Project Contex, Sylvain Ph.D. Project Title: Bios-based Multi-scale Model for Cancer Risk from GCR in Guercically Divene Populations Division Name: Human Recearch Program Dice/plina- Element Sylvatholispine: HUMAN RESERRCH-Radiation health Joint Agency Name: IV See Spee Radiation Human Research Program Rikes: (1) Ste Spee Radiation Human Research Program Rikes: (1) Concer-Risk of Radiation Cancinogenesis Space Biology Cross-Element None Space Biology Cross-Element Sylvati acouthy Zohna Space Special Cattery Parker PI Andres 1: Value acouthy Zohna Space Institute of	Fiscal Year:	FY 2017	Task Last Undeted.	FY 04/19/2017
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Space Biology Element: None Space Biology Special Category: None PI Email: sylvain acoutes (glmms): ong Fax: PY Corpanization Type: GOVERNMENT Phone: 650-604-5343 Organization Type: GOVERNMENT Phone: 650-604-5343 Organization Name: Blue Marble Space Institute of Science Phone: 650-604-5343 Organization Name: Blue Marble Space Institute of Science Phone: 650-604-5343 Organization Name: Blue Marble Space Institute of Science Phone: 650-604-5343 Organization Name: Blue Marble Space Institute of Science Phone: 650-604-5343 Organization Name: Blue Marble Space Institute of Science Phone: 650-604-5343 Organization Name: Blue Marble Space Institute of Science Phone: 650-604-5343 Construct Seatule State: WA Zip Code: 98104 Congressional 7 7 Comments: Nord Phone: Soulcitation / Funding: 2014-15 HERO NN14/2SA001N-RADIATION. Source: Soulcitation / Funding: 2014-15 HERO NN14/2SA001N-RADIATION. No. of PhD Decares:	Human Research Program Elements:	(1) SR:Space Radiation		
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PI Email: sylvain costes//bmais.org Fax: FY PI Organization Type: GOVERNMENT Phone: 650-604-5343 Organization Name: Blue Marble Space Institute of Science	Space Biology Cross-Element Discipline:	None		
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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 JSC Contact Monitor: Simonsen, Lisa Contact Phone: Contact Email: Jisa.c.simonsen@masa.gov Flight Program: Flight Assignment: Flight Assignment: NOTE: The lab moved from Lawrence Berkeley National Lab (LBNL) to NASA Ames Research Center in 2017, where it was established as the Radiation Biophysics Lab in Space Biosciences Division. Dr. Costes will continue collaborating with LBNL and some funding will be left at LBNL to cover more plate processing in collaboration with Dr. Weil (CSU) and for support from Col Dr. Snijders for the writing of the animal data. April 2017 report: - Elodie Guiet was a full time technician with a Bachelor in microbiology and biotechnology, working on this project from March 2016 until February 2017 she did not stay on the project when the lab moved to NASA Ames; - Louise Viger was a Postdoc working partly on this project from June 2016 to January 2017 she was only here for a quick postdoc, focused primarily on modeling ;- Charlotte Degore was a Postdoc working on data analysis visiting scientist for 1 month ; - Sebastien Penninckx was a PhD Student who has been helping on data analysis visiting scientist for 1 month ; - Sebastien Penninckx was a PhD Student who has been helping on data analysis visiting scientist for 1 month ; - Sebastien Penninckx was a PhD Student who has been helping on data analysis visiting scientist for 1 month ; - Sebastien Penninckx was a PhD Student who has been helping on data analysis visiting scientist for 1 month ; -	Start Date:	02/04/2016	End Date:	02/03/2019
No. of PhD Candidates: 1 Degrees: No. of Master's Candidates: No. of Bachelor's Degrees: No. of Bachelor's Candidates: Monitoring Center: NASA JSC Contact Monitor: Simonsen, Lisa Contact Phone: Contact Email: lisa.c.simonsen@nasa.gov Flight Program: Isa.c.simonsen@nasa.gov Flight Assignment: VOTE: The lab moved from Lawrence Berkeley National Lab (LBNL) to NASA Ames Research Center in 2017, where it was established as the Radiation Biophysics Lab in Space Biosciences Division. Dr. Costes will continue collaborating will be left at LBNL to cover more plate processing in collaboration with Dr. Weil (CSU) and for support from Col Dr. Snijders for the writing of the animal data. April 2017 report: - Elodic Guiet was a full time technician with a Bachelor in microbiology and biotechnology, working on this project from March 2016 until February 2017 she did not stay on the project when the lab moved to NASA Ames ; - Louise Viger was a Postdoc working partly on this project from June 2016 to January 2017 she was only here for a quick postdoc, focused primarily on modeling ; - Charlotte Degore was a Postdoc who helped executing BNL run 16C visiting scientist for 1 month ; - Sebastien Penninckx was a PhD student who has been helping on data analysis visiting scientist for 3 months ; - Shayoin Ray is a new recruit at NASA Ames, postdoctral fullor working on doing genomic analysis between animal DNA repair phenotypic data and their individual genes new postdoc full time at NASA Ames, started on April 10 2017	No. of Post Docs:	3	No. of PhD Degrees:	3
