Science & Technology Briefs

Nuclear Fusion Breakthrough

On Dec. 5, 2022, for the first time in history, physicists achieved a net energy gain from a controlled nuclear fusion reaction. The U.S. National Ignition Facility (NIF) at Lawrence Livermore National Laboratory in California produced the result.

A Dec. 13 Department of Energy/National Nuclear Security Agency press conference, followed by a technical panel of NIF team leaders, discussed the energetics of the experiment: "wall outlet power" for the laser array, 300 megajoules; laser input power delivered to the target fuel, 2.05 megajoules; output from ignited fuel, 3.15 megajoules—all in part of a nanosecond. Note the extremely low 0.7% power efficiency of the laser array.

But the new plasma ignition milestone only accounts for the laser energy in and the plasma energy out, not the sizable loss from converting electricity to laser light. What's more, the reaction lasted only a few billionths of a second, and can only be repeated every six hours.

The key innovation which has probably advanced the NIF experiments of the past two years more than any other—namely, the use of an electric coil to *surround the laser-imploded fuel pellet with a strong magnetic field as it implodes*—was never mentioned by any director or team leader in the 75-minute presentation of the results. This, despite a *Physical Review Letters* article on just that subject published Nov. 4, 2022, by the innovation's originator, John Moody.

Why not? Perhaps because it is irrelevant to the primary purpose of this inertial confinement fusion program at Livermore, which is to analyze U.S. nuclear warhead performance without nuclear weapons testing. The program will get $641 million from the Fiscal 2023 NDAA, while most fusion R&D now depends on private funds.

Were a serious national fusion energy development program to be launched, this successful step in "hybridization" of magnetic and inertial confinement fusion would be of great importance. Instead, improving warheads for possible thermonuclear exchanges with other world powers is the purpose for which U.S. tax dollars fund fusion research.

Great Water Projects in Afghanistan

In Afghanistan, "water means food." Not waiting any longer for international help, and fully committed to overcoming its current economic-financial breakdown, unemployment, and food crisis, the Afghan government is going ahead with several water infrastructure projects, mainly via Afghanistan's giant state construction group National Development Company (NDC).

Over the past year the NDC has launched 692 projects worth $1.26 billion, completing 81, including 55 in the construction sector.

The largest project, the Qosh Tepa Canal, is 280 km long and 100 m wide. With a carrying capacity of 650 m^3/sec, it will irrigate 500,000 hectares and resolve the water shortage in Balkh, Jawzjan and Faryab provinces. Work on the project is expected to take 5 years and cost $680 million. Forty-two km of the project has been completed, between the Qosh Tepa area and the Daulatabad district. One-hundred twenty private companies and about 2,300 people are involved in its construction.

At the March 30, 2022 launch ceremony, First Deputy Prime Minister Mullah Abdul Ghani Baradar said that the completion of the canal is a national priority. "The country will reach self-sufficiency in agriculture after the construction of the canal," he said, according to the April 3 issue of *Kabul Times*. Also quoted was Zabihullah Mujhaid, Deputy to the Ministry of Information and Culture: "Afghanistan will not get rehabilitated via aids from foreign countries."

SKA, World's Largest Radio Telescope

On Dec. 5, 2022, ceremonies in Australia and South Africa marked the inauguration of the build phase of the Square Kilometer Array (SKA), the world's largest radio telescope. The SKA will link new observing equipment in the two countries to function as one large receiver—initially 4 receivers in Australia and 6 in South Africa will begin working in tandem as a single telescope in 2024.

Operating frequencies will range from 50 MHz to 25 GHz, allowing observation of radio emissions with wavelengths from centimeters to meters.

Scientists are excited about the telescope's ability to trace out the history of hydrogen in the universe and to examine such phenomena as "fast radio bursts" that emit enormous amounts of energy over fractions of a second.

According to the SKA project's

website, "The SKA will eventually use thousands of dishes and up to a million low-frequency antennas that will enable astronomers to monitor the sky in unprecedented detail and survey the entire sky much faster than any system currently in existence.

