SPACE LIFE SCIENCES SYMPOSIUM (A1)
Interactive Presentations (IP)

Author: Dr. Krzysztof Turek
AGH University of Science and Technology, Poland, turek@agh.edu.pl

Dr. Piotr Liszkowski
MRI-TECH Sp. z o. o., Poland, pliszkowski@mri-tech.com
Dr. Gordon Sarty
University of Saskatchewan, Canada, gordon.sarty@usask.ca

A PERMANENT HALBACH MAGNET FOR WRIST MRI AT THE INTERNATIONAL SPACE STATION

Abstract

We have been working towards the installation of a magnetic resonance imager (MRI) on the International Space Station within a couple of years to study astronauts' bone and muscle loss and tissue changes due to microgravity. Its design has been funded between January and June, 2014 by the Canadian Space Agency. One of the critical design problems to be solved was the construction of the imager magnet. The magnet must be light and small enough to leave the room for the other parts of the system which as a whole will be housed in an double EXPRESS rack in an ISS standard International Payload Rack (ISBR). Whereas the magnet alone in a typical MRI weighs ever 3 tonnes, the mass of the complete ISS-MRI must be less than 50 kg. The requirements are fulfilled thanks of using the gradient-free "TRACE" imaging technique, the selection of wrist as an object of imaging and compromising on the magnetic flux density B which had been reduced to 0.15 T. The design solution was a permanent magnet consisting of a Halbach dipole of the bore aspect ratio 2 and total mass only 25 kg. MRI requires a highly homogeneous magnetic field in the imaging volume which in the ISS –MRI is a box of dimensions 6 cm x 6cm x 1cm. The peak-to-peak homogeneity of 50 ppm in this volume, satisfactory for imaging by the TRACE MRI, was reached by modifying the standard Halbach dipole geometry using new design methods. The inhomogeneity due to unavoidable errors in magnetization of Nd-Fe-B permanent magnet pieces, which the magnet is assembled of, as well as the errors in dimensions of the pieces are corrected by a novel shimming system.