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Space

Polaris Dawn crew prepare for riskiest spacewalk ever

Leah Crane

SPACEX is getting ready to perform the first civilian spacewalk. Until now, every time a human has left their spacecraft to venture into the void of space it has been a government-trained astronaut. But the Polaris Dawn mission – scheduled to launch during a window opening on 4 September as *New Scientist* went to press – is changing that, making it perhaps the most dangerous civilian space mission ever.

The main source of risk is that the Crew Dragon, which will carry four explorers into orbit, lacks an airlock. When astronauts on the International Space Station perform spacewalks, or extravehicular activities (EVAs), they don their suits and enter a sealed room. The air is then sucked out of that room before they head into open space, keeping the rest of the station sealed and full of air.

The Polaris Dawn crew members are due to spend up to five days in orbit. On the third day, the entire spacecraft will depressurise for about 2 hours, so even the two crew members who aren't leaving the capsule will have to wear specialised EVA suits. It isn't a new protocol – many of NASA's Gemini and Apollo spacecraft in the 1960s and 70s didn't have airlocks – but it is riskier than an EVA where the astronauts have a relatively safe airlock to retreat to in case of any issues.

"You're throwing away all the safety of your vehicle, right? And it now comes down to your suit, it becomes your spaceship," said mission commander Jared Isaacman during a 19 August press conference. Isaacman is the head of SpaceX's Polaris programme and its billionaire funder.

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The Polaris Dawn mission at Kennedy Space Center, Florida, ready for launch

Another source of risk is the spacesuits themselves, which are new. They have undergone extensive testing in vacuum chambers, but any new type of equipment tends to be more risky than one that has already been put through the wringer of space. There are other dangers too: the flight will travel further from Earth than any human has been since the end of the Apollo programme in 1972 and will have radiation and possibly micrometeorites to deal with.

"You're throwing away all the safety of your vehicle, right? And it now comes down to your suit"

Of the four crew members, only Isaacman has previously been to space. The other three are a retired test pilot, SpaceX's head astronaut trainer and one of SpaceX's lead space operations engineers. All three have worked in mission control for previous flights and have trained for this mission for two years.

"Even though these are not government astronauts, they are not space tourists – they are professionals," says Laura Forczyk, an independent consultant in the space industry. "I don't think you could come up with four better non-government astronauts for this mission."

So while the Polaris Dawn mission has many inherent dangers, the preparation of SpaceX and its astronauts should mitigate them. There is no such thing as a risk-free space mission, much less a risk-free spacewalk, but this is a crucial test for Crew Dragon and SpaceX's new EVA suits, plus the explorers will have nearly 40 science experiments to work on while they are up there.

"While every EVA is risky, I would not say this is extraordinarily risky," says Forczyk. "They have gone through every single scenario, they have backups and redundancies for every scenario, they are so well-prepared." ▮

Physics

Quantum holograms can send messages that disappear

Karmela Padavic-Callaghan

A QUANTUM disappearing act could make it possible to embed secure messages in holograms and selectively erase parts of them even after they have been sent.

Quantum light signals carrying information are inherently secure, as intercepting their messages destroys frail quantum states that encode them. To make use of this without bulky devices, Jensen Li at the University of Exeter in UK and his colleagues used a metasurface, a 2D material engineered to have special properties, to create quantum holograms.

The team encoded information into a quantum state of a particle of light, or a photon. They used a laser to make a crystal emit two photons that were inextricably linked via quantum entanglement. The photons travelled on separate paths, with only one encountering the metasurface. Thousands of tiny components on the metasurface, like nano-sized ridges, changed the photon's quantum state, encoding a holographic image into it.

The partner photon encountered a polarised filter, which controlled which parts of the hologram are revealed – and which disappear. The original photon's state was a superposition of holograms, so it simultaneously contained many possible variations of the message.

Because the photons were entangled, polarising the second one affected the image the first one created when hitting a camera. The test hologram contained the letters H, D, V and A, but adding a filter for horizontally polarised light erased the letter H from the final image.

Li says the metasurface could encode more complicated information into the photons, for example as part of a quantum cryptography protocol. He presented the work at the SPIE Optics + Photonics conference in San Diego on 21 August. ▮