Welcome to my

PORTFOLIO

Pujan Biswas

Education

IIT Bombay, India

B. Tech (2016-2020)

Aerospace Engineering

- Thesis on CFD simulations and validation with experiments
- Interns: NTU Singapore, Hokkaido University, Japan
- General research: Optimization, experimental testing, fluid flow
- Extracurriculars: Academic Council, Cultural festival

Stanford University

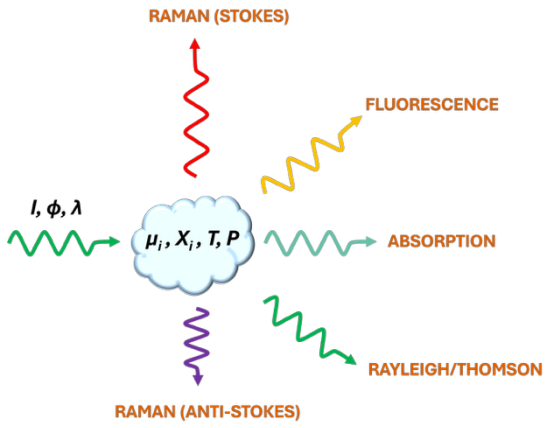
Ph.D. (2021-Present)

Mechanical Engineering

- Research: Compact-modeling, optical diagnostics, combustion kinetics

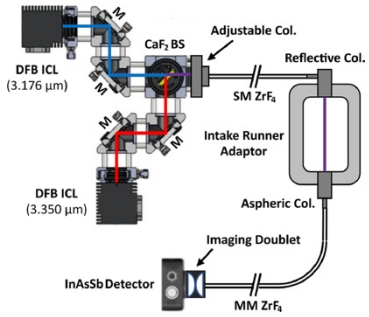
Ph.D. Research

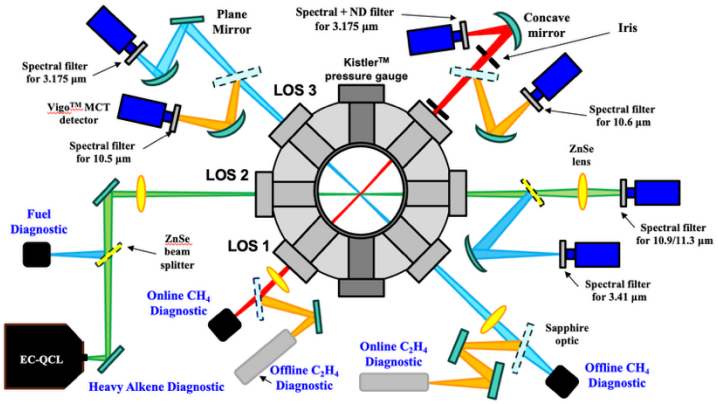
Light-matter interaction



Utilizing laser absorption spectroscopy to develop optical diagnostics for studying physical and chemical

