Science & Technology

U.A.E. Electronic Cloud Seeding Produces Rain

The United Arab Emirates used drones to deliver electrical charges into rain clouds in mid-July, creating conditions that led to rain. For a country that typically receives only about 4 inches of rain per year, with temperatures topping 110°F, the man-made rainfall came as a pleasant relief. In June, a sweltering day over 125°F was recorded. The UAE project was carried out by its National Center of Meteorology, in a project design which comes from a research team at the University of Reading, England. Rather than dispersing chemical particulates, as is done in traditional cloud seeding, and which the UAE has studied for years, this Summer program used drones to target certain clouds, and issue electrical discharges via concentrated lasers. What happens is that water droplets are forcibly formed of a certain size triggering the desired rainfall.

Scientists Achieve Room-Temperature Superconductivity

A March 31, 2021 press release provided an updated report on the work of the team of physicists at the University of Rochester led by Dr. Ranga Dias, which produced the world's first room-temperature superconductor in October 2020, a fundamental breakthrough that could pave the way for advances in maglev trains, superconducting transmission lines, and, most thrilling, the accelerated development of fusion power.

Superconductivity occurs when a material can conduct electricity with zero resistance, that is, without losing any energy to heat dissipation.

In 1911, it was discovered that mercury could be a superconductor when cooled to 4° above absolute zero (0° Kelvin, -272.15°C, -459.7°F). That critical temperature has been used in several processes, but a tremendous input of energy is needed to achieve and maintain such a low temperature. By the mid-1990s, physicists had developed materials that superconduct at -109°C (-164°F).

In 2020, Dr. Dias, a Sri Lankan, and his team used metallic hydrogen, a material that had been associated with superconducting for more than two decades, to achieve a new result. They placed a small sample of hydrogen, carbon, and sulfur at the tip of two opposing diamonds (a "diamond anvil"), at a pressure more than a million times that of the atmosphere at sea level. The result: a synthesized carbonaceous sulfur hydride, which exhibited superconductivity at 14.4°C (58°F), that is, at room temperature!

Dr. Dias remarked that room-temperature superconductors could "open the door to many potential applications": long-distance electricity transmission; "a new way to propel levitated trains" (i.e., maglev); "medical imaging and scanning techniques, such as MRI and magneto cardiology," and electronics, such as microchips, increasing the speed, according to one estimate, by as much as 1,000.

One of its most promising features could be in producing fusion power. Recently, researchers from MIT and a spinoff company, Commonwealth Fusion Systems, have published papers proposing that they could, with room-temperature superconducting materials, generate a self-sustaining demonstration reactor within the next five years, and a pilot operating plant within 15 years. The plant would be a donut-shaped tokamak reactor.

Promising Plasma Rocket Developments for Space Travel

There have been two breakthroughs recently in the development of plasma rockets, which would transform space travel.

As reported by *Politico*, on July 16, one of them is being developed by the Ad Astra Rocket Company. According to its website, their engine, the "Variable Specific Impulse Magnetoplasma Rocket (VASIMR), is a new type of electric thruster with many unique advantages. Gas such as argon, xenon, or hydrogen is injected into a tube surrounded by a magnet and a series of two radio wave (RF) couplers. The couplers turn cold gas into superheated plasma and the rocket's magnetic nozzle converts the plasma thermal motion into a directed jet. This engine is undergoing testing, which has been successful so far in maintaining a stable temperature. It will be developed to be an electric-fusion hybrid engine.

Ad Astra's CEO, Franklin Chang-Diaz, a mechanical engineer and a former NASA astronaut, told *Politico,* "There is no other electric rocket that has this capability. The most powerful operational electric rocket is 5 kilowatts. We're at 80 kilowatts right now

and we've been running for more than three days. No one has ever fired a rocket at this level. We can see missions to Mars that could be two to three months one way and even faster than that as the technology progresses ... [as compared to] seven to eight months and maybe even longer. It would completely transform the way transportation is done."

