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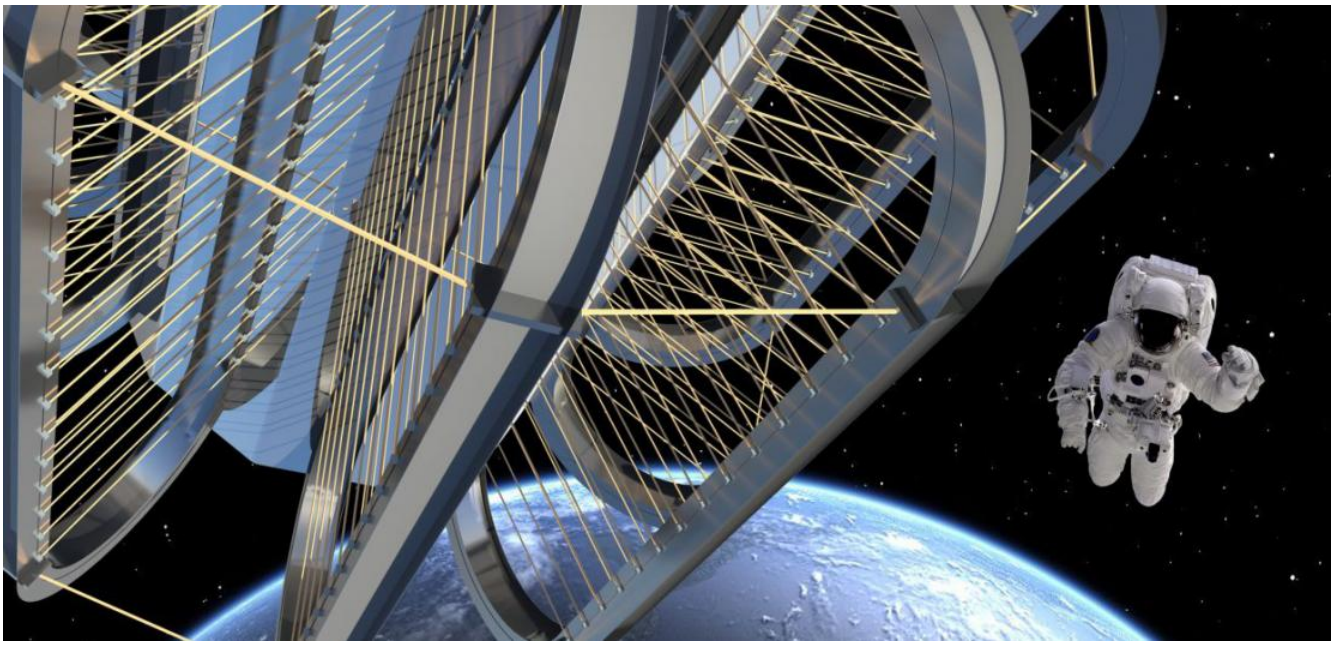

Radiation shielding to protect a mission to Mars

Lightweight magnetic shields could be the best way to protect an astronaut from deadly radiation as they travel to Mars or beyond.

21 July 2014 - By ALAN ARCHER-BOYD

Harmful radiation comes from two main sources in space; low-energy protons emitted from the sun, known as the solar wind, and much higher energy particles known as galactic cosmic rays that originate outside the solar system.

Long-term exposure to galactic cosmic rays and solar particles can lead to a significantly higher risk of developing cancer, researchers believe.

Increasing the thickness of spacecraft walls would be enough to protect astronauts from low-energy particles from the sun, however high-energy galactic cosmic rays would interact with the shielding materials to produce even more radiation.

The EU-funded SR2S project is developing magnetic shielding instead that can deflect these dangerous cosmic rays in the same way as the earth's magnetic shield protects humans from cosmic radiation.

The idea, originally proposed in 1969 by space engineer Wernher von Braun, the so-called father of rocket science, is to use a superconducting magnet to create the shield.

'As the magnetosphere deflects cosmic rays directed toward the earth, the magnetic field generated by a superconducting magnet surrounding the spacecraft would protect the crew,' said Dr Riccardo Musenich,

scientific and technical manager for the project.

‘SR2S is the first project which not only investigates the principles and the scientific problems (of magnetic shielding), but it also faces the complex issues in engineering.’

Superconductors

The project will evaluate the feasibility of making such a shield by the time it finishes at the end of 2015. To do this, it has turned to superconductors, materials that have no electrical resistance at extremely low temperatures, to help them solve one of the biggest problems with a magnetic shield - the weight of the large magnet required.

Superconducting magnets, commonly found in MRI scanners, produce stronger, more efficient magnetic fields using smaller and lighter magnets than magnets made using conventional materials such as copper or aluminium.

On earth, superconducting materials must be cooled to very low temperatures using liquid helium to utilize their superconducting properties, however the project has already found a solution that will work in space.

‘We have decided to use a new superconducting material, discovered in 2001: magnesium diboride or MgB2,’ explained Dr Musenich. MgB2 can superconduct at 10 kelvin, or -263 degrees Celsius, which removes the need for liquid-helium cooling as this temperature is comparable with that of deep space.

Simulations of the magnetic system suggest that a 10-metre-diameter magnetic field could be produced by a system weighing less than half that of a comparable passive shield.

Habitats for extreme environments

Once the astronauts have arrived on Mars with both themselves and their spacecraft intact, the thin atmosphere and weak magnetosphere means they still won’t be safe from harmful radiation. Researchers on the SHEE project are attempting to reduce the economic and human cost of establishing outposts in the most inhospitable environments.

By identifying common architectural considerations for extreme environments on earth and in space, the project will develop a self-deployable living and working space, which includes a rigid section to house life support systems, folding sections for workspaces and robotic motors to aid with deployment.

Future versions of the SHEE habitat could also be used on earth, providing shelters in areas recently hit by natural disasters, or mobile laboratories in difficult-to-access environments. Initial construction of a prototype began in April 2014 and a fully operational habitat suitable for two people will be finished in 2016.

For details, visit http://www.shee.eu/main

More info

SR2S

SHEE