No. of Bachelor's Candidates: Degrees: No. of Bachelor's Candidates: Monitoring Center: NASA JSC Contact Monitor: Simonsen, Lisa Contact Phone: Contact Email: Iisa.c.simonsen@nasa.gov Flight Program: Filight Assignment: Flight Assignment: NOTE: The lab moved from Lawrence Berkeley National Lab (LBNL) to NASA Ames Research Center in 2017, where it was established as the Radiation Biophysics Lab in Space Biosciences Division. Dr. Costes will continue collaborating with LBNL and some funding will be left at LBNL to cover more plate processing in collaboration with Dr. Weil (CSU) and for support from Col Dr. Snijders for the writing of the animal data. April 2017 report: - Elodie Guiet was a full time technician with a Bachelor in microbiology and biotechnology, working on this project from March 2016 until February 2017 she did not stay on the project when the lab moved to NASA Ames; 1- Louise Viger was a Postdoc working partly on this project from June 2016 to January 2017 she was only here for a quick postdoc, focused primarily on modeling ; - Charlotte Degore was a Postdoc who helped executing BNL run 16C visiting scientist for 1 month; - Sebastion Penninckx was a Postdoc who has been helping on data analysis visiting scientist for 3 months; - Shayoni Ray is a new recruit at NASA Ames, postdoctral fellow working on doing genomic analysis between animal DNA repair phenotypic data and their individual genes new postdoc full time at NASA Ames, started on April 10 2017	No. of PhD Candidates:	1		
Contact Monitor: Simonsen, Lisa Contact Phone: Contact Email: Iisa.c.simonsen@nasa.gov Flight Program: Flight Program: Flight Assignment: View Cover more plate processing in collaboration, Dr. Costes will continue collaborating with LBNL and some funding will be left at LBNL to cover more plate processing in collaboration with Dr. Weil (CSU) and for support from Col Dr. Snijders for the writing of the animal data. April 2017 report: - Elodie Guiet was a full time technician with a Bachelor in microbiology and biotechnology, working on this project from March 2016 until February 2017 she did not stay on the project when the lab moved to NASA Ames; - Louise Viger was a Postdoc working partly on this project from June 2016 to January 2017 she was only here for a quick postdoc, focused primarily on modeling; - Charlotte Degorre was a Postdoc who helped executing BNL run 16C visiting scientist for 1 month; Sebasten Penninckx was a PhD student who has been helping on data analysis visiting scientist for 3 months; Shayoni Ray is a new recruit at NASA Ames, postdoctoral fellow working on doing genomic analysis between animal DNA repair phenotypic data and their individual genes new postdoc full time at NASA Ames, started on April 10 2017	No. of Master's Candidates:			
Contact Email:Lisa.e.simonsen@nasa.govFlight Program:Flight Assignment:Flight Assignment:Key Personnel Changes/Previous PI:Key Personnel Changes/Previous PI:Contact Email:Contact Email:Contact Email:NOTE: The lab moved from Lawrence Berkeley National Lab (LBNL) to NASA Ames Research Center in 2017, where it was established as the Radiation Biophysics Lab in Space Biosciences Division. Dr. Costes will continue collaborating with LBNL and some funding will be left at LBNL to cover more plate processing in collaboration with Dr. Weil (CSU) and for support from Col Dr. Snijders for the writing of the animal data. April 2017 report: - Elodie Guiet was a full time technician with a Bachelor in microbiology and biotechnology, working on this project from March 2016 until February 2017 she did not stay on the project when the lab moved to NASA Ames; - Louise Viger was a Postdoc working partly on this project from June 2016 to January 2017 she was only here for a quick postdoc, focused primarily on modeling; - Charlotte Degorre was a Postdoc who helped executing BNL run 16C visiting scientist for 1 month ; - Sebastien Penninckx was a PhD student who has been helping on data analysis visiting scientist for 1 month ; - Shayoni Ray is a new recruit at NASA Ames, postdoctoral fellow working on doing genomic analysis between animal DNA repair phenotypic data and their individual genes new postdoc full time at NASA Ames, started on April 10 2017COL Name (Institution):Pluth, Janice Ph.D. (Lawrence Berkeley National Laboratory)	No. of Bachelor's Candidates:		Monitoring Center:	NASA JSC
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	COI Name (Institution):)

