

Fiscal Year:	FY 2013	Task Last Updated:	FY 04/04/2013
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:	11/30/2012
No. of Post Docs:	1	No. of PhD Degrees:	0
No. of PhD Candidates:	1	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:	<p>Main Findings:</p> <p>In this final year of the project we have finally succeeded in flying the planned experiment in the week August 29 – September 2, 2011. This happened only through extraordinary efforts on our part to secure a week of flight at greatly increased cost. Our progress can be summarized as follows:</p> <ul style="list-style-type: none"> • 1 week of flights (4) successfully performed • 5 high quality data sets out of a possible 8 collected • Gamma camera hardware worked with no anomalies • Minor nebulizer leak on flight 1 – resolved. • Low nebulizer output on flight 3 – cause undetermined, not repeated • Several further attempts at reflight unsuccessful • Successful completion of studies using 4-micron droplets • Studies using 1-micron droplet unable to be manifested • Publication submitted and favorably reviewed, under revision <p>Recommendation: This project has been hampered by the current NASA approach to funding aircraft access involving full payment of flight costs in advance, with costs spread across the payload elements, and with no agency input of backup funding. This produces an unstable condition where a single customer backing out of a flight week raises costs on all others, with resulting further withdrawals, and a cancellation of the flight week. Flight costs need to be considered as a programmatic cost, just as expenses such as beam time at Brookhaven, or the running cost of the bed-rest facility are covered by the program, as opposed to the project.</p>
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	<p>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 micro-g/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.</p>
Task Progress:	<p>This section on task progress deals with the technical aspects of the program. The reader is referred to the Main findings section for Scientific Progress (See Task Description section above).</p> <p>Flight Scheduling Progress</p> <p>Leading up to year 4 of this project, the project had been hamstrung by the problems directly stemming from changes in the NASA policy for accessing the reduced gravity aircraft. In brief, we attempted to fly multiple times with NASA without success. We instituted an attempt to fly the experiment on the European A300, securing European Space Agency (ESA) approval for those flights. After considerable effort this was abandoned in Feb 2011. At the time of the last progress report (April 2011) we articulated our contingency plans for ensuring scientific return from this project in the face of flight difficulties. Our preferred approach (Plan A) was a week of flights in July 2011 and a second week (date TBD). Our second approach (Plan B) was to buy the plane for a single week of flights. This approach had the advantage of flight certainty, but the significant disadvantage of reducing us to a single flight week (based on cost). When the July 2011 flight opportunity offered as part of the FAST program disappeared we opted for Plan B. In order to accomplish this we joined forces with a NASA investigator (Dr. Mark Shelhammer, Johns Hopkins) who was facing similar difficulties in terms of scheduling flights. Between us, we were able to commit a sufficient amount of flight money to guarantee a 3-day flight week (our absolute minimum requirement). Once we committed to this, other customers wanting fewer flight resources came on board because there was certainty the flights would occur. The effect of this was to increase the money pool to a level sufficient to allow a 4-flight week. In the week of August 29 to September 2, 2011 we finally succeeded in flying the experiment using the 4-micron particle size droplets. We subsequently learned of a further pathway to flight via the NASA Flight Opportunities (FO) program. We positioned ourselves for this opportunity, but when the FO program solicitation was released in April 2012, parabolic flight support was (to our great surprise, given previous discussions) explicitly excluded, making this pathway unavailable to us. We have on several occasions explored further routine flight opportunities through NASA Life Sciences (the standard path) with nothing forthcoming. In summary, we have succeeded in completing a 4-flight week of activities in August-Sept 2011. Further attempts to fly have been unsuccessful.</p>