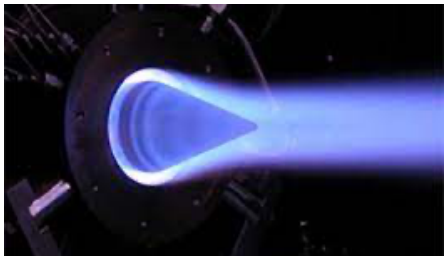
Complex opto-mechanical systems





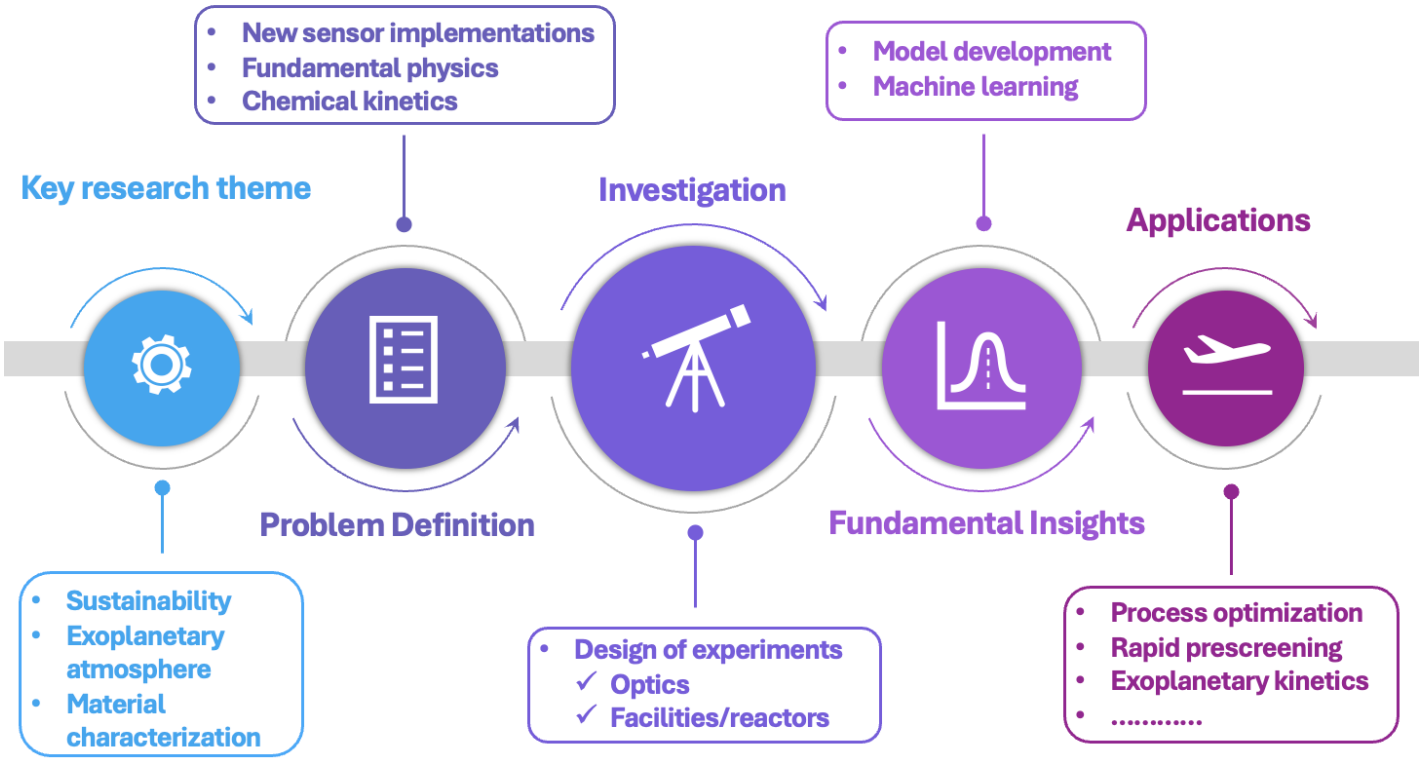
High-impact areas

Propelling tomorrow's vehicles

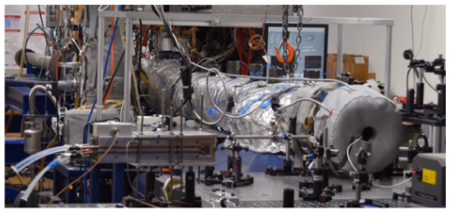


Studying extreme plasmas

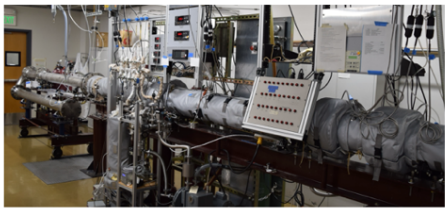
Workflow



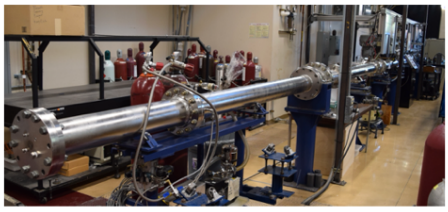
Reactor facilities



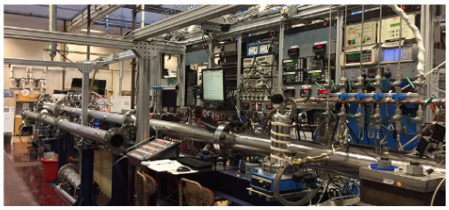
High Pressure Shock Tube (HPST):
Kinetics, high pressures! (1000 atm), heated



