Science & Technology Briefs

A Reliable Four-Minute COVID Test

Scientists at Fudan University in Shanghai have come up with a new method for coronavirus testing, which they say is as sensitive but much quicker than PCR lab testing. The new method uses ultrasensitive electromechanical sensors capable of detecting, with high precision, SARS-CoV-2 RNA in human genetic material, according to the study published Feb. 7 in the journal *Nature Biomedical Engineering*.

"We implemented an electromechanical biosensor for the detection of SARS-CoV-2 into an integrated and portable prototype device, and showed that it detected [the virus RNA] in less than four minutes," the researchers said.

The study involved testing the new method on 33 samples taken from COVID-19-infected patients and 54 COVID-negative controls taken from people with influenza and fever, as well as from perfectly healthy subjects. PCR tests were also taken. The new electromechanical sensor showed results that matched with the PCR tests, showing positive results for those infected with COVID-19 and negative for other samples. The results of the testing were received within four minutes.

A Yearly COVID-19 Booster?

Prof. Uğur Şahin, founder and CEO of BioNTech, the partner in Pfizer's mRNA-based COVID vaccine, told Germany's weekly *Bild am Sonntag* Nov. 21 that people all over the world will need to get "boosted" once a year. Dr. Şahin said the vaccine co-developed by his company was "very effective." Asked if people should worry about "breakthrough infections"—when those vaccinated with the Pfizer/BioNTech vaccine still developed COVID-19 symptoms—he dismissed that concern, saying that the Pfizer vaccine offers a "90% protection" against cases that require intensive care in those older than five.

Dr. Şahin added that Pfizer's "very high" level of protection against severe illness lasts for up to nine months, and reduces the rate and severity of hospitalization, but starts decreasing "from the fourth month." To maintain protection, he strongly pushed for yearly booster shots, arguing that they would not just restore levels of antibodies, but also would potentially help "to break … chains of infection," by "preventing its spread and the formation of new variants." He encouraged doctors to be as pragmatic as possible, and "not to send people home unvaccinated even though they could be vaccinated without any problems." He said that he expects protection from a booster shot to "last longer" than the immunity acquired after the initial two doses.

Lunar Nuclear Power Systems Are Coming

NASA and the Battelle Energy Alliance, a contractor for the U.S. Department of Energy's Idaho National Laboratory (INL), "are seeking proposals from nuclear and space industry leaders to develop innovative technologies for a Fission Surface Power (FSP) system for lunar power applications," they announced in a Nov. 19 press release. The FSP project aims "to establish a durable, high-power, sun-independent power source for NASA missions on the Moon by the end of the decade, as well as potential subsequent missions."

According to Sebastian Corbisiero, INL Fission Surface Power Project leader, "The feedback and enthusiasm we continue to see for space nuclear power systems has been very exciting, and understandably so. Providing a reliable, high-power system on the Moon is a vital next step in human space exploration, and achieving it is within our grasp."

"Plentiful energy will be key to future space exploration," said NASA Associate Administrator Jim Reuter, as quoted in the release.

Meanwhile, China is developing a nuclear reactor to power its Moon and Mars surface missions, "100 times more powerful than a similar device NASA plans to put on the surface on the Moon by 2030," according to an article in the Nov. 24 *South China Morning Post*.

China and Russia Space Cooperation Agreement

Russia and China are drafting a legally binding agreement to be signed in 2022 for a 5-year Space Cooperation Program, 2023-2027, including a plan to create an open and inclusive International Lunar Research Station (ILRS) by 2035, *Global Times* reported Dec. 29.

The agreement will support development of the ground segments of the two countries' national satellite sys-

tems—Russia's GLONASS and China's BeiDou Navigation Satellite System to be installed next year—and a schedule of projects Roscosmos and the China National Space Agency (CNSA) will work on in coming decades.

