Fiscal Year:	FY 2010	**Task Last Updated:**	FY 05/21/2010
PI Name:	Prisk, G. Kim Ph.D., D.Sc.		
Project Title:	Clearance of Particles Depositing in the Human Lung in Low Gravity		
Division Name:	Human Research		
Program/Discipline:	NSBRI		
Program/Discipline--Element/Subdiscipline:	NSBRI--Human Factors and Performance Team		
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **SHFH**:Space Human Factors & Habitability (archival in 2017)		
Human Research Program Risks:	(1) **Dust**:Risk of Adverse Health and Performance Effects of Celestial Dust Exposure (2) **Medical Conditions**:Risk of Adverse Health Outcomes and Decrements in Performance Due to Medical Conditions that occur in Mission, as well as Long Term Health Outcomes Due to Mission Exposures (3) **Renal Stone**:Risk of Renal Stone Formation		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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City:	La Jolla	**State:**	CA
Zip Code:	92093-0852	**Congressional District:**	53
Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	2007 Crew Health NNJ07ZSA002N
Start Date:	06/01/2008	**End Date:**	05/31/2012
No. of Post Docs:	1	**No. of PhD Degrees:**	0
No. of PhD Candidates:	0	**No. of Master' Degrees:**	0
No. of Master's Candidates:	0	**No. of Bachelor's Degrees:**	0
No. of Bachelor's Candidates:	0	**Monitoring Center:**	NSBRI
Contact Monitor:		**Contact Phone:**	
Contact Email:			
Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Bennett, William (University of North Carolina at Chapel Hill) Darquenne, Chantal (University of California, San Diego)		
Grant/Contract No.:	NCC 9-58-HFP01604		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Original Aims: The deposition of particulate matter (PM) in the human lung is known to bring with it both long-term and short-term adverse health consequences. The deposition of particles in the lung is strongly influenced by gravitational sedimentation. Studies by our group have shown that normal gravity provides a screening effect whereby inhaled PM larger than 0.5 micron is mainly deposited in the larger airways where it is cleared by mucociliary clearance transport within ~one day. However in low-gravity, such as that on the surface of the Moon (~1/6G) and Mars (~3/8G), this protective 'gravitational screening' is less efficient, and as a result particles are deposited in the sensitive alveolar regions of the lung where residence times are very much longer. Further, there is evidence that the dust present on the surface of the Moon may possess potent toxicological properties. We hypothesize that clearance rates from the lung of particles deposited in low-gravity will be substantially reduced compared to that in 1G, resulting in increased residence times of these particles in the periphery of the lung, enhancing their potential to cause lung damage. In order to test this hypothesis we propose to measure the clearance rates (measured in 1G) over a few hours to ~1-2 days, of radio-labeled particles deposited in healthy humans both in 1G and in low-gravity corresponding to the lunar surface (~1/6G) during parabolic flight. These data will provide a comprehensive assessment of alterations in the clearance rate of particles inhaled under normal 1G conditions compared to particles inhaled under conditions of lunar gravity (1/6G). Such an assessment is needed to determine the degree of effort and cost required to control lunar dust within a planned lunar outpost. Key Findings: This second year of the project has focused on completing the technical aspects of the project and preparing for flight aboard the Reduced Gravity Aircraft. Much of this has been focused on obtaining the necessary approvals for flight (which proved to be much more challenging than we anticipated, despite us anticipating considerable challenges) and in flight scheduling (which as proved to be virtually impossible). Our current status can be summarized as follows: • CPHS/Radiation approval in place • Subject certifications complete • Hardware and procedures fully tested and functional • Structural issues pending • Ready for flight No Earlier Than July 19, 2010 • Waiting on flight manifesting Year 3 Plan: We hope to fly both the 4 micron particle size objective AND the 1 micron particle size objective in Year 3 of the project. As part of our Year 2 activities, and in response to the extreme difficulty experienced in scheduling reduced gravity flights, we devised and tested (on the ground) a 2-subject-per-flight experimental structure that will permit more efficient use of scarce reduced gravity flight opportunities.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Airborne particulate matter is a health hazard The deposition of particulate matter (PM, often referred to as aerosols) in the human lung is known to bring with it both long-term and short-term adverse health consequences. On Earth, effects of PM-induced lung injury are most readily seen in individuals with pre-existing lung disease (i.e. asthma, chronic obstructive pulmonary disease). Studies suggest that particle-induced inflammation or edema likely enhance underlying pulmonary disease, leading to a worsening of already abnormal pulmonary ventilation/perfusion relationships and gas exchange. Such worsening can result in hypoxemia leading to fatal cardiac arrhythmia. There is also little question, that even healthy individuals exposed to PM for extended periods are susceptible to PM-induced lung injury. For example, the increase in risk of death from long-term exposure to PM in six US cities has been shown to be in the area of 17% for the general population for a modest increase in total PM load of 24.5 micrograms/m3. These studies will directly determine the consequences of a more peripheral site of aerosol deposition on the subsequent clearance of PM from the lung. It is well-established that the negative health consequences of exposure to environmental PM increase as particle size is reduced. These studies will provide insight into how much of this effect is a consequence of the increased residence time of particles that are deposited more peripherally in the lungs. Such peripheral deposition occurs not only on the Lunar surface but here on Earth.
	Task Progress Year 2 of this project has been focused on preparation for flight. The major milestones achieved in this year are summarized as follows: • Received the gamma camera head from the manufacturer (MiE). • Built the necessary structure to hold the camera head in place in the aircraft. • Performed a detailed structural analysis on the gamma camera structure to satisfy the requirements for flight of the Reduced Gravity Office (RGO). • Integrated the camera head into the structure and tested successfully. • In conjunction with the manufacturer, performed hardware and software modifications of the gamma camera system permitting integrated acquisition of the scintillation data and the ancillary data (g-level, flow, subject position, and aerosol generation operation). • Developed and successfully tested software to permit image reconstruction from raw gamma camera data permitting

Task Progress:	us to separate the gamma camera data on the basis of g-level or any other data of interest. Without this our in-flight acquisition would be limited by the integrated nature of the manufacture image capture software. • Built and successfully tested the 4 micron aerosol generation hardware (piezo-electric aerosol generation) incorporating safety hardware for in-flight dosing of subjects with radioactive tracer. • Built and successfully tested the 1 micron aerosol generation hardware (a fundamentally different hardware configuration from that above employing jet nebulization) incorporating safety hardware for in-flight dosing of subjects with radioactive tracer. • Submitted a Test Equipment Data Package to RGO for "pre-approval". • Received informal acceptance of the camera support structure. • Successfully performed end-to-end testing of the experiment for flight using both 4 and 1 micron aerosols and incorporating a 2 subject per day timeline. This is a significant advance over our previously planned single subject operations, and will permit a more efficient use of precious reduced gravity flight opportunities. • Performed all required medical examinations and physiological training of our subject population. • Received NASA Committee on the Protection of Human Subjects (CPHS) approval in January 2010 (including NASA Radiation Safety approval) following initial submission in Feb 2009. Despite these considerable achievements we have been severely hampered by a lack of access to the reduced gravity aircraft. In addition to these technical achievements, Dr Rui-Carlos Pereira de Sá was awarded a NSBRI Post-Doctoral fellowship with Dr G.K. Prisk as his mentor. Abbreviated Statement of Status: • CPHS/Radiation approval in place • Subject certifications complete • Hardware and procedures fully tested and functional • Structural issues pending • Ready for flight No Earlier Than July 19, 2010 • Waiting on flight manifesting
Bibliography Type:	Description: (Last Updated: 03/11/2021)