PLASMa: Precision ionic Liquids for Advanced Spacecraft thermal Management

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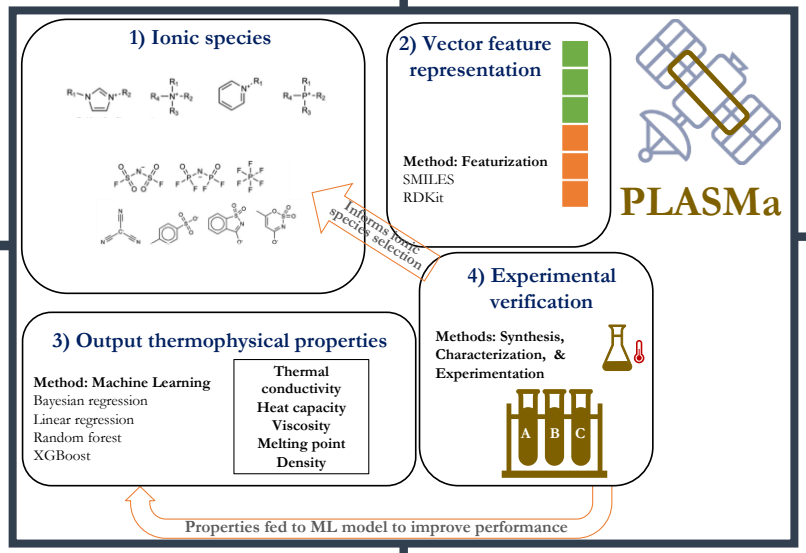
Research Objectives

Goal of this research program

- Use **machine learning** and **novel ionic liquids** to develop **thermally stable, low viscosity, high-performance heat transfer fluids.**

Innovation and Advancement of the State-of-the-Art

- Machine learning model enables **targeted fabrication of ionic liquids** for heat transfer applications
- Ionic liquids enable **low-volatility, near zero vapor pressure and tunable thermal properties**



TRL Levels

Initial: Ionic liquids for heat transfer applications **TRL 2**.

Upon Completion: Prototypes will be developed and validated (**TRL 3**).

Approach

We will use **machine learning** to design novel ionic liquids for spacecraft thermal management. We will **experimentally characterize** fluid stability, thermophysical properties, and material compatibility.

Research Step	Outcome
Build and train machine learning model	*Identify ionic liquids with requisite thermophysical properties*
Fabricate ionic liquids and measure properties	*Validate composition-property relationship for ionic liquids*
Create and test properties of ionic liquids	*Demonstrate novel high-performance heat transfer fluids*

Potential Impact

Benefits to…

Space Science and Exploration

- Safe non-toxic ionic liquids are suitable for future crewed missions
- Enabling technology for lunar surface and deep space thermal systems
- Machine learning for ionic liquid discovery proposed as a fundamentally new technology as part of active thermal control design

"Spin-off" Technologies

- Extensible to more complex ionic liquid formulations to increase domain space, as well as other subsystems (e.g., advanced ionic liquids for electric propulsion)