NASA SBIR 2015 Phase I Solicitation

Z1.01 Modeling and Measurements for Propulsion and Power

Lead Center: GRC

Participating Center(s): ARC, JPL, MSFC

To reduce the development time of advanced future systems needed for space exploration, physics-based modeling tools are sought for:Â

- Electrochemical systems such as batteries, fuel cells and electrolyzers.
- Nuclear power and nuclear power based propulsion systems.
- Microfluidic electrospray propulsion systems.

In each case, the emphasis is on determining performance-limiting features and identifying potential means to overcome limitations. Models should focus on aspects of the system where interactions of sub-systems or components is poorly understood and where development frequently relies on heuristics or iterative build and test cycles to settle on designs. Electro-chemistry models are sought that predict the rates of reaction, or side products of a reaction, predicated upon the thermodynamic or kinetic properties of electrode and electrolyte materials are needed. Nuclear systems models are required that model the fission reaction, heat transport, latent radiation, etc. in sufficient detail to predict design efficacy, evaluate engineering solutions, and reduce testing requirements. Creating interfaces between reactor models and engine system models, including radiation effects, and modeling nuclear thermal propulsion ground test engine exhaust filtering and containment are areas of particular interest. Physics based models are sought to predict flow properties of liquid metal or ionic liquids for microfluidic electrospray propulsion systems. Of particular interest are models that describe capillary flow forces as a function of micro-geometry, the characterization of end-to-end velocity profiles in a feed system, viscosity and velocity characterization as a function of thermal gradients, the boundary between flow characteristics determined by micro-fluidic capillary forces and flow characteristics determined by formation and operation of Taylor cones, and fluid properties under steady state and pulsed electric operation at the boundary of Taylor cones. Model validation will also be required; improved measurement techniques needed for validation are also of interest provided they are coupled with a modeling activity outlined above. Tools that exclusively model proprietary systems will not be considered for award.Â Â