government says that this focus, and the project's management structure — each programme has its own manager, who coordinates research between mostly university-based scientists — were inspired by DARPA, a powerhouse for blue-skies research.

Critics have charged that ImPACT also mimics DARPA's explicit focus on 'dual-use' technologies with both military and civilian applications, and there are signs that it could have a military dimension. The military is "watching the ImPACT projects closely", says a defence-ministry representative who did not want to be named. And Atsushi Sunami, a researcher at the National Graduate Institute for Policy Studies in Tokyo who helped to create ImPACT, says that although Abe's main goals were economic, he was also drawn to the potential military applications "because of the changing security environment surrounding Japan, including the rising tensions with China".

However, some researchers whose projects have dual-use potential say that they feel little pressure to devise military uses.

Satoshi Tadokoro of Tohoku University will get ¥3.5 billion for a 'tough robotics' project developing aerial and legged automatons to withstand heat and explosions. He says that his project has no connection with the military and will be used for disaster relief.

Similarly, Yoshiyuki Sankai at the University of Tsukuba and his team are using ImPACT funding to develop an exoskeleton that picks up nerve signals from its wearer and converts them to mechanical force. It will be used in health care, to help caregivers who have to lift patients, says Sankai.

The ministry of defence's ¥300-million fund is much less ambitious than ImPACT. The money will go to a competitive grant programme similar to those run by the health and economics ministries. But it will be explicitly earmarked for dual-use technologies, including ones that create military equipment or apply cutting-edge technology to defence.

"In terms of the government strategy of asking universities and research institutes to do military research, this is a major turning point," says Norikazu Kameyama, an agricultural scientist at the University of the Ryukyus in Okinawa.

University budgets have been cut over the past decade, and scientists have become increasingly reliant on ministry grants. Hamada says that some researchers are describing the defence grants as a "blessing". But he fears that the funding will come with restrictions on the ability to share data.

His is not a lone voice. He set up his online appeal with Kameyama in March last year, in response to earlier signs that the military was making incursions into research. It now has 1,000 signatures. "We are appealing to the conscience of scientists," says Kameyama. ■

NASA/JHUAPL/SWRI/STEVE GRIBBEN

The New Horizons probe (artist's impression) will be the first to visit Pluto and its moon Charon close up.

PLANETARY SCIENCE

Pluto mission hunts for hazards

Unknown moons pose a danger to the New Horizons craft as it journeys to the edge of the Solar System.

BY ALEXANDRA WITZE

On 11 May, a telescope aboard a NASA craft will turn and stare at Pluto — like a space-robot equivalent of a sailor watching for shoals that could take out his vessel.

As the New Horizons craft hurtles towards its 14 July rendezvous with Pluto, mission scientists are preparing to guide it through what could be a dangerous dusty realm. It will skim the orbit of the dwarf planet's largest moon, Charon, at more than 48,000 kilometres per hour. At that speed, hitting a dust particle the size of a rice grain could be fatal.

To minimize the risk of hitting debris from Charon or another, unknown moon, scientists will conduct seven 45-minute observation sessions between 11 May and 1 July. If they find a potential hazard, the team can change the spacecraft's course. That would mean forgoing some science observations, but it could also mean the difference between life and death for the first spacecraft ever to visit Pluto.

Mission leaders calculate that the chance of a dust particle knocking out New Horizons is just 1 in 10,000. The only way to avoid the hazard completely would be to stay away from Pluto altogether, says Marc Buie, a mission co-investigator at the Southwest Research Institute in Boulder, Colorado.

New Horizons, now roughly 90 million kilometres from Pluto, is giving humans their best-ever view of the dwarf planet. The spacecraft carries the Long Range Reconnaissance Imager, a giant zoom lens with a 20.8-centimetre aperture. During the hazard observations, the instrument will scan the space around Pluto and its five known moons, looking for objects as small as a few kilometres across.

The mission is almost certain to discover new moons in the process. The Hubble Space Telescope found two during its hazard searches before the Pluto mission: Kerberos, which measures 14–40 kilometres across, in 2011, and the smaller Styx in 2012. "I wouldn't be at all surprised if there were more," says Cathy Olkin, a New Horizons deputy project scientist at the Southwest Research Institute.

Charon, which is roughly the same width as Texas, is thought to have formed during a giant impact early in Pluto's history. The other four known moons are much smaller and may be debris spit out during the same collision. "The architectural details of this system are fascinating," says William McKinnon, a planetary scientist at Washington University in St. Louis,

Missouri. "It's like a miniature planetary system."

