Science & Technology Briefs

Anti-Russia Sanctions Put Pressure on ITER Fusion Energy Cooperation

"In less than ten days, a whole section of the Western academic world has chosen to cut its ties with Russian research as a sign of protest against the war in Ukraine led by the Kremlin," reported the French daily *La Tribune* March 14. This, despite the fact that, fearing to be cut off from the West, 7,000 Russian researchers Feb. 24 had openly disapproved of Russia's military operation in Ukraine in an open letter to President Vladimir Putin posted on the website of *Troitsk Variant: Science*.

That didn't prevent MIT from ending its partnership with the Skolkovo Institute of Science and Technology (Skoltech). On March 7, it was the turn of the Association of European Universities (EUA), which suspended its collaboration with 12 Russian universities whose rectors had said that supporting the army and the President was part of their patriotic duty. The EUA replied that they had betrayed the European values they "had embraced by joining the association."

Germany, Denmark, the Netherlands, Norway, Sweden and Lithuania have all announced that they are halting all partnerships with Russia and Belarus. In France, the National Center for Scientific Research (CNRS) has suspended "all new forms of collaboration" with Russia, while assuring that Russian scientists currently working in CNRS labs will be able to continue, for now.

And on March 9, the board of the 23-nation prestigious European Organization for Nuclear Research (CERN), the world's largest particle physics center, in the formerly neutral country of Switzerland, voted to suspend Russia's observer status and forbade its representatives from attending CERN's deliberations. It chose, however, not to expel the 1,000 Russian scientists who represent about 8% of CERN's international users.

Such decisions are also the result of intense lobbying from Ukrainian scientific institutions. "We call on the world scientific community to immediately stop the bloodshed and barbaric destruction of a civilized European country," said Anatoly Zagorodny, president of the National Academy of Sciences of Ukraine, in late February. "Do not leave us alone in the face of the brutal aggressor."

However, many scientists doubt that such a political commitment would serve science. Last week, the International Astronomical Union (IAU) rejected a petition from Ukrainian astronomers to ban Russian astronomers from IAU activities. "The IAU was founded just after World War I to bring colleagues together, so we do not want to alienate them by deciding whom to support based on what their governments are doing," wrote IAU President Debra Elmegreen.

The freezing of numerous scientific collaborations with Russia could also cause the International Thermonuclear Experimental Reactor (ITER) program under construction in Cadarache, France, to falter. Russia participates in the ambitious international research project (9.1%) along with the European Union (45.6%), and the United States, China, India, Japan and South Korea (9.1% each), all providing most of their contributions in kind, in the form of precision parts, systems, and buildings for the titanic experimental puzzle made up of 10 million components. For the moment, ITER has no plans to expel Russia, a full member of the major scientific collaboration.

China Releases Space Plan

On Jan. 28, China's State Council released a White Paper, "China's Space Program: A 2021 Perspective." Since the last White Paper in 2016, China has had major accomplishments in space: the completion of the first phase of the lunar exploration program, the start of the construction of a space station, and its first interplanetary mission to Mars. China and Russia jointly announced their planned International Lunar Research Station (ILRS) in June 2021.

For the next five years, China's focus will be on consolidating its accomplishments and developing space industry in China and in partnering nations. The Preamble states: "The space industry is a critical element of the overall national strategy" and will "contribute more to China's growth as a whole." Already space assets have become an important part of China's high-speed rail program, disaster alleviation capabilities, and poverty alleviation programs.

China has a two-pronged approach to international cooperation. First, to seek partners among other space-faring nations for its *Tiangong* space station and ILRS. Second, to bring developing countries into the space arena. "Since 2016 China has signed 46 space cooperation agreements or memoranda of understanding with 19 countries and regions and four international organiz-

ations," the White Paper states.

Through programs affiliated with the UN and its own regional organizations, China has trained almost 1,000 space industry professionals. The Belt and Road countries are a special focus for increasing access to space technology.

ESA Suspends ExoMars Space Mission

In response to Russia's military operation in Ukraine, at its March 17 meeting the European Space Agency's Council unanimously voted to suspend cooperation with Russia on the ExoMars mission, previously scheduled to launch on a Russian rocket in September.

