

# **IAF/IAA Space Life Sciences Symposium 2021**

Held at the 72nd International Astronautical Congress  
(IAC 2021)

Dubai, United Arab Emirates  
25-29 October 2021

ISBN: 978-1-7138-4294-1

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© (2021) by International Astronautical Federation  
All rights reserved.

Printed with permission by Curran Associates, Inc. (2022)

For permission requests, please contact International Astronautical Federation  
at the address below.

International Astronautical Federation  
100 Avenue de Suffren  
75015 Paris  
France

Phone: +33 1 45 67 42 60  
Fax: +33 1 42 73 21 20

[www.iafastro.org](http://www.iafastro.org)

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2633  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

# TABLE OF CONTENTS

## **1.BEHAVIOUR, PERFORMANCE AND PSYCHOSOCIAL ISSUES IN SPACE**

THE ICE-Q: A TOOL FOR THE ASSESSMENT OF PSYCHOLOGICAL ADAPTATION PROCESSES (PAP) IN ISOLATED AND CONFINED EXTREME (ICE) ENVIRONMENTS .....	1
<i>Michel Nicolas, Guillaume Martinent, Peter Suedfeld, Marvin Gaudino, Lou Perrot</i>	
COMPARISON OF THE CREW-MCC COMMUNICATION PARAMETERS DURING ROUTINE AND STRESSFUL DAYS .....	2
<i>Natalya Supolkina, Angelina Chekalina, Vadim Gushin, Dmitry Shved, Anna Yusupova, Elena Fomina</i>	
GENERAL TENDENCIES IN EXTERNAL COMMUNICATION OF THE AUTONOMOUS CREWS UNDER SIMULATION OF INTERPLANETARY MISSIONS .....	8
<i>Dmitry Shved, Anna Yusupova, Natalya Supolkina, Alexandra Savinkina, Svetlana Lebedeva, Angelina Chekalina, Vadim Gushin, Elena Fomina</i>	
RE-PAIRING TO REPAIR: A COUNTERMEASURE THAT ENHANCES CREW RELATIONS IN DEEP SPACE .....	17
<i>Brennan Antone, Alina Lungeanu, Leslie Dechurch, Suzanne Bell, Noshir Contractor</i>	
SEXUAL WELLBEING & SEXUAL SECURITY IN ISOLATION & CONFINEMENT ENVIRONMENTS (SWICE).....	28
<i>Dorothee Grevers, Till Amelung, Martina Anna Maggioni, Nathalie Pattyn, Hanns-Christian Gunga</i>	
ANALOGUE EVA RESULTS FROM HI-SEAS FOR DEVELOPMENT OF THE RXEVA HUMAN FACTORS SUBSYSTEM.....	29
<i>Lea Smart Miller, Nikolas Blanks, Ryan Kobrick, Erik Seedhouse</i>	
MULTI-SENSORY VIRTUAL REALITY ENVIRONMENT FOR THE MAINTENANCE OF LONG-TERM BEHAVIORAL HEALTH.....	40
<i>Renee Woodruff, Colton Duncan, Diego Robledo, Ana Diaz Artilles</i>	
THE EFFECT OF MICROGRAVITY ON VISUAL SEARCH GUIDED BY AUGMENTED REALITY.....	52
<i>Daniela Markov-Vetter</i>	

## **2.HUMAN PHYSIOLOGY IN SPACE**

CHANGES IN THE NIGHT SLEEP ARCHITECTURE AND BLOOD PRESSURE DURING 21-DAY DRY IMMERSION .....	53
<i>Evgeny Bersenev, Gennady Kovrov, Ukraintseva Yulia, Posokhov Sergey, Galina Vassilieva, Josef Yakhya, Grechkovskaya Dariya, Konstantin Pikalov, Artemy Orlov, Elena Tomilovskaya, Ilya Rukavishnikov, Oleg Orlov</i>	
EFFECTS OF THE LONG SPACE FLIGHTS ON THE HINDLIMB SKELETAL MUSCLES. ....	55
<i>Muhammad Azeem, Rizwan Qaisar, Asima Karim, Anu Ranade, Adel Elmoselhi</i>	
A COMPUTATIONAL MODEL-BASED FRAMEWORK FOR HOLISTIC MITIGATION OF SPATIAL DISORIENTATION IN SENSORY-DEPRIVED ENVIRONMENTS.....	56
<i>Jordan Dixon, Torin Clark, Tristan Endsley</i>	

