA hybrid rocket computational fluid dynamics (CFD) simulations by JPL and Caltech collaborators
- Developed a chemical kinetic mechanism algorithm involving Cantera simulations and genetic algorithm optimization to modify sensitive reaction rate parameters to improve chemical model agreement with experimental time-resolved speciation data

Awards and Recognition

BEST PAPER AWARD – HYBRID ROCKETS | 2022

- American Institute of Aeronautics and Astronautics

NSERC DOCTORAL SCHOLARSHIP – MECHANICAL ENGINEERING | 2019 – 2023

- Natural Sciences and Engineering Research Council of Canada

DEAN'S HONOUR LIST – ENGINEERING PHYSICS | 2016 – 2019

- Queen's University Faculty of Engineering and Applied Science
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