In contrast with the U.S. lunar exploration project (the Artemis Accords) which *Global Times* claims expresses its "exclusive nature for mimicking a space-based NATO," the China-Russian partnership will emphasize bringing advancement for all, with the vision of building a shared future for mankind. It will be the largest current cooperation project between the two "long-standing and reliable partners" in the space field, providing for the construction of a station by 2035 on the lunar surface, while establishing experimental research facilities for broader work in lunar orbit. The ILRS will include an Earth-to-Moon flight system, a lunar surface travel and operations system, an auxiliary long-term operating system for the lunar surface, and automatic facilities with complexes of scientific instruments.

Wu Yanhua, the Deputy Administrator of CNSA who announced the ILRS program last Spring, announced recently that the government has approved Phase 4 of China's lunar missions, which will include new Chang'e-6, -7 and -8 missions to be carried out in the next decade. Chang'e-7 will be a probe to the lunar South Pole, followed by Chang'e-6 sample and return mission from the South Pole, and Chang'e-8, the last of Phase 4, will construct the core of the ILRS.

Adding to its cooperation with the upcoming Chang'e series, Roscosmos says it has begun implementing agreements with CNSA in the coordination of the Russian Luna-Resurs-1 (OA) orbital spacecraft and the Chinese Chang'e-7 mission, as well as cooperation in the creation of a joint Lunar and Deep Space Exploration Data Center.

Support for More Fusion Energy Funds in Congress Is Partisan, Insufficient

On Feb. 4, the U.S. House of Representatives passed an amendment to the bill H.R. 4521 to increase support for fusion energy. The amendment, sponsored by Democratic Reps. Lori Trahan (MA), Donald Beyer (VA), and Jamaal Bowman (NY), would increase the authorized funding for the Department of Energy's proposed milestone-based public-private partnership program for fusion energy from $325 million over 5 years to $800 million. It would also increase authorized funding for a new materials development program from $200 million to $400 million over the coming five years.

The amendment passed as part of a larger block of science-related amendments by a vote of 221-211, and the underlying legislation passed by 222-210, in each case with all but one Democrat voting in favor, and all but one Republican voting against. Rep. Trahan is a longtime supporter of fusion energy, having sponsored the fusion amendment to the Energy Act of 2020 that created the fusion energy milestone program; Rep. Beyer is Chairman of the Bipartisan House Fusion Energy Caucus; and Rep. Bowman is the Chairman of the Subcommittee on Energy of the House Committee on Science, Space, and Technology.

Even if passed by the Senate, which is not expected, this legislation only increases the *authorized* level of funding, and does not *appropriate* any funding.

Space Telescope for X-Ray Polarimetry To Explore Pulsars and Nebulae

A SpaceX Falcon 9 rocket launched NASA's IXPE, the Imaging X-Ray Polarimetry Explorer, from the Kennedy Space Center in Florida on Dec. 9. The mission will explore some of the inner workings of the universe's most dynamic and intriguing objects—black holes, pulsars, quasars, and magnetars—and, for the first time, will be able to image the polarization of x-rays coming from these objects.

Electromagnetic waves—that is light waves, including x-rays—may have wave motion at any perpendicular angle with respect to the light's line of travel. When light is polarized, it is limited to wave motion at a specific such angle. (Polarized sunglasses filter out all light waves except for those with a particular angle of wave motion, relative to the line of travel.)

As reported in *MIT Technology Review*, "IXPE actually has three telescopes, each equipped with a set of mirrors and a detector that's able to track and measure four properties of light: its direction, arrival time, energy, and polarization. Data about the incoming x-rays from those three detectors is combined to create an image. Scientists hope to use IXPE's images to refine their theories about different celestial environments and the objects inside them."

When looking at something like the Crab Nebula—it is the first object that IXPE will investigate—its x-ray polarization will perhaps provide clues as to why the pulsar at the center of this nebula—the remains of an exploded star—is spinning rapidly and flashing like a lighthouse.

Perhaps the most exciting portion of the IXPE mission will be its focus on the supermassive black hole at the center of our Milky Way galaxy.

"There are only really three things that you can measure about the properties of a black hole: its mass, its spin, and its charge," says Gregory Sivakoff, an associate professor at the University of Alberta. "I'm really interested about the ability for IXPE to give us a new way of measuring the spin, and possibly even checking to see if there are any changes to that spin over a long enough time."