Fiscal Year:	FY 2014	**Task Last Updated:**	FY 07/29/2014
PI Name:	Williams, Jason Ph.D.		
Project Title:	Fundamental Interactions for Atom Interferometry with Ultracold Quantum Gases in a Microgravity Environment		
Division Name:	Physical Sciences		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:	FUNDAMENTAL PHYSICS--Fundamental physics		
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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City:	Pasadena	**State:**	CA
Zip Code:	91109-8001	**Congressional District:**	27
Comments:			
Project Type:	FLIGHT	**Solicitation:**	2013 Fundamental Physics NNH13ZTT002N (Cold Atom Laboratory--CAL)
Start Date:	04/01/2014	**End Date:**	05/03/2019
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:		**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JPL
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Flight Program:	ISS		
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	D'Incao, Jose Ph.D. (University of Colorado)		
Grant/Contract No.:	Internal Project		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Understanding of the effects of interatomic interactions is becoming increasingly important for the broad range of studies with ultracold quantum gases. Rapid progress in these studies is attributed to the unprecedented level of control over the interatomic interactions, which has been translated into development of the next-level instruments for precision metrology as well as triggered the creation of novel quantum phases and the deeper understanding and control of chemical reactions. Our proposed studies explore fundamental aspects of the interactions that, perhaps, can only be accessible in the microgravity environment of the NASA's multi-user Cold Atom Laboratory. In the first part of our proposed flight experiment, we will investigate the association/dissociation dynamics of weakly bound heteronuclear diatomic molecules in microgravity to produce dual-species gases with unprecedented overlap in both position and momentum space. This technology would overcome one of the greatest sources of systematic uncertainty in future precision tests of the Weak Equivalence Principle with atom interferometry. We also plan to study a novel method of canceling nonlinear effects due to few-body interactions that can extend the coherence times of dense atomic gases for even more precise metrology applications, enabling next-generation tests of the principles of Einstein's Theory of General Relativity with atomic clocks and atom interferometers. In the second part of our proposal, we plan to explore the physics of Boson-mediated interactions allowing for fundamental studies of the pairing mechanisms affecting both few- and many-body nature of the system. Our proposed studies require the effective position invariance and/or the extremely low temperature samples generated by the CAL apparatus. We believe that our proposed studies can lead to an unprecedented level of control and accuracy necessary to explore some of the most fundamental physical concepts in nature and open up venues for exploration of novel quantum phases in exotic dynamical regimes.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	0
Task Progress:	New project for FY2014.
Bibliography Type:	Description: (Last Updated: 05/02/2019)