SO YOU WANT TO GO TO MARS?

NASA's most recent robotic mission to the red planet encountered a savage radiation environment during the journey there. Will it be too much for human astronauts, asks **Nicky Guttridge**?

▲ Will astronauts survive the radiation on Mars?Image: NASA/Pat Rawlings/SAIC.

Cold, unforgiving, arid and unfamiliar: the Red Planet has very much an alien landscape. Although astronomers have been peering at Mars for many years and studying it from afar, the appeal of setting foot on Martian soil to view it for ourselves remains strong.

This urge to explore and understand the Solar System around us has sparked various initiatives for interplanetary travel. Some private organisations are now offering the chance to travel to Mars, such as Mars One or the Inspiration Mars Foundation. But is this really possible? Earlier this year NASA held a press conference to discuss the viability of a manned mission to Mars. This was sparked by a set of measurements gathered from the Mars Science Laboratory (MSL), which carried NASA's Curiosity rover to the surface of Mars last year. As MSL travelled from Earth to the Red Planet, some of its instruments were switched on so they could monitor the environment in deep space.

"NASA is aiming to send humans to Mars around the middle of the 2030s," says Chris Moore, NASA's deputy director of advanced exploration systems. "Before we can send astronauts there, we need to understand the environment and hazards they'd face."

The team took seven months of data, which led to disappointing news for Mars enthusiasts: with our current technology, a trip to Mars is just too risky.

Violent and energetic radiation

A round trip to Mars takes around 520 days on average, although if the planets are aligned in a certain way this journey can take as little as 501 days. This alignment next takes place in 2018, which is when the Inspiration Mars Foundation plan to launch their first crewed fly-by trip to Mars. The second will occur in the 2030s, around the time that NASA would like to launch a manned mission.

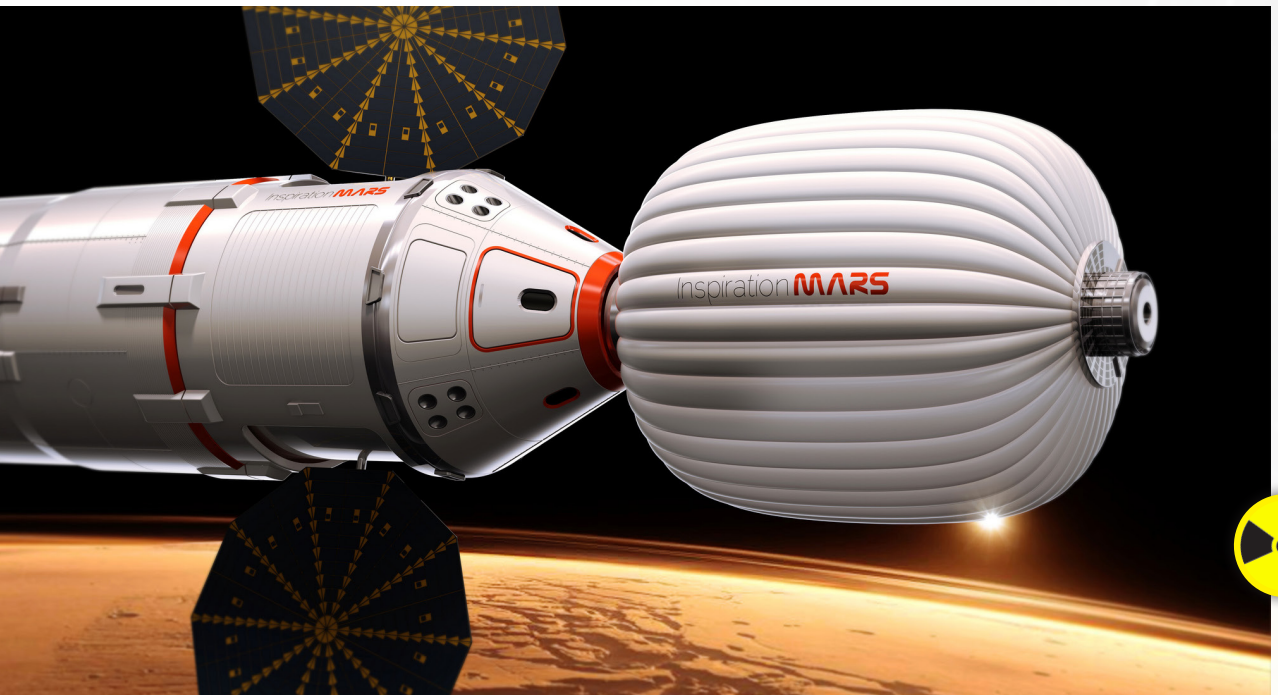
The biggest risk involved in both a trip to the planet and a stay on its surface is radiation. On the surface of Earth we are still exposed to cosmic radiation, although this is just a fraction of what we would experience in deep space thanks to the shielding from our atmosphere. This violent and energetic radiation comes in two forms: solar radiation and galactic cosmic rays.