A plan to go ahead without Russia for ExoMars would involve more than replacing the Proton rocket. Russia also built the Kazachok lander. The rover itself includes Russian instruments and radioisotope heating units. The next launch windows are Nov. 2024 and Dec. 2026—about every 26 months. Replacing all Russian-made parts would take three years. If the 2026 window were missed, the aging of the technologies might cause the ESA to scrub the mission.

A statement by ESA also addressed Russia's Feb. 26 decision to halt Soyuz launches from Kourou, French Guiana, and the withdrawal of its personnel from Kourou in response to the European sanctions. That decision puts five European missions in limbo—two launches of Galileo navigation satellites, ESA's Euclid space observatory, EarthCARE Earth science satellites, and a French military reconnaissance satellite.

For his part, Roscosmos Director Dmitry Rogozin wrote on Telegram: "The Europeans are withdrawing from the ExoMars project. This is a very bitter event for all space enthusiasts. It is very regrettable." Rogozin was, however, reassuring that Russia itself could carry out this mission alone "in a few years. Yes, we will lose a few years … but we will be able to carry out this research mission by ourselves from Vostochny, our new launch site."

Hovercraft Feasible for the Moon and Asteroids

Aerospace engineers at the Massachusetts Institute of Technology (MIT) are testing a concept for a hovercraft rover. It would be a small vehicle, as the forces involved are only strong enough to levitate 1 kg (2.2 lb.).

The Moon and other airless bodies "can build up an electrical field through direct exposure to the Sun and surrounding plasma. On the Moon, this surface charge is strong enough to levitate dust more than 1 meter above the ground, much the way static electricity can cause a person's hair to stand on end," wrote Jennifer Chu, in "MIT Engineers Test an Idea for a New Hovering Rover," in *MIT News* Dec. 21.

Chu quotes Prof. Paulo Lozano, Director of MIT's Space Propulsion Lab: "An asteroid's terrain could be totally uneven, and as long as you had a controlled mechanism to keep your rover floating, then you could go over very rough, unexplored terrain."

The potential of this surface charge was demonstrated in 2005 when the Cassini spacecraft encountered Hyperion, one of Saturn's moons, as reported Oct. 16, 2014 by NASA's Jet Propulsion Laboratory ("Cassini Caught in Hyperion's Particle Beam"):

"The [MIT] concept, which resembles a retro-style, disc-shaped flying saucer, uses tiny ion beams to both charge up the vehicle and boost the surface's natural charge…. The team's levitating design relies on the use of miniature ion thrusters, called ionic-liquid ion sources. These small, micro-fabricated nozzles are connected to a reservoir containing ionic liquid in the form of room-temperature molten salt. When a voltage is applied, the liquid's ions are charged and emitted as a beam through the nozzles with a certain force. The Cassini Plasma Spectrometer detected that the spacecraft was magnetically connected to the surface of Hyperion for a brief period, allowing electrons to escape from the moon toward the robotic probe."

Tom Nordheim, then a doctoral candidate at Mullard Space Science Laboratory, University College London, wrote:

"The finding is surprising, as the small but odd-looking moon was thought to be a simple inert object, which would not undergo any strong interactions with the Saturnian magnetosphere. Nevertheless, … Cassini remotely detected a strongly negative voltage on Hyperion. It was rather like Cassini receiving a 200-volt electric shock from Hyperion, even though they were over 2,000 km apart at the time."

Venus' Winds May Make It Rotate

A paper published on April 20 in *Nature Astronomy* presents a new theory that the winds of Venus cause it to rotate, not the gravitational relationship between it and the Sun.

Venus rotates, albeit very, very slowly—it takes 117 Earth days for Venus to complete one day (sunrise to sunrise, as we think of it). It also spins in the opposite direction of most of the planets. Stephen Kane, an astrophysicist at the University of California at Riverside, and his co-authors, are now hypothesizing that this slow spin is driven by its high-speed winds. The *prevailing* winds on Venus are in the range of 225-250 mph, and the entire atmosphere circles the planet every 96 hours.