Fiscal Year:	FY 2024	**Task Last Updated:**	FY 11/09/2023
PI Name:	Allen, Jeffrey S.		
Project Title:	Reduced-Order Modeling of Interfacial Dynamics to Enable Large-Scale, Mission-Length Simulations of Low-Gravity Propellant Management Using CVB PSI Data		
Division Name:	Physical Sciences		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	None		
Human Research Program Risks:	None		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	49931	**Congressional District:**	1
Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	2022 Physical Sciences NNH22ZDA001N-PSI E.8 Physical Sciences Informatics
Start Date:	10/01/2023	**End Date:**	09/30/2025
No. of Post Docs:		**No. of PhD Degrees:**	
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No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA GRC
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Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Bellur, Kishan Ph.D. (University of Cincinnati)		
Grant/Contract No.:	80NSSC24K0193		
Performance Goal No.:			
Performance Goal Text:			
Task Description:	Current state-of-the-art allows for simulation of liquid-vapor phase change and thermal management of large (1 to 10 meter diameter), low-gravity orbiting propellant depots (LH2 and LOx) for a few seconds with weeks-to-months of computational time. Part of the computational cost arises from having to resolve microscale features (10e-6 meters) on a dynamic liquid-vapor interface (ullage waves and liquid slosh) in order to capture local phase change and heat transfer. The result is an extremely fine mesh on a very large computational domain. The objective of the proposed work is to develop a reduced-order interface model capable of capturing all the relevant physics of interfacial dynamics for two-phase flow in low gravity. We intend to expand a non-linear evolution of the interface using a Eulerian vortex sheet model implemented on an unfitted finite element mesh. The interfacial model will be formulated to integrate mass, momentum, and energy exchange at the interface into an evolution equation for a vortex sheet. The unique configuration,		

	test conditions, and data (imaging and thermal) of the Constrained Vapor Bubble (CVB) experiment conducted on the International Space Station (ISS) can isolate several important instability physical mechanisms, such as Marangoni stresses. CVB data, without the overpowering effect of gravity, will enable incorporation and validation of the nuances of unstable interfacial dynamics to the reduced-order interface model.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	New project for FY2024
Bibliography Type:	Description: (Last Updated: 08/06/2023)