Fiscal Year:	FY 2020	**Task Last Updated:**	FY 08/19/2020
PI Name:	Khusid, Boris Ph.D.		
Project Title:	Advanced Colloids Experiment-Temperature and Gradient Control (ACET11)		
Division Name:	Physical Sciences		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:	COMPLEX FLUIDS/SOFT MATTER--Complex Fluids		
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		
PI Email:	khusid@njit.edu	**Fax:**	FY
PI Organization Type:	UNIVERSITY	**Phone:**	973-596-3316
Organization Name:	New Jersey Institute of Technology		
PI Address 1:	Chemical & Materials Engineering		
PI Address 2:	University Heights		
PI Web Page:			
City:	Newark	**State:**	NJ
Zip Code:	07102-1982	**Congressional District:**	10
Comments:			
Project Type:	FLIGHT	**Solicitation / Funding Source:**	2013 Complex Fluids & Macromolecular Biophysics NNH13ZTT001N
Start Date:	09/01/2019	**End Date:**	08/31/2021
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:	1	**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA GRC
Contact Monitor:	McQuillen, John	**Contact Phone:**	216-433-2876
Contact Email:	john.b.mcquillen@nasa.gov		
Flight Program:	ISS		
Flight Assignment:	ISS--Space X-19		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Chaikin, Paul Ph.D. (New York University) Hollingsworth, Andrew Ph.D. (New York University)		
Grant/Contract No.:	80NSSC19K1655		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	NOTE 1/21/2020: Continuation of "Kinetics of Electric Field-Driven Phase Transitions in Polarized Colloids," grant NNX13AQ53G, with same Principal Investigator Dr. Boris Khusid. Motivation: The widespread use of colloidal processes for scalable manufacturing of structured materials emphasizes a critical need for improving fundamental understanding of the role of external fields in directing non-equilibrium phenomena in suspensions. The challenge is due to kinetic limitations because the particles can be trapped into metastable configurations for a long time due to the lower mobility of multi-particle structures compared to that of individual particles. Microgravity offers a unique opportunity to study these phenomena by removing masking gravity effects, such as particle sedimentation, convection, and jamming. The proposed research addresses both fundamental and technological questions in the science of colloids aimed at understanding the equilibrium and metastable crystalline, liquid, and glassy structures and the use of these materials in additive manufacturing. Objectives: Conduct tests in the International Space Station (ISS) Advanced Colloids Experiment (ACE) facility to elucidate the mechanisms of non-equilibrium phenomena underlying the assembly of colloidal particles assisted by temperature field gradients and suggest novel routes for processing functional materials. Methodology: A novel approach will be used to study mechanisms for formation of metastable and glassy phases in suspensions in the ISS and for comparison on Earth. A single sample will be exposed to a temperature gradient to cover the interesting range of particle densities. As the particle density is directly measured by microscopy, a priori knowledge of the gradient profile is not required. Experiments will involve setting up a temperature gradient to observe the resulting structures and then locally mix a region of known density to watch it glassify or crystallize. Quantitative data on the suspension rheology will come from microrheology measurements through tracking particle thermal motion. Deliverables: Understanding of non-equilibrium phenomena in colloids driven by temperature gradients and experimental database for the control and manipulation of colloidal structures in space and terrestrial applications.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Understanding of non-equilibrium phenomena in colloids driven by temperature gradients and experimental database for the control and manipulation of colloidal structures in space and terrestrial applications.
Task Progress:	The study was conducted within the scope of the originally-proposed research plan. The New Jersey Institute of Technology (NJIT) and New York University (NYU) researchers worked in closed collaboration with researchers from the NASA Glenn Research Center and ZIN Technologies to develop and test hardware, experimental procedures, and samples for microgravity experiments on colloidal crystallization of hard-sphere suspensions in the Fluids Integrated Rack (FIR) and the Light Microscopy Module (LMM) on the International Space Station (ISS). Space X -19 delivered the module equipped with three capillaries filled with colloids to the ISS on Dec 5, 2019.
Bibliography Type:	Description: (Last Updated: 09/17/2023)
Significant Media Coverage	Jenkins J. "Article about PI's flight experiment, 'Researchers take exploration of key 'building block' particles into space.' " Phys Org site, January 9, 2020. https://phys.org/news/2020-01-exploration-key-block-particles-space.html , Jan-2020
Significant Media Coverage	Jenkins J. "Article about PI's flight experiment. 'Researchers take exploration of key 'building block' particles into space.' " EurekAlert! American Association for the Advancement of Science, January 8, 2020. https://www.eurekalert.org/pub_releases/2020-01/njio-rte010820.php , Jan-2020
Significant Media Coverage	Sicker R, Meyer W, Khusid B, Chaikin P, Hollingsworth A. "Advanced Colloid Experiments – (ACE) T11." In: Space Life and Physical Sciences Research and Applications Mission Payloads for SpaceX-19, Dec 6, 2019. https://www.nasa.gov/feature/space-life-and-physical-sciences-research-and-applications-mission-payloads-for-spacex-19 , Dec-2019