Google vs. EU

Google's three-day appeal hearing against a €2.4-billion antitrust fine imposed by the European Commission started in Luxembourg on Wednesday, BBC reported.

IRAN DAILY Science & Technology

Europe's Mars rover heads for fit checks

Europe's Mars rover, "Rosalind Franklin", is on the move again.

The robot has just completed environmental testing at the Airbus factory in Toulouse, France, and is now going east to another aerospace facility run by Thales Alenia Space, BBC reported.

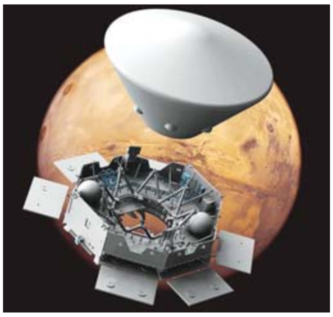
It's on the French Riviera, in Cannes, that the vehicle will join the hardware that will carry it to the Red Planet and put it safely on the surface.

Once this integration is complete, the rover can then go for launch.

Rosalind Franklin is due to leave Earth in July or August this year on a Proton rocket, arriving at Mars in March 2021.

The six-wheeled robot is equipped with scientific instruments designed to look for signs of life.

The project is a joint venture of the European Space Agency (ESA) and its Russian counterpart, Roscosmos.



ESA

The rover will travel to Mars inside a capsule attached to a German cruise vehicle.

Rosalind Franklin was assembled in the UK over a period of about 18 months. Airbus then took the vehicle to Toulouse to put it in a thermal-vacuum chamber – a testing unit that can simulate the extreme conditions of travelling to, and working on, Mars.

Having survived this challenge of heat, cold and airlessness, the rover must now be joined to its entry, descent and landing (EDL) system; and the spacecraft that will shepherd everything to the Red Planet.

These other elements have been manufactured by different companies across Europe and Russia; and it is the job now of Thales Alenia Space, as prime contractor, to make sure all parts work together.

Assuming no technical problems in this fit-check are encountered, the entire hardware package can move to the Baikonur Cosmodrome in Kazakhstan to meet the launch Proton.

In parallel to all this, ESA continues to work on the parachutes that will help slow Rosalind Franklin during its EDL phase. These chutes, which will be deployed at high velocity, have experienced tearing during testing.

They must perform flawlessly in two final high-altitude practice deployments in the US in the coming weeks before the final go-ahead for the rover mission is given.

ALAMY

Something special about bat immunity makes them ideal viral incubators

Ebola. SARS. Rabies. MERS. Most probably even the flourishing new coronavirus, COVID-19. There's one animal that innocently and unwittingly gifts all these virulent scourges to humanity. Bats.

Why is that? According to new research, it's because bats may be the ultimate incubator, courtesy of a fiercely effective and robust immune system that seems to, in effect, train up viral strains, encouraging them to adapt and evolve into becoming as fit and infectious as they possibly can, eLife reported.

It's an unfortunate side effect of what is otherwise an awesome survival mechanism. Not unfortunate for bats, that is, but certainly for other species – because when viruses manage to leap from bats to other sorts of animals, including humans, the recipients' immune responses aren't equipped to counter these attuned, efficient, and highly transmissible pathogens.

"The bottom line is that bats are potentially special when it comes to hosting viruses," said disease ecologist Mike Boots from University of California, Berkeley.

"It is not random that a lot of these viruses are coming from bats."

In a new study, Boots and fellow researchers investigated virus infectivity on bat cell lines, including cultures from the Egyptian fruit bat (*Rousettus aegyptiacus*) and the Australian black flying fox (*Pteropus alecto*).

Cells called Vero cells from a monkey (the African green monkey, *Chlorocebus*), were also used as a control, but these monkey cells were at a definite disadvantage.

That's because one of the molecular mechanisms in bats' immune systems is the lightning fast production of a signaling molecule called interferon-alpha, which is triggered in the response of viruses. When interferon proteins are secreted by virus-infected cells, nearby cells go into a defensive, antiviral state.

The African green monkey cell line does not possess such advantages. In experiments, when the cell cultures were exposed to viruses mimicking Ebola and Marburg virus, the monkey cells were quickly overwhelmed. The bat cells, on the other hand, resisted the viral onslaught, thanks to their rapid interferon signaling.

The paradox, though, is that interferon ultimately seems to benefit viruses, even while it hinders their capacity to kill cells. While the signaling system prevents cells from dying, the infection nonetheless holds on, and the virus starts to adapt to the defensive regime, at least according to the team's computer simulations.

