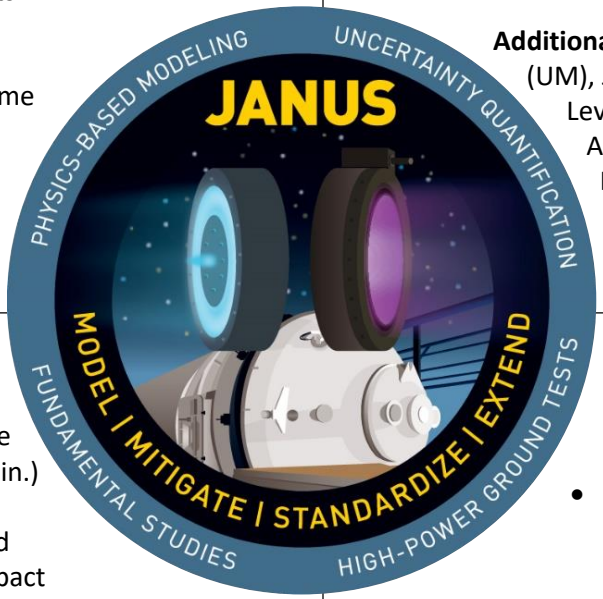
JOINT ADVANCED PROPULSION INSTITUTE (JANUS)

Vision Statement

Enable the flight of high-power electric propulsion (EP) by creating physics-based limits, mitigation techniques, and extrapolation procedures to predict the in-space performance, operation, and lifetime of high-power EP devices from ground tests

Research Objectives

1. Define new standards and requirements for when a test environment is sufficiently "space-like" for high-power EP testing
2. Develop procedures and techniques for facility design, upgrades, and thruster operation to meet testing requirements
3. Demonstrate tools and methodologies built on physics-based models to make probabilistic assessments of in-space performance and lifetime based on non-optimal ground tests
4. Educate the next generation of engineers and scientists in high-power EP



Leadership Team

- Mitchell Walker (GT), Director, Facility Fidelity, Co-Lead
- Benjamin Jorns (UM), Co-Director, Facility Fidelity, Co-Lead
- Richard Wirz (UCLA), Physics-based Modeling & Integration, Lead
- Joshua Rovey (UI), Diagnostics & Fund. Studies, Co-lead
- John Williams (CSU), Diagnostics & Fund. Studies, Co-lead

Participant organizations: Georgia Institute of Tech. (GT), U. Michigan (UM), U. California, Los Angeles (UCLA), U. Illinois (UI), Colorado State U. (CSU), Penn State U. (PSU), Stanford U. (SU), U. Colorado-Boulder (UCB), Western Michigan U. (WMU), Clark Atlanta U., Chicago State U., CC of Chicago

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Industry partners: Aerospace Corp., Aerojet Rocketdyne, Busek

Approach

1. Develop predictive engineering models (PEMs) of EP performance and lifetime that incorporate facility effects (pressure, electrical, and contamin.)
2. Apply methods of rigorous uncertainty quantification (UQ) to identify uncertainties and knowledge gaps in PEMs that most critically impact prediction confidence
3. Apply optimal experimental design (OED), to identify basic plasma experiments, higher fidelity simulations and theory development, and systems-level tests for reducing uncertainty in model predictions
4. Periodically reevaluate and pivot resources to maintain focus on research with the greatest potential to reduce uncertainty in PEM predictions
5. Validate and verify PEMs with high-power (> 100 kW) systems-level tests
6. Leverage PEMs to identify new standards, extrapolation procedures, and mitigation techniques for high-fidelity ground testing

Benefits

- Development of new physics-based requirements for the accurate ground testing of high-power EP
- Development of guidelines and best practices for designing new facilities to test high-power EP concepts
- Development of open-source numerical tools, diagnostics, experimental methods, and mitigation techniques that can be applied to translate ground tests from test facilities to in-space performance
- Support and adoption of Institute methods for predicting in-space operation by industry
- Demonstration of methods on relevant thrusters
- Development of well-characterized university test facilities suitable for the evaluation of high-power EP devices
- Creation of a talent pipeline for the workforce in advanced propulsion