BBC

WHY IS SPACE TRAVEL SO DANGEROUS?

Video transcript: The invisible threat to humans in space

HELEN CZERSKI:

During the Apollo missions, humans travelled further from Earth than ever before. They made history. They walked on the moon, saw unprecedented views of our planet. But they also reported something very strange. They saw mysterious white flashes when their eyes were closed.

Mission control was so concerned they asked the astronauts to record every flash. They weren't sure but they had a hunch that they were caused by a kind of radiation originating from outer space called ‘cosmic rays’.

Cosmic rays are charged particles travelling extremely quickly through interstellar space. They can be really damaging to living tissue, but down here on Earth we're protected because the Earth's magnetic field acts as a shield. For the Apollo 16 mission, NASA developed a special device to find out if cosmic rays were causing the flashes.

A helmet that could detect the energy levels of single particles. The astronauts ran several tests with it and the results were conclusive - cosmic rays from deep space were indeed penetrating the astronauts' eyes and interfering with the cells on the back of the retina.

And that led to a question. If a single particle could produce an effect you could see, what else were these particles doing to the tissues of the body? The biggest fear was that the high levels of cosmic radiation that exist in deep space would lead to cancer.

So to understand the risks, NASA established a space radiation laboratory here at Brookhaven National Laboratory in Long Island. Frank Cucinotta, who heads up NASA's programme here, has come to show me around.

FRANK CUCINOTTA:

OK, so this is the computer control system.

HELEN CZERSKI:

Highly charged particles are so dangerous I'm not allowed inside the radiation chamber. But what they do here is fire a beam of particles at human and animal tissues, like lung, stomach and brain – the soft tissues most vulnerable to cancers – to find out what kind of damage cosmic rays cause and whether there's such a thing as a safe dose for humans.

VOICE OVER A LOUDSPEAKER:

Attention. Attention. Beam is evident.

HELEN CZERSKI:

What they're finding is that cosmic ray damage is different to any other form of radiation we've ever come across.

FRANK CUCINOTTA:

We're looking at images of brain cells where the blue colour indicates the nucleus of the brain cell and the green colour shows you a wake of DNA damage that's been caused by the ion particle.

HELEN CZERSKI:

What's striking is that a single cosmic ray has come right the way through these two nuclei and caused a really strong trail of damage. But if it had been an x-ray, it might just have caused one spot on one of these nuclei. So as far as radiation goes, a cosmic ray has much more bang for its buck.

FRANK CUCINOTTA:

Yeah, it's much more of a concern. It's a qualitative difference.

HELEN CZERSKI:

The reason cosmic rays are so damaging is because they're thought to originate in some of the most energetic events in the universe – supernova explosions, where charged particles are accelerating close to the speed of light and spat out into the cosmos. Frank's team has shown

that just one of these particles has the power to charge through human tissue, strip molecules of electrons and physically break the DNA – potentially leading to cell mutations and cancer.

So far, we've seen astronauts with the highest levels of exposure develop early cataracts because the soft tissue of the eye is most vulnerable to damage. The current thinking is that on a mission to Mars, the change of developing terminal cancer could be as high as 30%. I asked Frank what the solutions are.

FRANK CUCINOTTA:

We have some good strategies. The first one would be shielding spacecraft by changing the composition of the walls or the thickness of the walls of the spacecraft. Water and polyethylene seem to be the best shielding materials. The second one is the knowledge of the solar cycle. We know that cosmic ray intensity is higher at the part of the 11-year solar cycle called solar minimum. So if we stay away from solar minimum we can reduce the exposures. The last way is the person themself. As we learn more about genetic factors we'll be able to find attributes that make a person more resistant and more eligible for a long space mission.

HELEN CZERSKI:

When it comes to future space exploration, rocket technology clearly isn't the only challenge, because until we can protect ourselves from cosmic radiation in deep space, we may not be going anywhere.