"Its unique configuration will give the SKA unrivalled scope in observations, largely exceeding the image resolution quality of the Hubble Space Telescope [but in radio wavelengths — ed.]. It will also have the ability to image huge areas of sky in parallel, a feat no survey telescope has ever achieved on this scale with this level of sensitivity. With a range of other large telescopes in the optical and infrared being built and launched into space over the coming decades, the SKA will perfectly augment, complement and lead the way in scientific discovery."

The SKA is in the southern hemisphere, where the view of our Milky Way Galaxy is best and radio interference least. Headquarters will be in the UK, where the computers processing the data will be located. By 2028, SKA will have an effective area of 500,000 m^2, half the final desired size of one square kilometer.

"Around 100 organizations across about 20 countries are participating in the design and development of the SKA. World-leading scientists and engineers are working on a system which will require two supercomputers each 25% more powerful than the best supercomputer in the world in 2019, and network technology that will see data flow at a rate 100,000 times faster than the projected global average broadband speed in 2022," according to the SKA website.

New Alloy Gets Stronger As It Gets Colder

ScienceAlert's website reported Dec. 11 on a new alloy with the highest fracture toughness ever measured in a material on Earth.

Normally, a metal or alloy may become stronger at a low temperature, but it will also become more brittle. This alloy, however, composed of equal amounts of chromium (Cr), cobalt (Co), and nickel (Ni), has exceptionally high strength and ductility—what a team of scientists has called "outstanding damage tolerance."

Science Alert explains:

"Strength, ductility, and toughness are three properties that determine how durable a material is. *Strength* describes resistance to deformation. And *ductility* describes how malleable a material is. These two properties contribute to its overall toughness: the resistance to fracture. *Fracture toughness* is the resistance to further fracture in an already-fractured material."

The experiment took the material first to the temperature of liquid nitrogen (−196°C, −321°F), and then to that of liquid helium (−253°C, −424°F). The James Webb Space Telescope's sunshield is kept at about –223°C (−370°F).

The scientific paper was published in *Science* Dec. 1. One of the senior authors, mechanical engineer Robert Richie of Berkeley National Laboratory and the University of California, Berkeley, said:

"The toughness of this material near liquid helium temperatures … is as high as 500 megapascals square root meters. In the same units, the toughness of a piece of silicon is 1, the aluminum airframe in passenger airplanes is about 35, and the toughness of some of the best steels is around 100. So, 500, it's a staggering number."

Neanderthals Try To Define Anthropocene Era

The *New York Times* Dec. 18 covered a debate among geologists as to when the "Anthropocene Era" began—when mankind became the dominant force on Earth. The debate, however, is embroiled in the political agenda of the "climate catastrophe" crowd, who insist on deriving "Anthropocene" from the time when man began to "pollute" the environment. An Anthropocene Working Group has been assigned the task of defining the beginning of that "era," but they can't seem to come to an agreement.

That era had already been defined at the beginning of the 20th century in the notion of the noösphere, which was given a quite precise definition by Russian scientist Vladimir Vernadsky. But the emphasis for Vernadsky and his cothinkers was not on *anthropos* as simply another species *per se*, but rather a species that had the power of thought (*nous* in Greek). It was the power of thought radically and successively changing the energy throughput of the biosphere which characterized this "revolution." The beginning of that era was defined by Vernadsky as between the voyages of exploration in the 15th century and the beginning of the 1900s. When humankind had reached almost every point of the globe, it was evident that *scientific thought* had become *the* dominant force in the Earth's biosphere.

The Anthropocene Working Group unfortunately concerns itself only with man *in* the biosphere, with no notion of the noösphere, and with many participants even viewing man as a parasite that has simply polluted a "pristine" nature. Those who say that humans should retreat to let other species thrive are only the most extreme proponents of this view. Many who are opposed to defining "Anthropocene" this way perhaps (correctly) fear that such a notion will be used to herd the credulous with such nihilistic views.