ALTERATION OF THE RELATIONSHIP BETWEEN VENTRICULAR REPOLARIZATION AND HEART RATE INDUCED BY 60-DAY HEAD-DOWN BED REST .....	68
<i>Sarah Solbiati, Pierre Vaïda, Lorenzo Costantini, Enrico Gianluca Caiani</i>	
MICROGRAVITY-INDUCED REDUCED JUGULAR VEIN FLOW IS MORE PRONOUNCED ON THE NON-DOMINANT SIDE .....	76
<i>Mimi Lan, Mike Van Akin, Jay Buckley, Allison Anderson</i>	
INVESTIGATING THE EFFECTS OF PAIRED HEEL-RAISE AND SQUAT EXERCISE FOLLOWING CENTRIFUGATION ON CEREBROVASCULAR FLOW USING A SHORT-ARM HUMAN CENTRIFUGE (SAHC).....	81
<i>Donya Naz Divsalar, Farshid Sadeghian, Malcom Tremblay, Andrew Blaber</i>	
STUDY OF THE DYNAMICS OF BIOCHEMICAL MARKERS OF BONE METABOLISM IN THE PARTICIPANTS OF A 120-DAY ISOLATION IN A HERMETICALLY CLOSED CHAMBER (SIRIUS-19).....	85
<i>Galina Vassilieva, Rinat Gimadiev, Daria Sidorenko, Agaptseva Tatiana, Kirill Gordienko, Oleg Orlov</i>	
BUILDING CAPACITIES IN HUMAN SPACEFLIGHT IN THE UAE: MBRSC SPONSORED MBRU COLLABORATIVE PROJECTS .....	86
<i>Stefan Du Plessis</i>	
COSMONAUTS WITH ORBITAL FLIGHT EXPERIENCE WILL BE MORE SUCCESSFUL IN PERFORMING MARS MISSION TASKS .....	87
<i>Elena Fomina, Kryuchkov Boris, Tatyana Kukoba, Alexey Grishin, Maksim Kharlamov</i>	
ADAPTIVE CHANGES IN THE PARAMETERS OF THE CARDIOVASCULAR SYSTEM DURING THE ACUTE PERIOD OF ADAPTATION TO WEIGHTLESSNESS AND DURING THE PERIOD OF RECOVERY AFTER SHORT-TERM SPACE FLIGHT .....	95
<i>Elena Luchitskaya, Anna Kussmaul, Hazza Al Mansoori, Mariam Al Zarouni, Noora Al Rafi, Saeed Karmustaji, Salem Humaid Al Marri</i>	
<b><u>3.MEDICAL CARE FOR HUMANS IN SPACE</u></b>	
COCHLEAR FUNCTIONAL STATUS TESTING USING DIFFERENT CLASSES OF OTOACOUSTIC EMISSION AS A PROMISING METHOD FOR INTRACRANIAL PRESSURE MONITORING DURING SPACEFLIGHT .....	98
<i>Liliia Marchenko</i>	
METHODOLOGICAL INNOVATION/ADAPTATION FOR SYSTEMATIC REVIEWS FOR SPACE MEDICINE .....	99
<i>Mona Nasser, Anna Fogtman, Alexandra Bannach-Brown, Diana Donovan, Murray Mackay</i>	
KYMIRA: ASTRONAUT PHYSIOLOGICAL HEALTH MONITORING USING SMART UNDERLAYER GARMENT .....	108
<i>Ashfaq Gilkar</i>	
FRIDGE – THE NEXT GENERATION FREEZER / REFRIGERATOR / INCUBATOR FOR FOOD AND EXPERIMENT CONDITIONING ONBOARD THE ISS .....	115
<i>Tobias Niederwieser, Robert Aaron, Stefanie Countryman, Shankini Doraisingam, Howard Fultz, Ryan Griffith, Alexander Hoehn, Mark Rupert, Jim Wright, Louis Stodieck</i>	
MEDICAL SUPPORT OF EXPERIMENTS IN THE CONDITIONS OF DRY IMMERSION AS A MODEL FOR IDENTIFYING THE MEDICAL RISKS OF SPACE FLIGHT .....	120
<i>Ilya Rukavishnikov, Roman Chernogorov, Inna Nosikova, Elena Tomilovskaya, Oleg Orlov</i>	