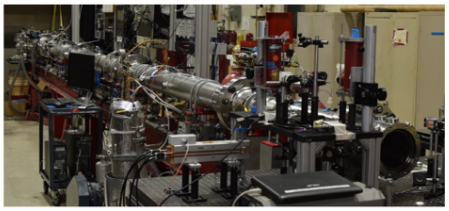
Kinetics Shock Tube (KST):
Kinetics, jet fuels, exoplanetary science, heated (30 atm)



NASA Shock Tube:
Plasma, high-temperature air (30 atm)

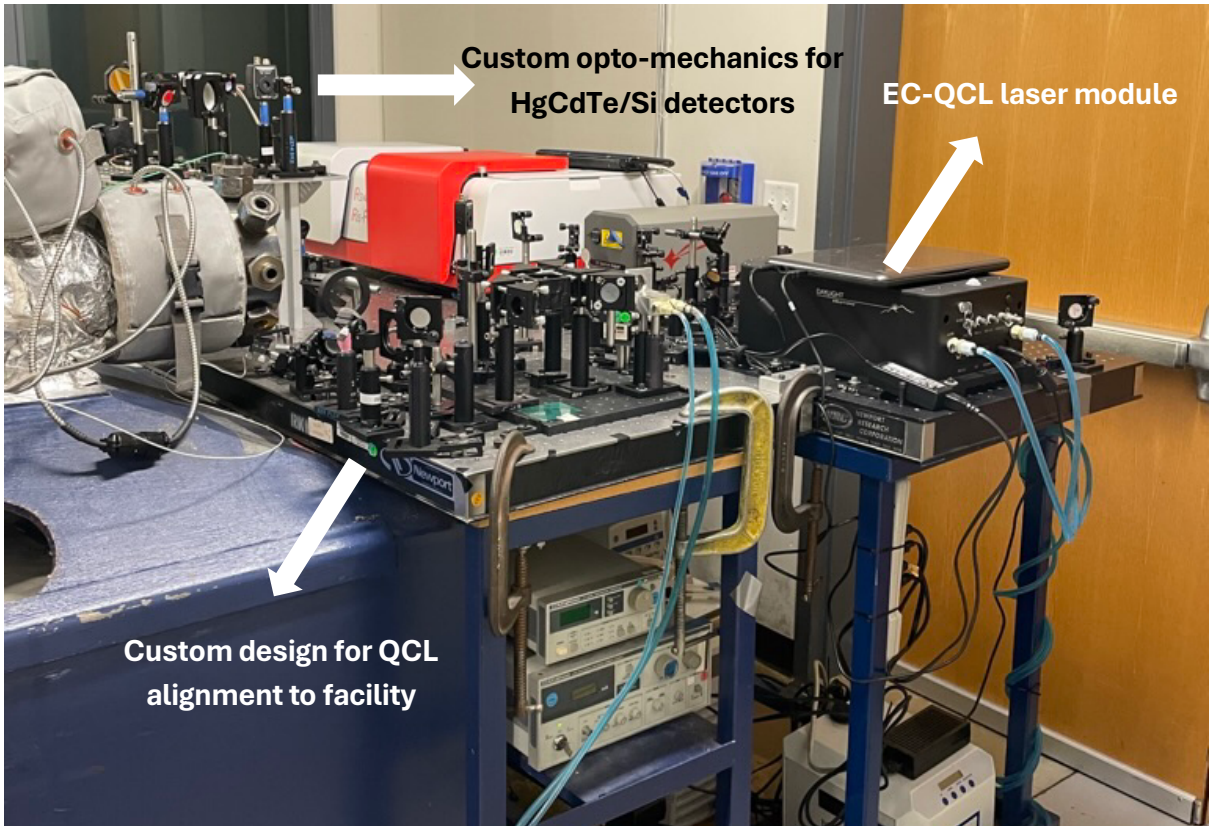


Imaging Shock Tube (IST):
Long test-time, imaging, aerosol (30 atm)