Bibliography Type:	Description: (Last Updated: 03/11/2021)
Abstracts for Journals and Proceedings	<p>Darquenne C, Zeman KL, Sa RC, Cooper TK, Fine JM, Bennett WD, Prisk GK. "Removal of sedimentation decreases deposition of coarse particles in the lung periphery, reducing retention." 2013 NASA Human Research Program Investigators' Workshop, Galveston, TX, February 12-14, 2013.</p> <p>2013 NASA Human Research Program Investigators' Workshop, Galveston, TX, February 12-14, 2013. , Feb-2013</p>
Articles in Peer-reviewed Journals	<p>Darquenne C. "Aerosol deposition in the human lung in reduced gravity." J Aerosol Med Pulm Drug Deliv. 2014 Jun;27(3):170-7. Review. http://dx.doi.org/10.1089/jamp.2013.1079 ; PubMed PMID: 24870702; PubMed Central PMCID: PMC4088354 , Jun-2014</p>
Articles in Peer-reviewed Journals	<p>Lejeune L, Caiani EG, Prisk GK, Migeotte PF. "Evaluation of ensemble averaging methods in 3D ballistocardiography." Conf Proc IEEE Eng Med Biol Soc. 2014 Aug;2014:5176-9. https://doi.org/10.1109/EMBC.2014.6944791 ; PubMed PMID: 25571159 , Aug-2014</p>

Articles in Peer-reviewed Journals	Prisk GK. "Microgravity and the respiratory system." Eur Respir J. 2014 May;43(5):1459-71. Epub 2014 Mar 6. Review. https://doi.org/10.1183/09031936.00001414 ; PubMed PMID: 24603820 , May-2014
Articles in Peer-reviewed Journals	Migeotte PF, Lejeune L, Delière Q, Caiani E, Casellato C, Tank J, Funtova I, Baevsky R, Prisk GK, van de Borne P. "Three dimensional Ballistocardiogram and Seismocardiogram: what do they have in common?" Conf Proc IEEE Eng Med Biol Soc. 2014;2014:6085-8. https://doi.org/10.1109/EMBC.2014.6945017 ; PMID: 25571385 , Aug-2014
Articles in Peer-reviewed Journals	Lejeune L, Prisk GK, Nonclercq A, Migeotte PF. "MRI-based aortic blood flow model in 3D ballistocardiography." Conf Proc IEEE Eng Med Biol Soc. 2015 Aug;2015:7171-4. https://doi.org/10.1109/EMBC.2015.7320046 ; PMID: 26737946 , Aug-2015
Articles in Peer-reviewed Journals	Sá RC, Zeman KL, Bennett WD, Prisk GK, Darquenne C. "Effect of posture on regional deposition of coarse particles in the healthy human lung." J Aerosol Med Pulm Drug Deliv. 2015 Dec;28(6):423-31. Epub 2015 Mar 31. https://doi.org/10.1089/jamp.2014.1189 ; PMID: 25826480 , Dec-2015
Articles in Peer-reviewed Journals	Sá RC, Zeman KL, Bennett WD, Prisk GK, Darquenne C. "Regional ventilation is the main determinant of alveolar deposition of coarse particles in the supine healthy human lung during tidal breathing." J Aerosol Med Pulm Drug Deliv. 2017 Oct;30(5):322-31. Epub 2017 Mar 9. https://doi.org/10.1089/jamp.2016.1336 ; PMID: 28277885 ; PMCID: PMC5650708 , Oct-2017
Articles in Peer-reviewed Journals	Asadi AK, Sá RC, Arai TJ, Theilmann RJ, Hopkins SR, Buxton RB, Prisk GK. "Regional pulmonary perfusion patterns in humans are not significantly altered by inspiratory hypercapnia." J Appl Physiol (1985). 2019 Aug 1;127(2):365-75. https://doi.org/10.1152/japplphysiol.00254.2018 ; PMID: 31169470 ; PMCID: PMC6732437 , Aug-2019
Articles in Peer-reviewed Journals	Prisk GK. "Pulmonary challenges of prolonged journeys to space: taking your lungs to the moon." Med J Aust. 2019 Sep;211(6):271-6. https://doi.org/10.5694/mja2.50312 ; PMID: 31420881 ; PMCID: PMC6745695 , Sep-2019
Articles in Peer-reviewed Journals	Inan OT, Migeotte PF, Park KS, Etemadi M, Tavakolian K, Casanella R, Zanetti J, Tank J, Funtova I, Prisk GK, Di Rienzo M. "Ballistocardiography and seismocardiography: a review of recent advances." IEEE J Biomed Health Inform. 2015 Jul;19(4):1414-27. Epub 2014 Oct 7. https://doi.org/10.1109/JBHI.2014.2361732 ; PMID: 25312966 , Jul-2015
Articles in Peer-reviewed Journals	Darquenne C, Prisk GK. "Particulate deposition in the human lung under lunar habitat conditions." Aviat Space Environ Med. 2013 Mar;84(3):190-5. PubMed PMID: 23513279 , Mar-2013
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Awards	Prisk GK. "ARTP Lifetime achievement award for services to respiratory science, January 2012." Jan-2012