THE HEART RATE VARIABILITY VALUES ALTERATION DURING 8-HOUR COMPENSATION OF THE EARTH'S MAGNETIC FIELDS .....	121
<i>Evgeny Bersenev, Andrey Vasin, Margarita Onuchina, Vladislav Kukanov, Oleg Orlov</i>	
ASSESSMENT OF THE FUNCTIONAL STATE OF THE CENTRAL NERVOUS SYSTEM IN VOLUNTEERS UNDER NOISE EXPOSURE .....	126
<i>Liliia Marchenko</i>	
RADIATION ADAPTIVE RESPONSE PHENOMENON AND INDIVIDUAL RADIOSENSITIVITY .....	127
<i>Krzysztof Fornalski</i>	
PHARMACEUTICAL STABILITY AFTER EXPOSURE TO VACUUM.....	128
<i>Jennifer Fleischer, Claire Ellis, Dan Buckland</i>	
DEVICES FOR CARDIOVASCULAR CONTROL: WHEN SPACE AND EARTH TACKLE COMMON CHALLENGES.....	134
<i>Tanya Scalia, Lucia Bonventre, Maria Letizia Terranova</i>	

#### **4.MEDICINE IN SPACE AND EXTREME ENVIRONMENTS**

SPACE MEDICINE FOR AUSTERE I.C.E (ISOLATED, CONFINED, ENVIRONMENTS: TRAINING ANALOG ASTRONAUTS MARS MEDICS TEAMS IN HIGH-FIDELITY ANALOG MISSIONS IN NEPAL, HIMALAYAS - A CASE STUDY FOR FUTURE PLANETARY SURFACE EXPEDITIONS.....	145
<i>Susan Ip-Jewell</i>	
COPING WITH ISOLATION DURING COVID-19: A GLOBAL SPACE ANALOGY .....	146
<i>Karoly Schlosser, Elena Antonova, Andreea Petrut</i>	
CAVE DIVING AS AN APPROPRIATE HIGH-FIDELITY ANALOG TO STUDY BEHAVIOURAL HEALTH IN SPACE.....	147
<i>Karoly Schlosser</i>	
ADVANCED TECHNOLOGY FOR ENHANCING AUTONOMY IN SPACE MEDICINE.....	153
<i>Adam Sirek, Nathalie Sleno, Allyson Hindle, Scott Bishop, Dave Williams</i>	
THE OVERVIEW EFFECT: A NEW INTERDISCIPLINARY METHODOLOGY AND POTENTIAL APPLICATIONS.....	167
<i>Maya Perlmutter, John M. Horack, Elizabeth Newton</i>	
IMPACT OF SPACE ANALOGS ON ORAL IMMUNITY AND INFLAMMATION.....	180
<i>Balwant Rai</i>	
ELECTRICAL MUSCLE STIMULATION EXOSKELETON SUIT TO MITIGATE MUSCULOSKELETAL ATROPHY FOR AEROSPACE MISSIONS AND REHABILITATION THERAPY.....	181
<i>Diana Estela Mendoza Sanchez, Jose Cordova Puente</i>	
EYE MONITORING IN SPACE AND EXTREME ENVIRONMENTS: ADDRESSING THE SPACEFLIGHT ASSOCIATED NEURO-OCULAR SYNDROME (SANS) RED RISK THROUGH MOBILE BIOMEDICAL DIAGNOSTICS DURING THE COSMIC KISS MISSION ABOARD THE INTERNATIONAL SPACE STATION (ISS) .....	182
<i>Scott Ritter, Juergen Drescher, Eoin Tuohy, Steffen Stupp, Raphael Sznitman, Aidan Cowley, Claudia Stern</i>	

EFFECTS OF PROLONGED EXPOSURE TO A SPACE ANALOG ENVIRONMENT ON CARDIOVASCULAR VARIABILITY AND CARDIO-POSTURAL INTERACTIONS: A JOINT MBRSC AND IBMP RAS PROJECT. NANDU GOSWAMI, ANDREW BLABER, HANAN AL SUWAIDI, STEFAN DU PLESSIS .....	188
---	-----