Another design being developed is that at DOE's Princeton Plasma Physics Laboratory (PPPL), by physicist Fatima Ebrahimi, as reported by *Interesting Engineering*. Her design uses the tokamak or spherical torus principle for fusion power. In January, Ebrahimi told *PPPL News*:

"There are three main differences between Ebrahimi's thruster concept and other devices. The first is that changing the strength of the magnetic fields can increase or decrease the amount of thrust. By using more electromagnets and more magnetic fields, you can in effect turn a knob to fine-tune the velocity."

"Second, the new thruster produces movement by ejecting both plasma particles and magnetic bubbles known as plasmoids. The plasmoids add power to the propulsion and no other thruster concept incorporates them.

"Third, unlike current thruster concepts that rely on electric fields, the magnetic fields in Ebrahimi's concept allow the plasma inside the thruster to consist of either heavy or light atoms. This flexibility enables scientists to tailor the amount of thrust for a particular mission." While other thrusters require heavy gas, made of atoms like xenon, in this concept you can use any type of gas you want."

Faster space travel with a plasma rocket would not only make faraway planets and moons more accessible, but lessen the amount of time that astronauts would be exposed to cosmic radiation and other hazards of space travel. It would also mean that with the development of a controlled fusion reaction, mankind could develop unlimited resources, here and beyond.

Russian Space Agency Plans Nuclear Power on Mars

Engineers at the Arsenal Design Bureau, subsidiary of Roscosmos, the Russian space agency, have proposed the creation of a nuclear power plant for a future Russian Mars base, reports Sputnik July 11. Based in St. Petersburg, the ADB specializes in the production of spacecraft, satellites, and other space technologies.

"Under Arsenal's proposal, the reactor would be delivered to the Red Planet aboard the Zeus [an interplanetary nuclear-powered space tug], and floated down to its surface using a parachute system. After landing, the power plant would be activated to provide energy to a prospective Russian Martian base."

NASA Budget Increase Not Enough for Manned Space Missions

On July 12, the U.S. House Commerce, Justice and Science Subcommittee advanced a spending bill, approving $25.04 billion for NASA in FY2022, 7.6% higher than what NASA received in FY2021, but just 1% above the administration's request.

The biggest change in the budget is in space exploration, giving almost $400 million above the requested amount, increasing the funding for the Space Launch System (SLS), Exploration Ground Systems, and Exploration Research and Development, but this change in emphasis creates several problems for the Artemis (Moon-Mars) mission:

First, logistics for lunar development. *SpaceNews* reported July 12 that, despite the overall increase, "at a meeting of the steering committee of the planetary sciences decadal survey July 7, a NASA official said that the limited production rate of the SLS—currently one a year, and not slated to increase to two per year until as late as the early 2030s—meant that the cargo version of SLS would not be available until at least the late 2020s in order to support Artemis missions."

Second, nuclear propulsion. Rep. Robert Aderholt (R-AL), ranking member of the subcommittee, expressed disappointment that the bill does not require the funding to support a flight demonstration by 2024, a goal supported in past years' bills. He said, "I am deeply disappointed that the long-standing bipartisan language requiring NASA to use $80 million of the funding for the design of a flight demonstration was not included. The omission imperils the progress of, and our previous investments in, nuclear thermal propulsion capabilities." NASA's work on nuclear thermal propulsion is led by the Marshall Space Flight Center in Alabama.

The bill added $150 million to the nearly $2.4 billion requested for the development of the Human Landing Systems (HLS) program. But Aderholt also stated this may be insufficient for more than one lunar lander contractor: "This bill fails to adequately address recent unwise NASA decisions that have jeopardized the Human Landing System," meaning NASA's selection of only a single company, SpaceX, for an HLS award because of limited budgets. "I believe this committee must provide appropriate direction to NASA to restore foundational aspects of this program."