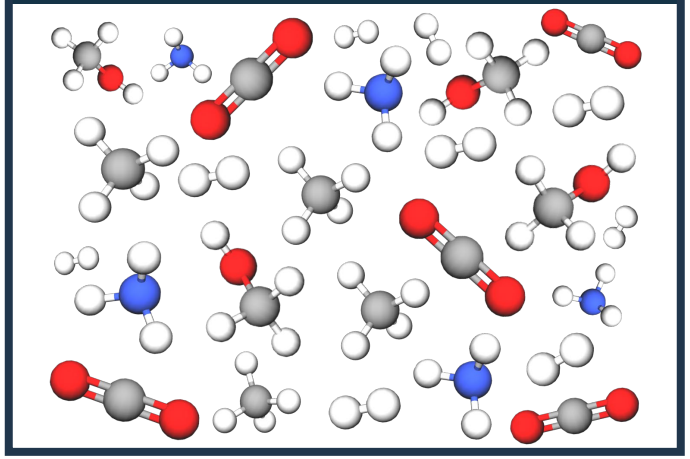
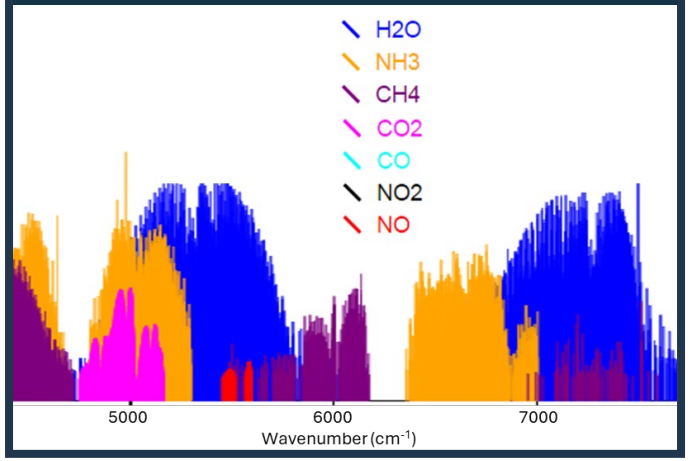
Ferris Research Group

Principal Investigator: Prof. Alison M. Ferris
Department of Mechanical and Aerospace Engineering

Chemical Kinetics



Optical Diagnostics

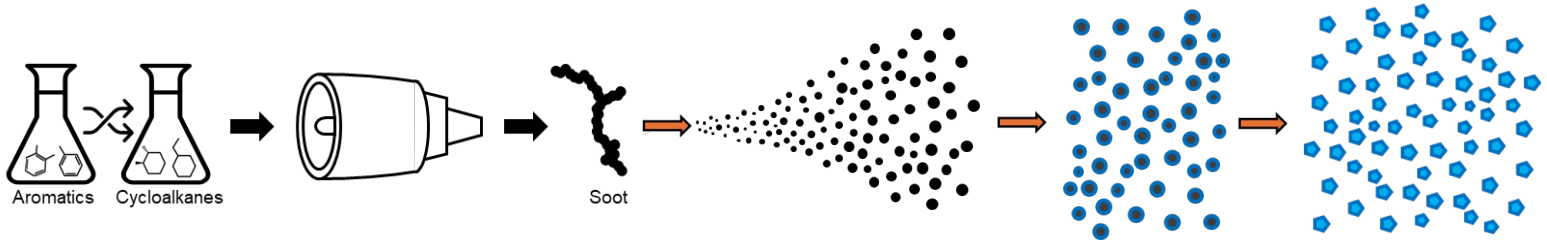


Fuel Design

Research interests: development of **laser-based diagnostics** and **experimental methods** to better understand **gas-phase reaction chemistry** and **novel flame phenomena**; **design of sustainable fuels**

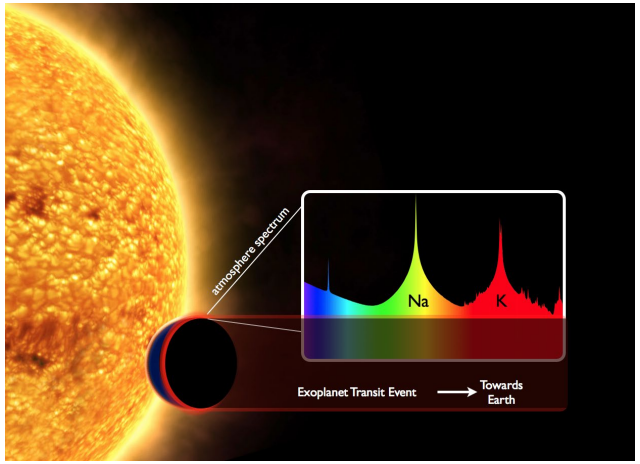
Research Topics

FTIR-based pre-screening tool for sustainable aviation fuel development

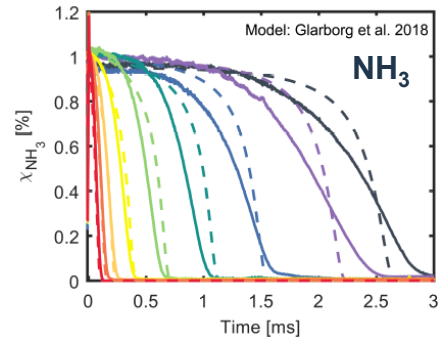


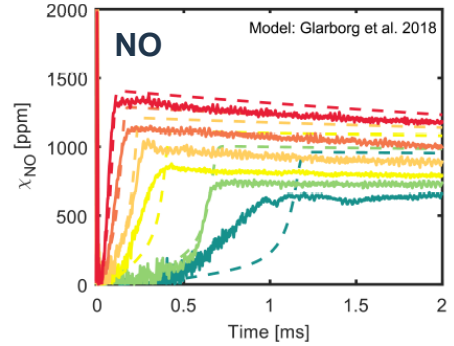
Jet fuel molecular structure effects on soot/contrail formation

Broadband, ultra-fast light sources for simultaneous, multi-species measurements



Exoplanet atmospheric chemistry & spectroscopy





Chemistry of low-carbon fuels (e.g., ammonia, etc.)

Octane number

Engine parameters

	Compression ratio	Bore (cm)	Stroke/Bore
Spark-ignition engines:			
Small (e.g., motorcycles)	6-11	5-8.5	1.2-0.9
Passenger cars	8-10	7-10	1.1-0.9
Trucks	7-9	9-13	1.2-0.7
Large gas engines	8-12	22-45	1.1-1.4
Diesel engines:			
Passenger cars	17-23	7.5-10	1.2-0.9
Trucks	16-22	10-15	1.3-0.8
Locomotive, industrial, marine	12-18	15-40	1.1-1.3
Large engines, marine and stationary	10-12	40-100	1.2-3

Heywood, *Internal Combustion Engine Fundamentals*, McGraw-Hill, 1988.

Engine efficiency

- Combustion efficiency: fraction of fuel's chemical energy that is released

$$\eta_c = \frac{H_R(T_A) - H_P(T_A)}{m_f Q_{HV}}$$

- Thermal conversion efficiency: actual work per cycle relative to amount of fuel chemical energy released

$$\eta_t = \frac{W}{\eta_c m_f Q_{HV}}$$

- Overall fuel conversion efficiency:

$$\eta_f = \eta_c * \eta_t$$