*Nandu Goswami, Andrew Blaber*

STUDY OF THE HUMAN CARDIORESPIRATORY SYSTEM DURING A LONG STAY AT THE ANTARCTIC VOSTOK STATION IN RELATION TO THE FUTURE LONG-TERM INHABITED MOON BASE .....	189
--	-----

*Olga Man'Ko, Evgeny Bersenev, Nikolay Osetsky, Viktor Tikhonenko, Irina Berseneva, Eugeny Ilyin, Oleg Orlov*

WHAT ABOUT SUPPORTING MISSION SUPPORT? THE EVOLVING ROLE OF PSYCHOLOGY IN MISSION SUPPORT CENTER. ....	196
--	-----

*Karoly Schlosser, Tajana Lucic*

MIRA – THE MAGNETIC-FIELD BASED IMMUNOTHERAPY FOR REMISSION USING ENDOWED ANTIBODIES: CURRENT STATUS AND FUTURE ACTIVITIES .....	197
--	-----

*Norbert Frischauf, Doris Dangler, Alexander Kraus, Robert Mayer, Otto Koudelka, Michael Taraba, Thomas Turetschek*

## **5.RADIATION FIELDS, EFFECTS AND RISKS IN HUMAN SPACE MISSIONS**

SPACE RADIATION FIELD CHARACTERIZATION USING THE ASTROPARTICLE OPERATING DETECTORS. ....	199
--	-----

*Alessandro Bartoloni, Lidia Strigari*

RADI-N2 AND MATROSHKA-R: MEASUREMENTS OF NEUTRON RADIATION ON THE INTERNATIONAL SPACE STATION (2009 – 2020).....	207
--	-----

*Martin Smith, Hugh Robert Andrews, Harry Ing, Eric Johnston, Sergey Khulapko, Martin Koslowsky, Rachid Machrafi, Bruce Nicayenzi, Igor Nikolaev, Vyacheslav Shurshakov, Leena Tomi*

THE LIDAL EXPERIMENT ON BOARD ISS .....	209
---	-----

*Livio Narici, Luca Di Fino, Giulia Romoli, Giovanni Valentini, Marino Crisconio, Marta Albano, Gabriele Mascetti, Dario Castagnolo, Gianni Truscetti, Elisa Carrubba, Antonio Bardi, Francesco Tommasino, Marco Passerai, Cinzia De Donato, Roberto Messi, Marco Pullia, M. Cristina Morone, Alessandro Rizzo, Giovanni Nobili, Carolina Berucci, Giuseppe Masciantonio, Pietro Albicocco*

COMFORT AND HUMAN FACTORS ASTRO-RADIATION GARMENT EVALUATION (CHARGE) ON THE ISS .....	216
--	-----

*Oren Milstein, Rajarshi Pal Chowdhury, Shirit Schwarz, Kathleen Coderre, Eleanor Morgan, Hesham Hussein*

COMPARATIVE AND COMPUTATIONAL ANALYSIS OF SOLIBACILLUS KALAMII UV DAMAGE REPAIR PROTEINS .....	222
--	-----

*Rida Fatima, Sarmad Habib Khan, Areeba Khan*

ANALYSIS OF COMPOSITION OF MARTIAN REGOLITH FOR VIABILITY OF FUNGAL CELLS TO ASSIST IN PLANT GROWTH AND BIOREMEDIATION OF RADIATION THROUGH MYCO-FILTRATION.....	235
--	-----

*Ilankuzhali Elavarasan, Julio Rezende*

SPACE RADIATION IN A LONG-TERM HUMAN MISSIONS: RISK ASSESSMENT ON THE MOON AND ITS IMPACT ON THE PLANTS .....	238
<i>Funmilola Adebisi Oluwafemi, Adhithiyan Neduncheran, Rohan Chandra</i>	