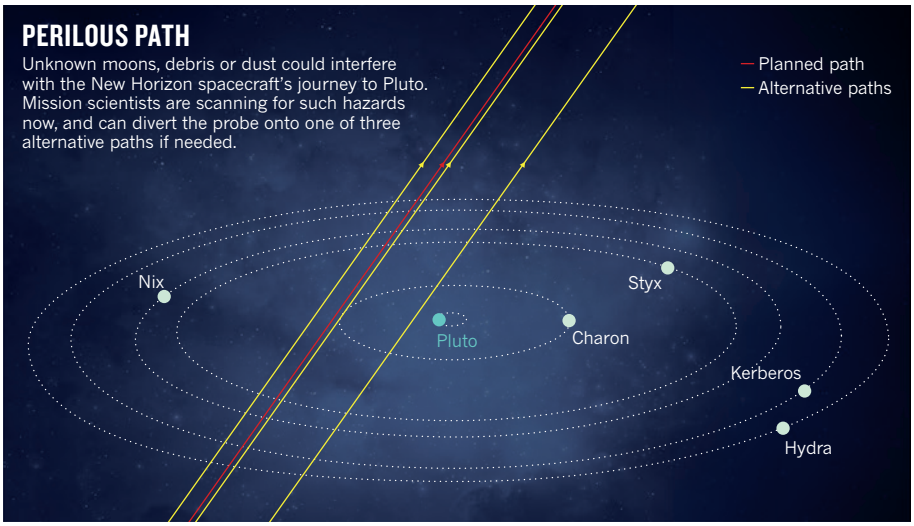
New-found moons might appear in any of a number of places around Pluto, says Buie. There is, for example, a pocket that nestles inside the orbit of Charon that is gravitationally stable enough for a moon to survive there for millions of years. But planetary scientists do not have a plausible explanation for how a moon might have appeared there to begin with, Buie says.

Another place that could have small moons is outside the orbit of Hydra, Pluto's outermost known moon. Buie hopes to find an exotic arrangement: moons sharing the same orbit. Any such discovery would rewrite the origin story of the Pluto–Charon system, he says.

As New Horizons gets closer to Pluto, it may even spot rings of dust around the dwarf planet. These could form when meteorites hit the small moons, kicking up dust that drifts away from the moons' low-gravity environments and into orbit around Pluto.

It is this streaming dust that poses the biggest danger to New Horizons. Mission scientists have been modelling where they think the dust from Pluto's moons might flow, and will do so again after the upcoming hazard searches.

If mission planners do spot something dangerous, they can divert New Horizons onto one of three alternative routes (see 'Perilous path').



PERILOUS PATH

Unknown moons, debris or dust could interfere with the New Horizon spacecraft's journey to Pluto. Mission scientists are scanning for such hazards now, and can divert the probe onto one of three alternative paths if needed.

SOURCE: NASA/JHU APPL. PHYS. LAB./SOUTHWEST RES. INST.

One option would leave the spacecraft on its current course but rotate it so that its antenna acts as a shield against incoming debris. Another possibility would send the craft diving much closer to Pluto, inside the orbit of Charon — assuming that there is no extra moon there. A third would nudge the spacecraft slightly farther away from Pluto.

The last chance to divert to one of these courses comes on 4 July. Choosing any of them would burn some of the fuel that engineers need to steer the spacecraft when it departs Pluto for a planned visit to a second icy world in the outer Solar System's Kuiper belt.

Even so, mission planners have a backup for this backup. They will command New Horizons to radio a little of its crucial data back to Earth in the two days before its Pluto encounter — just in case something takes the spacecraft out. ■

BIOTECHNOLOGY

Pint-sized DNA sequencer impresses first users

Portable device offers on-the-spot data to fight disease, catalogue species and more.

BY ERIKA CHECK HAYDEN

In April, Joshua Quick boarded a plane to Guinea with three genetic sequencers packed in his luggage. That fact alone is astonishing: most sequencing machines are much too heavy and delicate to travel as checked baggage in the hold of a commercial airliner. What came next was even more impressive. For 12 days, Quick used these sequencers — called MinIONs — to read the genomes of Ebola viruses from 14 patients in as little as 48 hours after samples were collected.

That turnaround has never been available to epidemiologists in the field before, and could help them to trace sources of infection as they try to stamp out the West Africa epidemic. The European Mobile Laboratory Project, based in Hamburg, Germany, is building a dedicated MinION lab at a treatment centre in Coyah, Guinea, where the machines will be used to sequence patient DNA.

"This is democratization of sequencing," says Quick, who studies Ebola genomes with Nicholas Loman (both are bioinformaticians at the University of Birmingham, UK). "You don't have to rely on expensive infrastructure and costly equipment."

Quick and Loman's research exemplifies what excites biologists about the MinION, a palm-sized gene sequencer made by UK-based Oxford Nanopore Technologies. The device is portable and cheap. It can read out relatively long stretches of genetic sequence, an ability increasingly in demand for understanding complex regions of genomes. And it plugs into the USB port of a laptop, displaying data on the screen as they are generated, rather than at the end of a run that can take days.

"The MinION is pretty extraordinary," says David Deamer, a biochemist at the University of California, Santa Cruz. "We're all on kind of a high right now."

The MinION was first released last spring through an early-access programme that offered researchers the device and flow cells — the disposable working guts of the sequencer — for a US$1,000 deposit. At a meeting in London on 14 and 15 May, users will share their experiences of testing the device and writing programs to analyse the data it generates. For example, Deamer is using it to detect and study the kinds of nucleic acids that might have given rise to Earth's earliest life.

The pilot programme has helped Oxford Nanopore to recover from a recent gaffe. It promised in 2012 that in 2013 it would release not just the MinION but also other machines able to sequence a human genome in 15 minutes. Those superfast machines have not yet come to pass, but in February 2014 the company rolled out the MinION. Initial tests suggested that it was not nearly as fast as ▶