SPACE LIFE SCIENCES SYMPOSIUM (A1)
Medical Care for Humans in Space (3)

Author: Dr. Gordon Sarty
University of Saskatchewan, Canada, gordon.sarty@usask.ca

Dr. Jonathan Sharp
NRC Institute for Biodiagnostics, Canada, Jonathan.Sharp@nrc-cnrc.gc.ca
Dr. Boguslaw Tomanek
NRC Institude for Biodiagnostics, Canada, Boguslaw.Tomanek@nrc-cnrc.gc.ca
Dr. Krzysztof Turek
MRI-Tech, Canada, kturek@mri-tech.com
Dr. Andre Obenaus
Loma Linda University, United States, aobenaus@llu.edu
Dr. Alan Scott
COM DEV Ltd., Canada, alan.scott@comdev.ca
Mr. Louis Piche
COM DEV Canada, Canada, Louis.Piche@comdev.ca
Dr. Saija Kontulainen
University of Saskatchewan, Canada, saija.kontulainen@usask.ca
Dr. Phil Chilibeck
University of Saskatchewan, Canada, phil.chilibeck@usask.ca
Dr. Jonathan Farthing
University of Saskatchewan, Canada, jon.farthing@usask.ca
Dr. Adam Baxter-Jones
University of Saskatchewan, Canada, baxter.jones@usask.ca
Dr. Roger Pierson
University of Saskatchewan, Canada, Roger.Pierson@usask.ca

A MAGNETIC RESONANCE IMAGER FOR THE INTERNATIONAL SPACE STATION

Abstract

A complete understanding of the physiological changes that occur during long-duration spaceflight, and of the countermeasures needed to stop those changes, remains elusive. A primary reason for that lack of basic knowledge is the very limited amount of in-flight physiological data available. The ability to image astronauts frequently, during their mission, with a magnetic resonance imager (MRI) would provide a wealth of information, especially of the musculoskeletal system, that could be used to solve the problem of keeping them fit and healthy on long spaceflights. MRI would provide information about not only bone and muscle mass but it would also provide information about bone and muscle strength and muscle metabolic efficiency using imaging protocols that have been developed for the study of athletes and of the osteoporosis population on Earth. Using technology that has recently been developed and is currently undergoing development, it is possible to build a whole body "Compact MRI" that can fit within the mass and space envelope of an International Space Station (ISS) International Standard Payload Rack (ISPR). The new technology is composed of two critical pieces: 1. an RF image encoding system, the "TRASE" RF system, and 2. light-weight Halbach magnet designs that additionally produce no magnetic

field external to the magnet. The TRASE RF system eliminates the need for heavy, power-consuming, electromagnet gradient magnetic field coils. The elimination of the magnetic gradients leads to an MRI design that is simple from the hardware point of view and will therefore be robust and reliable. With modest funding, the ISS MRI could be functional in about 5 years. Beyond the ISS, the Compact MRI will provide the basis for the development of MRI for solar system wide medical care. On Earth, the development of the Compact MRI promises to have a significant impact on worldwide healthcare delivery by making portable MRI available to populations that otherwise could not afford MRI or who would otherwise have to wait in long queues for an MRI exam. On the Moon, Mars, Phobos, Deimos and the many other destinations of interest to our descendants, derivatives of the Compact MRI will provide both medical diagnostic capability and a tool for basic research on physiological adaptation to the hypogravity of those distant worlds.