SPACE RADIATION SHIELDING BY WATER DOME IN ASTRAX LUNAR CITY ON THE MOON.....	248
<i>Taichi Yamazaki</i>	

PRELIMINARY RADIATION ENVIRONMENTAL ANALYSIS AND SHIELDING DESIGN STRATEGIES FOR FUTURE VENUS EXPLORATION MISSIONS .....	260
<i>Jack Rosenthal, Luca Gramegna, David Sulley, Carlo Bianco, Lee Shauffer-Ellis, Teddy Butscher, Lanre Logan</i>	

## **6.ASTROBIOLOGY AND EXPLORATION**

EXTENDED HABITABLE ZONE AND BIOSIGNATURE DETECTION OF M-DWARF PLANETS .....	274
<i>Amri Wandel</i>	

IMPACT SHOCK SYNTHESIS OF CYSTEINE: EXPLORING THE CREATION OF LIFE'S PRECURSORS BEYOND EARTH.....	278
<i>Vassilia Spathis, Jon D. Tandy, Justyn Campbell-White, Mark C. Price, Aurora Sicilia-Aguilar, Penelope J. Wozniakiewicz</i>	

SUPER RESISTANCE OF DSDNA TO GAMMA-RADIATION DAMAGE AT DEEP COLD (-195.80°C).....	279
<i>Sergey Bulat</i>	

PUSHING THE LIMITS OF LIFE: WHAT ARE THE PROTEOMETABOLOMIC MECHANISMS USED BY DEINOCOCCUS RADIODURANS TO RESIST THE DAMAGING EFFECTS OF OXIDATIVE STRESS INDUCED BY EXTREME RADIATION DOSES? .....	283
<i>Laura Molares Moncayo</i>	

GENOME ANALYSIS OF ANOXYBACILLUS STRAINS FROM AN ANTARCTIC POLAR VOLCANO HIGHLIGHTS POTENTIAL FEATURES FOR ASTROBIOLOGY .....	301
<i>Junia Schultz, Fabricio Almeida Araujo, Rommel Thiago Juca Ramos, Bertram Brenig, Vasco Azevedo, Alexandre Rosado</i>	

ASTRO DOGS: FAST, RESILIENT, AUTONOMOUS LEGGED ROBOTS FOR THE SCIENTIFIC EXPLORATION OF PLANETARY BODIES.....	302
<i>Thomas Touma, Jennifer Blank, Muhammad Fadhil Ginting, Christopher Patterson, Ali Agha</i>	

SCIENCE AND AUTONOMOUS EXPLORATION OF A TERRESTRIAL LAVA TUBE: A STRUCTURED PLANETARY CAVE MISSION SIMULATION .....	303
<i>Jennifer Blank, Benjamin Morrell, Ali Agha</i>	

## **7.LIFE SUPPORT, HABITATS AND EVA SYSTEMS**

OXYGEN AND FOOD PRODUCTION USING A MICROALGAE PHOTOBIOREACTOR FOR A LUNAR BASE .....	310
<i>Gisela Detrell</i>	

AUTOMATED PRODUCTION OF MICROALGAE AS AN EFFICIENT FOOD SOURCE FOR FUTURE MANNED MISSIONS TO MARS. ....	321
<i>Matjaz Vidmar, Mikaela Hoellrich, Nicole Pietrasiak, Mate Ravasz</i>	

ANALYSIS OF PLANT MORPHOLOGY AND PHYLOGENETICS OF INDIGENOUS PLANTS AS A SOURCE OF FOOD, OXYGEN AND MEDICINAL PURPOSES FOR SPACE APPLICATIONS AND HABITATS. ....	328
<i>Ilankuzhali Elavarasan, Julio Rezende, Davi Alves Feitosa Souza, Elakya Elavarasan</i>	

SPACE FOOD FOR BONE HEALTH: VITAMIN D FORTIFIED CAMEL MILK WITH DATES SMOOTHIE (SMOOTHISS) .....	342
<i>Carine Platat, Mahra Alshamsi, Mariam Aldhaheri, Maitha Alsalmi</i>	

CAREGIVR: A VR-BASED SYSTEM FOR MEDICAL SKILLS TRAINING & EDUCATION ON EXPLORATION-CLASS MISSIONS .....	343
<i>Shawna Pandya, Mike Wesolowski</i>	