Grant/Contract No.:	NNJ16HP24I		
Performance Goal No.:			
Performance Goal Text:			
Task Description:	Crews on future exploration missions to Mars and other destinations in our solar system will be exposed to acute low doses (<100 mSv) and chronic low doses (<0.1 mSv/min) of high-LET (linear energy transfer) ionizing radiation from solar particle events (SPE) and galactic cosmic radiation (GCR). Predicting cancer risk associated with these radiation types is a mission-critical challenge for NASA radiation health scientists and mission planners. Epidemiological methods lack sensitivity and power to provide detailed risk estimates for cancer, mainly because the number of exposed individuals to date is relatively small, limited to several hundred individuals exposed to trapped radiation in low Earth orbit and fewer than two dozen Apollo astronauts exposed to GCR for several days at a time. Moreover, population-based studies do not take individual radiation sensitivity into account, are sensitive to the presence of other confounding environmental insults, and require long follow-up times. In collaboration with the radiation Biodosimetry Laboratory and the modeling group at NASA Johnson Space Center and with the International Computer Science Institute (ICSI) at University of California (UC) Berkeley, our team will bring unique inter-disciplinary experites to integrate the large array of cancer data generated over the past 25 years and archived by NASA under the various Human Research Program (HRP) funded projects. The main goal of this proposal is to identify factors influencing radiation-induced carcinogenesis and integrate them into a multi-scale model laready started at the Berkeley Lab that encompasses DNA damage response and inter-cellular signaling to predict cancer risk for any types of HZE (high energy particles). Because experimental data redispresed across many different cancer models, radiation qualities, and measurement types, this project will also generate a complete set of experimental data designed to fully inform and validate the model. In this project, the model will impose the types of measuremen		
Rationale for HRP Directed Research:			
Research Impact/Earth Benefits:	A current radiobiology challenge is the ability to predict cancer risk associated with exposure to acute (<100 mSv) and chronic (<0.1 mSv/min) low doses of high-LET ionizing radiation. Epidemiological methods lack the sensitivity and power to provide detailed risk estimates for cancer, mainly because the astronaut cohort exposed to galactic cosmic rays (GCR) is relatively small. Moreover, population-based studies do not take individual radiation sensitivity into account, are affected by the presence of other confounding environmental insults, and require long follow-up times. We have hypothesized that characterizing the dose and time dependence of 53BP1 radiation induced foci (RIF) after exposure to a systematic array of X-ray doses and time points is sufficient to describe someone's ability to respond to any other LET. The main concept is that the non-physiological response to low and high doses of radiation is modulated by different pools of genes. Such work provides a new approach combining novel biomarkers with sophisticated mathematical analysis to better characterize individual sensitivity to space radiation. Once validated across mice and eventually a large cohort of humans, this approach could be generalized to establish individualized health risk management for astronauts and for the population at large being exposed to ionizing radiation.		
Task Progress:	Skin fibroblast cells were extracted and cultivated from 72 individual mice. This cohort was made on average of 3 males and 3 females from 15 different strains of mice with various genetic backgrounds, including the collaborative cross (CC) genetic model (10 strains) and five known reference mice. Cells were exposed to two fluences of three HZE particles at Brookhaven National Laboratory (Si 350MeV/n, Ar 350MeV/n and Fe 600 MeV/n) and to 0.1, 1, and 4 Gy from 160 kV X-ray at Lawrence Berkeley National Laboratory. Individual radiation sensitivity was investigated by DNA repair kinetics high throughput measurement evaluating RIF numbers at various time following the different doses and fluences for each radiation type. The high-LET particle dose response shows a linear dependence that is unchanged and very close to the number of track per cell for both 4 and 8 hours post-irradiation, even though each track are known to induce multiple DNA double strand breaks (DSB). By comparing the slope of the high-LET dose dependence to the expected number of tracks per cell for each dose, we propose a new approach where the number of remaining unrepaired tracks are evaluated against the time post-irradiation. The results obtained using this approach show that the percentage of unrepaired track over a 48 hours follow-up is strain dependent and is slower as the LET increases. We also observe a strong correlation between the high dose repair kinetic following exposure to 160 kV X-ray and the repair kinetic of tracks, with an increasing correlation with higher LET. At the in-vivo level for the 10 CC strains, we observe that drops in the number of T-cells and B-cells found in the blood of mice 24 hours after exposure to 0.1 Gy of 320 kV X-ray correlate well with slower DNA repair kinetic found in skin is a surrogate marker for in vivo radiation sensitivity in other tissue, such as blood cells and such response is modulated by genetic. On the other hand, different genes seem to be		

involved for low dose of low-LET sensitivity versus high dose low-LET or high-LET sensitivity. This work also validates our hypothesis showing that DNA repair kinetic following high doses of X-ray is an accurate predictor for radiation sensitivity to high-LET when evaluated on cell culture.

Single-nucleotide polymorphism arrays are currently being used to identify potential pools of genes responsible for radiation sensitivity to low-LET and/or high-LET. To the best of our knowledge, this work is one of the most extensive studies done on such a large animal genetic diversity regarding both low dose radiation and high-LET.

NOTE: The lab moved from Lawrence Berkeley National Lab (LBNL) to NASA Ames Research Center in 2017, where it was established as the Radiation Biophysics Lab in Space Biosciences Division. Dr. Costes will continue collaborating with LBNL and some funding will be left at LBNL to cover more plate processing in collaboration with Dr. Weil (CSU) and for support from CoI Dr. Snijders for the writing of the animal data.

Bibliography Type:

Description: (Last Updated: 05/01/2025)