Fiscal Year:	FY 2007	**Task Last Updated:**	FY 06/05/2008
PI Name:	Rubin, Clinton Ph.D.		
Project Title:	A Low Intensity Mechanical Countermeasure to Prohibit Osteoporosis in Astronauts During Long-Term Spaceflight		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Biomedical countermeasures		
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	(1) **Bone Fracture**:Risk of Bone Fracture due to Spaceflight-induced Changes to Bone (2) **Osteo**:Risk Of Early Onset Osteoporosis Due To Spaceflight		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
PI Email:	clinton.rubin@sunysb.edu	**Fax:**	FY 631-632-8577
PI Organization Type:	UNIVERSITY	**Phone:**	631-632-8521
Organization Name:	State University of New York		
PI Address 1:	Department of Biomedical Engineering		
PI Address 2:	Center for Biotechnology		
PI Web Page:	http://www.bme.sunysb.edu		
City:	Stony Brook	**State:**	NY
Zip Code:	11794-2580	**Congressional District:**	1
Comments:			
Project Type:	FLIGHT	**Solicitation / Funding Source:**	ILSRA 2001
Start Date:	03/15/2004	**End Date:**	03/15/2007
No. of Post Docs:	1	**No. of PhD Degrees:**	1
No. of PhD Candidates:	2	**No. of Master' Degrees:**	1
No. of Master's Candidates:	0	**No. of Bachelor's Degrees:**	0
No. of Bachelor's Candidates:	1	**Monitoring Center:**	NASA JSC
Contact Monitor:	McCollum, Suzanne	**Contact Phone:**	281 483-7307
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Flight Program:			
Flight Assignment:	In flight development phase (not yet manifested) NOTE: end date changed to 3/15/07 per info from PI (6/08)		
Key Personnel Changes/Previous PI:	0		
COI Name (Institution):	Judex, Stefan (State University of New York at Stony Brook) Qin, Yi-Xian (State University of New York at Stony Brook)		
Grant/Contract No.:	NNJ04HD87A		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Osteoporosis, the progressive loss of bone density and strength that cripples tens of millions on our planet, distinguishes itself as perhaps the greatest physiologic obstacle to an extended human presence in space. The principal objectives of this proposal are to establish the efficacy of a unique, mechanical countermeasure to inhibit bone loss - and muscle strength- in the lower appendicular skeleton of astronauts and payload specialists during International Space Station missions. Using a ground based model of microgravity, the tail-suspended rat, we have shown that brief exposure (10 minutes) to extremely low magnitude (0.25g, engendering <5 microstrain), high frequency (30-90 Hz) mechanical signals will inhibit the bone loss which typically parallels disuse, even though 10 minutes of full weightbearing failed to curb this loss. Longer-term experiments in sheep have shown this stimulus to be strongly anabolic, increasing bone mineral density, trabecular number and connectivity, and improving bone strength. Preliminary results in post-menopausal women and children with cerebral palsy indicate that this intervention can inhibit, and perhaps reverse, osteoporosis. To determine this intervention's ability to inhibit bone loss - and muscle strength - in people during prolonged space missions, we will subject astronauts, in single let stance, to brief exposures to the low level stimulus (10 minutes at 30 Hz, 0.3g), allowing the contralateral limb to serve as an intra-subject control. The proposal is structured to "piggy-back" onto ongoing flight studies, and thus the assays for efficacy will be determined by collaborative decisions between NASA teams studying the musculoskeletal system. At a minimum, DXA, QCT, and muscle strength measurements will be made both pre- and post- flight. This work represents a critical step in establishing a physiologically based, non-pharmacologic, non-invasive treatment for osteoporosis, for use on Earth or in space.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	The intervention represents the basis for a non-pharmacologic interevention for the prevention and/or reversal of bone loss (osteoporosis) here on earth. Three clinical studies have been completed (post-menopausal women, children with cerebral palsy, young women w/ osteoporosis), each which supports the hypothesis that low-level mechanical signals can benefit the mass and morphology of the musculoskeletal system.
Task Progress:	Project ended sometime in early 2007.