## **8.BIOLOGY IN SPACE**

A NOVEL ROLE OF MEMBRANE RECEPTOR HEMOJUVELIN IN UNLOADED MUSCULAR ATROPHY AND ITS MECHANISM .....	344
<i>Xiaoping Chen</i>	

CHARACTERIZING THE EFFECTS OF SIMULATED MICROGRAVITY ON CYTOTOXICITY OF HUMAN NATURAL KILLER CELLS .....	345
<i>Marieke De Korte, Rob Laister, Armand Keating, Chen Wang</i>	

CONTROVERSY ON ENDOGENOUS AND EXOGENOUS BIO-RESOURCES FOR THE ORIGIN OF FIRST LIFE ON PLANET EARTH.....	350
<i>Brij Tewari</i>	

DEVELOPMENT OF AN ALOE VERA AND CELLULOSE BASED BEAD TO AID THE GROWTH OF EDIBLE CROPS ON MARS REGOLITH.....	351
<i>Axel Garcia-Burgos, Jose Couvertier, Gilberto Jimenez</i>	

DUAL CULTURE IN MICROGRAVITY CONDITIONS: POTENTIAL APPLICATION IN THE STUDY OF SYMBIOTIC AND ANTAGONISTIC INTERACTIONS FOR PLANT GROWTH IN SPACE. ....	363
<i>Fiorella Arias Bonilla</i>	

HUMAN NEURAL STEM CELLS FLOWN ONTO SPACE PROLIFERATE MORE THAN GROUND CONTROL IN SPACE AND UPON RETURN TO EARTH: IMPLICATIONS FOR LONG-TERM SPACE TRAVEL .....	364
<i>Araceli Espinosa-Jeffrey</i>	

IMPACT OF MICROGRAVITY ENVIRONMENT ON GUT BACTERIAL METABOLITES .....	365
<i>Naveed Khan, Adel Elmoselhi</i>	

INVESTIGATING THE EFFECTS OF GRAVITY ON THE GENETIC REGULATION OF HUMAN TELOMERES .....	373
<i>Anthony Piro, Taylor Peters, C. Mackenzie Campbell, Erin Richardson, Miranda Badovinac, Dunja Matic, Rodrigo Fernandez-Gonzalez</i>	

INVESTIGATING THE USE OF MATERIAL COATINGS FOR THE PREVENTION OF BIOFILMS ON ISS WATER SYSTEM MATERIALS .....	383
<i>Madelyn Mettler</i>	

MICROGRAVITY COMPATIBLE, PORTABLE, AND AUTOMATED NUCLEIC ACID EXTRACTION SYSTEM FOR FUTURE HUMAN MISSIONS .....	384
<i>Kasthuri Venkatweswaran</i>	



SPACEFLIGHT-INDUCED EFFECTS ON OCULAR RESPONSE AND BLOOD-RETINA BARRIER FUNCTION.....	385
<i>Xiao Wen Mao</i>	
SUTURE IN SPACE: PREPARATION OF AN EXPERIMENT ON THE HEALING OF SUTURED WOUNDS ON BOARD THE ISS .....	397
<i>Monica Monici, Francesca Cialdai, Daniele Bani, Stefano Bacci, Lucia Morbidelli, Desiree Pantalone</i>	
THE ETHICAL CODE FOR OUTER SPACE .....	408
<i>Zvi Sever</i>	