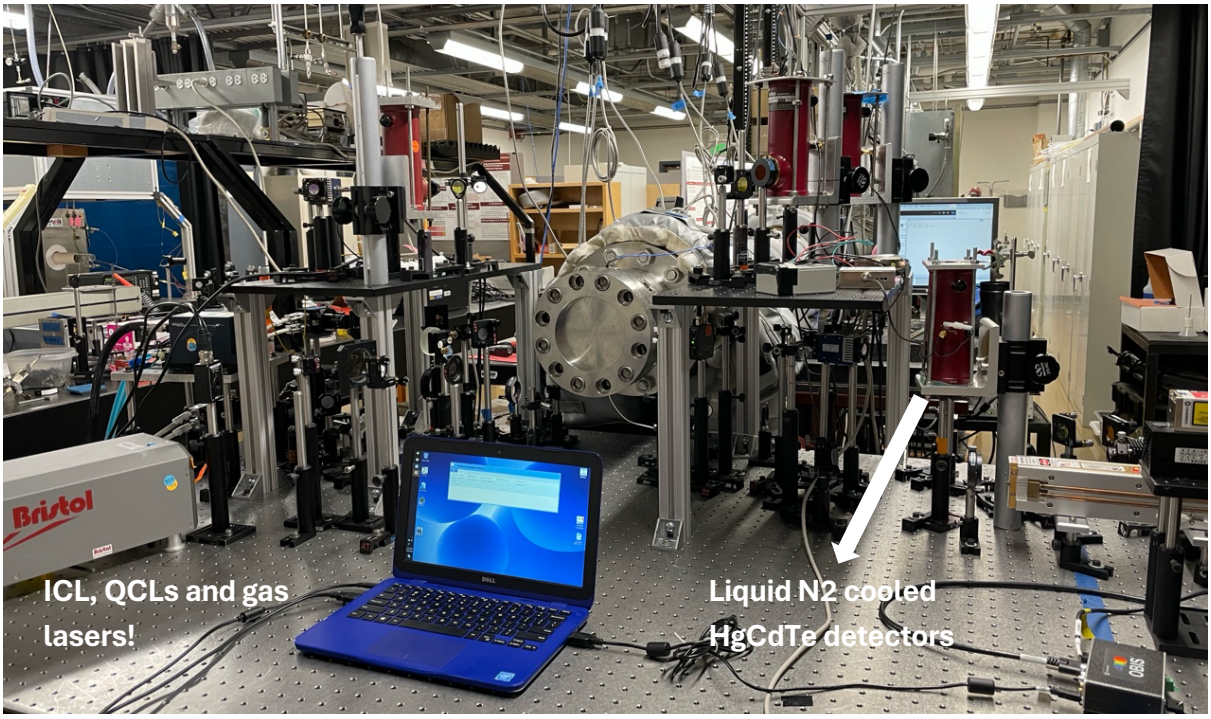


Flexible-Application Shock Tube (FAST):
Material characterization, diagnostic validation (30 atm)

Peak into opto-mechanical projects



Laser alignment on the "HPST" facility for fundamental chemical kinetics

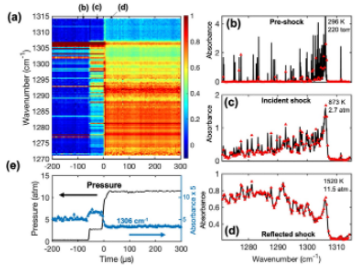


Multi-wavelength laser alignment on the "KST" facility for sustainable energy research (one of the world's first!)