"This suggests that having a really robust interferon system would help these viruses persist within the host," said biologist and first author of the study, Cara Brook.

"When you have a higher immune response, you get these cells that are protected from infection, so the virus can actually ramp up its replication rate without causing damage to its host. But when it spills over into something like a human, we don't have those same sorts of antiviral mechanism, and we could experience a lot of pathology."

It's important to note that humans do have interferon-alpha, but bats seem to have a much easier time with viruses than we do.

Even when bats are infected with pathogens that can kill humans, they don't demonstrate obvious disease symptoms, but instead carry viruses as long-term persistent infections. That persistence, the researchers say, seems to be encouraged by interferon.

More research is needed to investigate why bat interferon systems seem to be more robust and faster than ours.

"Critically, we found that bat cell lines demonstrated a signature of enhanced interferon-mediated immune response … which allowed for establishment of rapid within-host, cell-to-cell virus transmission rates," the authors explain in their study.

"The antiviral state induced by the interferon pathway protects live cells from mortality in tissue culture, resulting in in vitro epidemics of extended duration that enhance that probability of establishing a long-term persistent infection."

The upshot, the team says, is that rapidly replicating viruses that have evolved within bats will probably cause enhanced virulence if they jump to subsequent hosts, including humans, with immune systems that diverge from those unique to bats.

Sometimes an intermediary is involved, like pigs, camels, or horses. Whichever animal is unlucky enough to be a spillover host, though, it's unlikely they'll be ready for the fate that awaits them.

Nonetheless, knowing how and why this happens is vital to fighting these viruses, no matter how formidable their training, gleaned inside the invulnerable bodies of bats, may have made them.

"It is really important to understand the trajectory of an infection in order to be able to predict emergence and spread and transmission," Brook said.

Sound, light to help generate ultra-fast data transfer

Researchers have made a breakthrough in the control of terahertz quantum cascade lasers, which could lead to the transmission of data at the rate of 100 gigabits per second – around one thousand times quicker than a fast Ethernet operating at 100 megabits a second.

What distinguishes terahertz quantum cascade lasers from other lasers is the fact that they emit light in the terahertz range of the electromagnetic spectrum. They have applications in the field of spectroscopy where they are used in chemical analysis, eurekalert.org reported.

The lasers could also eventually provide ultra-fast, short-hop wireless links where large datasets have to be transferred across hospital campuses or between research facilities on universities – or in satellite communications.

To be able to send data at these increased speeds, the lasers need to be modulated very rapidly: Switching on and off or pulsing around 100 billion times every second.

Engineers and scientists have so far failed to develop a way of achieving this.

A research team from the University of Leeds and University of Nottingham believe they have found a way of delivering ultra-fast modulation, by combining the power of acoustic and light waves. Their findings were published in Nature Communications.

John Cunningham, professor of Nanoelectronics at Leeds, said, "This is exciting research. At the moment, the system for modulating a quantum cascade laser is electrically driven – but that system has limitations.

"Ironically, the same electronics that delivers the modulation usually puts a brake on the speed of the modulation. The mechanism we are developing relies instead on acoustic waves."

A quantum cascade laser is very efficient. As an electron passes through the optical component of the laser, it goes through a series of 'quantum wells' where the energy level of the electron drops and a photon or pulse of light energy is emitted.

One electron is capable of emitting multiple photons. It is this process that is controlled during the modulation.

Instead of using external electronics, the teams of researchers at Leeds and Nottingham Universities used acoustic waves to vibrate the quantum wells inside the quantum cascade laser.

The acoustic waves were generated by the impact of a pulse from another laser onto an aluminum film. This caused the film to expand and contract, sending a mechanical wave through the quantum cascade laser.

Tony Kent, professor of physics at Nottingham said "Essentially, what we did was use the acoustic wave to shake the intricate electronic states inside the quantum cascade laser. We could then see that its terahertz light output was being altered by the acoustic wave."

Cunningham added, "We did not reach a situation where we could stop and start the flow completely, but we were able to control the light output by a few percent, which is a great start.

"We believe that with further refinement, we will be able to develop a new mechanism for complete control of the photon emissions from the laser, and perhaps even integrate structures generating sound with the terahertz laser, so that no external sound source is needed."

Kent said, "This result opens a new area for physics and engineering to come together in the exploration of the interaction of terahertz sound and light waves, which could have real technological applications."

UNIVERSITY OF LEEDS

Image shows Aniela Dunn, research fellow at the University of Leeds, holding the laser on its mounting.