### **IP.INTERACTIVE PRESENTATIONS - IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM**

INTERNATIONAL COOPERATION IN THE IMPLEMENTATION OF SCIENTIFIC MEDICAL AND BIOLOGICAL RESEARCH AND EXPERIMENTS ON THE ISS .....	413
<i>Elena Luchitskaya, Anna Kussmaul, Agaptseva Tatiana, Mark Belakovskiy</i>	
PSYCHOLOGICAL FACTORS ASSOCIATED WITH HABITAT DESIGN FOR SPACE ANALOG MISSIONS.....	414
<i>Ravneet Kaur, Vipul Mani, Manuel Ortega, Prabhpreet Data</i>	
ANALOG SELECTION TOOL: CHARACTERIZING THE CHALLENGES OF MIMICKING THE SPACEFLIGHT ENVIRONMENT ON EARTH.....	415
<i>May Li Uy, Virginia Wotring</i>	
STUDY OF SOLAR RADIATION IN MARS .....	428
<i>Sandhya Rao</i>	
ECOSYSTEMS FOR THE DEVELOPMENT OF LIFE ON MARS .....	429
<i>Miguel Angel Sanchez Gamez, Ana Luisa Vallejo Romero</i>	
CENTRIFUGAL FLASH DISTILLER FOR LIFE SUPPORT SYSTEM .....	430
<i>Andrii Solomakha, Vladimir Rifert, Petr Barabash, Maryna Yaroshevych, Valerii Petrenko</i>	
CONCEPTUAL DESIGN OF MARTIAN HABITAT AND LIFE SUPPORT SYSTEM USING IN-SITU RESOURCES.....	437
<i>Anand Nagesh, Shoubhik Pal, Jaspreet Singh, Aakansha Sharma</i>	
BIOSIGNATURES OF LIFE IN EXOPLANETS .....	445
<i>M. S. Siri, Ananya Kodukula, Aditya Balasubramaniam, Arnab Mazumder</i>	
ASPARAGINE INDUCED DEVELOPMENT OF CELL LIKE ORGANIZATIONS ORIGINATING FROM CHEMICALS COMMONLY PRESENT IN GIANT MOLECULAR CLOUDS.....	446
<i>Satadal Das</i>	
STATICAPONIC LOW WASTE PLANT NOURISHMENT .....	447
<i>Bryan Llumiquinga</i>	
RESEARCH OF MONITORING THE USE OF GARMENT, UNDERWEAR AND PERSONAL HYGIENE MEANS IN 17-DAY AND 120-DAY ISOLATION CONDITIONS OF THE SIRIUS PROJECT .....	448
<i>Irina Shumilina</i>	

OXYGEN AND ENERGY FOR INTERPLANETARY TRAVELS.....	453
<i>Miguel Angel Serrano, Axel Nunez Arzola, Daniela Fernanda Gonzalez Chavez, Cecilia Guadalupe Torres Perea, Arantza Mendez Rodriguez, Itzcoatl Nunez San Miguel, Alvaro Regules, Hector Delgado</i>	
BACTERIAL POSSIBILITIES FOR SUSTAINABILITY ON MARS – IN-SITU RESOURCE UTILIZATION WITH MICROORGANISMS .....	456
<i>Diana Pawlicki, Mateusz Balka</i>	
IMPROVED LEAK-PROOF HELMET FOR SPACE EXPLORERS.....	468
<i>Chelsea Bahenduzi</i>	
DESIGN OF PERFORMGLOVE FOR QUANTIFYING PERFORMANCE OF SCIENTIFIC FIELDWORK TASKS WHEN WEARING A MARS EXTRAVEHICULAR MOBILITY UNIT (MEMU) GLOVE .....	469
<i>Nina Purvis</i>	
BIOCOLCHON SPACE GARDEN.....	470
<i>Alejandro Salinas Tellez, Federico Granados Unger</i>	
THE ANAEROBIC MEMBRANE BIOREACTOR (ANMBR), A HYBRID BIOLOGICAL CREW-WASTE TREATMENT SYSTEM FOR SUSTAINABLE RESOURCE RECOVERY IN LONG-DURATION, DEEP-SPACE HUMAN EXPIRATION .....	471
<i>Talon Bullard</i>	
PULSED ELECTROMAGNETIC FIELDS (PEMF) TO SUSTAIN LIFE IN SPACE COLONIES AND HABITATS.....	472
<i>Kolemann Lutz, Herve Cadiou, Ilaria Cinelli, Terry Trevino</i>	
THE UNSOLVED CHALLENGES OF SPACE BIOSPHERES: A RESEARCH AGENDA .....	487
<i>Floriana Scarpisi, Paolo Pino, Lorenzo Rabagliati, David Gomez-Fernandez, Silvia Panetta, Davide Carabellese, Antonino Salmeri</i>	
BIOSYSTEMS TO FEED ON MARS: CONSIDERATIONS ABOUT HIGH-PERFORMANCE SYSTEMS FOR OPTIMAL SPACE GREENHOUSE OPERATION .....	496
<i>Davi Alves Feitosa Souza, Julio Rezende, Ilankuzhali Elavarasan, Riyabrata Mondal</i>	

**Author Index**