Galactic cosmic rays are flung inwards towards our Solar System from incredibly energetic sources beyond our Sun's neighbourhood. Solar radiation originates a little closer to home and is sporadically and unpredictably emitted by our Sun in the form of events such as solar storms or flares. Both types are dangerous and can increase an astronaut's likelihood of contracting cancer.

"For human exploration we're interested in the effect on human tissue," says Cary Zeitlin of the South-west Research Institute, principal scientist of the recent MSL Curiosity radiation measurements. Different particle types have different effects on human biology. "This is something NASA is working to better understand, particularly in the context of space radiation," adds Zeitlin.

"Several hundred times more intense"

During a year on Earth's surface, an average human will soak up an amount of radiation from galactic cosmic rays equivalent to just a fraction of a unit known as a millisievert.



◀ An artist's impression of the capsule and habitat module that might take Inspiration Mars' astronauts on a fly-by of the red planet in 2018. Such a vessel will require extra shielding to minimise radiation exposure. Image: Inspiration Mars Foundation.

When this is extended to include all kinds of radiation we encounter in our day-to-day lives, this rises to a few millisieverts. "So we get somewhat more radiation from other sources on Earth than from cosmic radiation," says Zeitlin. "If you go and get an abdominal CT scan, for example, you get a little bit less than 10 millisieverts from that."

Radiation workers in the US are allowed up to 50 millisieverts per year. By contrast, astronauts that visit the International Space Station are exposed to around double this dose in just six months. During a six-month trip in deep space, this leaps up to 330 millisieverts meaning a round-trip to Mars would total around 660 millisieverts – very close to NASA's lifetime limits for astronauts. "And that's just the cosmic ray part of it," says Zeitlin. "If there was a large solar event, that could add significantly to that total. The radiation environment in deep space is several hundred times more intense than it is on Earth."

Water, food and faeces

So, bad news: one round trip to Mars, not including an extended stay on the surface or any trial runs or previous trips into space, could expose you to a radiation dose very close to NASA's safe limit for astronauts in a whole lifetime. This also assumes that the Sun is going through a calm, inactive phase, as it currently is.

To try to reduce the risk of damage from these energetic particles, we need effective shielding. Currently, astronauts are shielded by various materials and substances that are packed into the walls of their spacecraft – for example, water or food, as the hydrogen both contain is a very effective shielding material. Packing the walls with astronaut faeces or certain kinds of plastics has also been suggested. Indirectly, we can shield a spacecraft's crew by improving our ability to predict how our Sun will behave.

"We're also developing deployable storm shelters, so that in the case of a solar storm event the astronauts could get additional protection," says Chris Moore. "We have to understand how radiation interacts with a spacecraft's structure." When a particle hits the material of a spacecraft, its collision generates a secondary spray of particles that can be more harmful than the initial ray itself.

Another way of minimising this radiation exposure is to travel more quickly, so the astronauts are in deep space for a shorter time, but this would require methods that are currently still in development.

A risk worth taking

With ongoing improvements in both of these areas, NASA hope to launch a manned mission to Mars in the 2030s, but other organisations claim that a launch is possible much sooner than this.

One, Inspiration Mars, is aiming for a manned fly-by mission – where the traveller does not touch down on the surface – that will pass within 100 miles of the surface of Mars in 2018. The organisation claims that the current data indicates that a manned fly-by mission to Mars would be possible with our current technology, "without exposing the crew to unnecessarily high levels of radiation," says Dr Jonathan Clark, who is Chief Medical Officer for Inspiration Mars.

The feasibility of Inspiration Mars' planned launch may be based on their aims – a fly-by mission rather than a manned touchdown. "The fly-by architecture lowers risk, with no critical propulsive manoeuvres, no entry into the Mars atmosphere, no rendezvous and docking," says Clark. They also intend to exploit the 2018 planetary alignment, which represents the shortest possible duration round-trip mission to Mars.

Despite all of the dangers, as of May 2013 another private organisation, Mars One, had around 80,000 applicants to travel to Mars – and they expect to reach 500,000 by the end of August. Inspiration Mars is also optimistic that wannabe Mars explorers won't be discouraged. "We don't believe that this will dampen the enthusiasm we have seen from people who would volunteer for a mission to Mars," says Clark. "Our crew will be fully aware of all the risks posed by this mission. All exploration involves risk, and we believe that the radiation exposure is a risk worth taking."

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