Key scientific contributions

Sub-μs diagnostics

Challenge: Developing reliable diagnostics for extreme environments

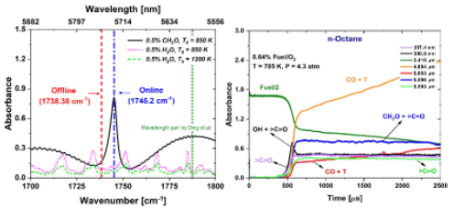


Approach:

- Implement state-of-the-art spectroscopy techniques such as dual-comb and intensity modulation spectroscopy
- **Design complete set of optical systems** to provide accurate and noise-free measurements
- Deploy diagnostics in harsh conditions (e.g., race car engines)

Target-specific sensors

Challenge: Modeling large molecule chemistry is computationally expensive

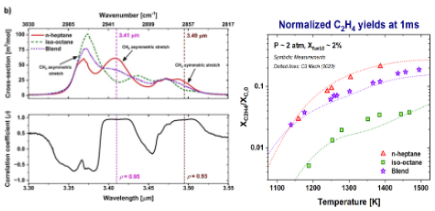


Approach:

- Develop **molecule-specific optical diagnostics** for precise time-resolved measurement
- Utilize sensors on shock reactors
- Design remarkably concise, accurate models for
  - O(10) species, predictive uncertainty < 25%

Laser-guided predictive models

Challenge: SAF evaluation takes years, O($10M), O($10^6$) gallons of fuel

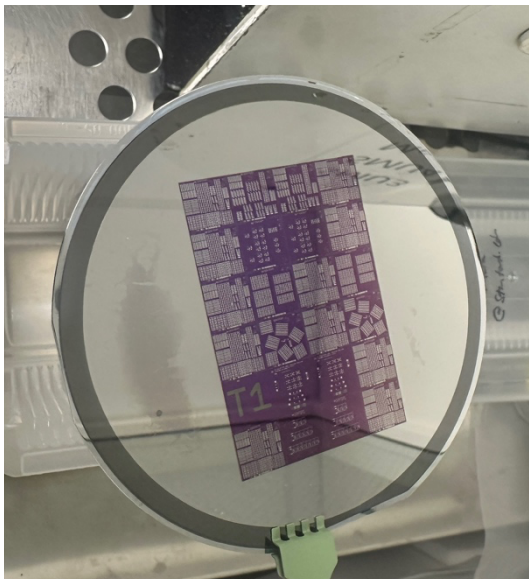


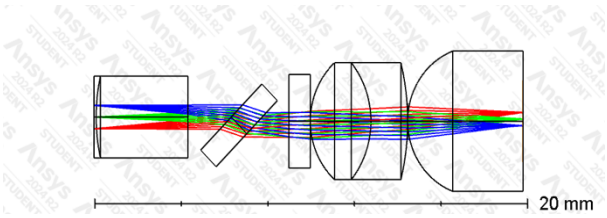
Approach:

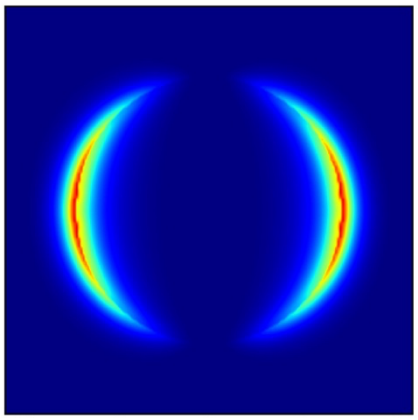
- Leverage **optical diagnostics** to understand fuel chemistry at high-T
- Obtain fundamental insights in combustion behavior based on fuel composition
- Implement machine-learning models (e.g., GPR, SVR) to directly build chemical kinetic models

For more rigorous discussion on scientific contributions, visit my [google scholar]

Beyond research







IC fabrication, optical design, nanophotonics and many more!