Bibliography Type:	Description: (Last Updated: 10/22/2009)
Abstracts for Journals and Proceedings	Muir, J., Evans, H., Judex, S., Qin, Y-X., Lang, T, Rubin, CT. "Extended Bed-Rest, Like Spaceflight, Causes Rapid and Significant Loss of Bone Mineral Density and Postural Control." 28th Annual Meeting of the American Society for Bone and Mineral Research, Philadelphia, Pennsylvania, September 15-19, 2006. Abstracts of the 28th Annual Meeting of the American Society for Bone and Mineral Research, September 2006. , Sep-2006
Abstracts for Journals and Proceedings	Qin, Y-X., Xia, Y, Lin, W., Evans, H., Judex, S., & Rubin, C. "Bone Quality and Quantity Assessment in 90-Day Bed Rest Using Confocal Scanning Ultrasound System and DEXA Measurement." 28th Annual Meeting of the American Society for Bone and Mineral Research, Philadelphia, Pennsylvania, September 15-19, 2006. Abstracts of the 28th Annual Meeting of the American Society for Bone and Mineral Research, Sept 2006. , Sep-2006
Abstracts for Journals and Proceedings	Muir J, Judex S, Qin Y, Rubin CT. "Safety of Whole Body Vibration, Considered for the Prevention and/or Treatment of Osteoporosis, Relative to Standards Set by the International Safety Organization." 28th Annual Meeting of the American Society for Bone and Mineral Research, Philadelphia, Pennsylvania, September 15-19, 2006. Abstracts of the 28th Annual Meeting of the American Society for Bone and Mineral Research, Sept 2006. , Sep-2006
Abstracts for Journals and Proceedings	Rubin CT. "Mechanical Signals as the Basis for a Non-Pharmacologic Treatment for Osteoporosis." Translational Research Symposium for the 28th Annual Meeting of the American Society for Bone and Mineral Research, Philadelphia, Pennsylvania, September 15-19, 2006. Abstracts, Translational Research Symposium for the 28th Annual Meeting of the American Society for Bone and Mineral Research, Sept 2006. , Sep-2006
Abstracts for Journals and Proceedings	Rubin C. "Harnessing mechanobiology: anabolic potential of low-level mechanical signals as a therapy for osteoporosis." 12th Annual Canadian Connective Tissue Conference, University of Ottawa, Ottawa, Canada, May 25-26, 2006. Abstracts, 12th Annual Canadian Connective Tissue Conference, May 2006, p. 36. , May-2006
Abstracts for Journals and Proceedings	Holguin N, Muir J, Evans H, Qin Y-X, Rubin C, Wagshul M, Judex S. "Volume changes of intervertebral disc, muscle and adipose tissue under long term bedrest." 2006 Annual Fall Meeting of the Biomedical Engineering Society, Chicago, Illinois, October 11-14, 2006. Proceedings, 2006 Annual Fall Meeting of the Biomedical Engineering Society, Chicago, Illinois, October , 2006. , Oct-2006
Abstracts for Journals and Proceedings	Patel M, Tlish R, Rubin C, Jo H. "Low-magnitude, high frequency mechanical vibration prevents simulated microgravity-induced decrease in a bone formation response in osteoblasts. " 57th International Astronautical Congress, Valencia, Spain, October 2-6, 2006. Transactions, 57th International Astronautical Congress, October 2006. , Oct-2006
Articles in Peer-reviewed Journals	Rubin C, Judex S, Qin YX. "Low-level mechanical signals and their potential as a non-pharmacological intervention for osteoporosis." Age Ageing. 2006 Sep;35 Suppl 2:ii32-ii36. PMID: 16926201 , Sep-2006
Books/Book Chapters	Rubin C, Rubin J. "Biomechanics and mechanobiology of bone." in "Primer on the Metabolic Bone Diseases and Disorders of Mineral Metabolism, Sixth Edition." Ed. M. Fauvus. Washington, D.C. : American Society of Bone & Mineral Research, c2006. pp. 36-42., Jun-2006
Books/Book Chapters	Qin Y-X, Lin W, Mittra E, Xia Y, Rubin C, Mueller R. "Non-invasive Bone Quality Assessment Using Quantitative Ultrasound Imaging and Acoustic Parameters." in "Advanced Bioimaging Technologies in Assessment of the Quality of Bone and Scaffold Materials." Ed. L. Qin et al. Springer, in press. Due to be published May 2007., May-2007