Study Opens Way for Crash Program Joining Space Travel to Fusion Power

by Paul Gallagher

Oct. 19—The presentation which follows, "Mining Helium-3 on the Moon," was given at the Schiller Institute's October 5 conference, "Man as a Galactic Species," in New York City, as part of more than 1,500 worldwide celebrations of "International Observe the Moon Night." The speaker, Dr. Aaron Olson, has been working at the Fusion Technology Institute of the University of Wisconsin in a fusion research program with a unique focus. It includes one of the most scientifically inquisitive and distinguished astronauts of Project Apollo, the planetary geologist Dr. Harrison Schmitt. Now 84, Harrison Schmitt has only recently[1] written scientific papers about an idea he formed while walking on the Moon nearly half a century ago; but he has discussed the possibilities of the idea with Dr. Olson and other colleagues.

That moment of lunar insight in 1972 seems to lie at the origin of the realization of what is, today, the potential that a gas trapped in the surface soil of the Moon could power the production of electricity on the Earth for centuries.

Observing the remains of an ancient avalanche down a mountain on the Moon, Dr. Schmitt observed—as Dr. Olson explains in his talk—that something *like a fluid* had carried the avalanche along, far from the mountain. No liquid seemed present. He hypothesized an explanation: that volatile gases were trapped in significant quantities in the lunar surface (the Moon has no gaseous *atmosphere*), and that rapid movement or "agitation" of the soil released them. He did not then know what those gases could be.

Now, many years later, Dr. Aaron Olson has been continuing experiments at Wisconsin to test that phenomenon Harrison Schmitt guessed at, together with the application of heat, to release a gas which, today, is known to be potentially the very best fuel for the long-sought process to produce commercial fusion power.

In fact, helium-3 could fuel the most energy-efficient form of limitless fusion power with no radioactive emission, versatile enough to propel rockets to Mars in a couple of weeks and to power civilization on Earth using the products of fusion reactions in the Sun, which the solar wind has deposited in large volume on and in the surface of the Moon—where it can be "mined."

A Crucial Experiment

Dr. Olson designed an experimental "miner" device to test the hypothesis and the potential to recover this fuel of potentially boundless benefit to mankind, helium-3, which scarcely exists on Earth.

It is a considerable challenge, given what Harrison Schmitt "discovered" (in his own mind) about the behavior of volatile gases on the Moon, without knowing then that one of them was helium-3. Inside the heating section of the experimental device, where the scientist wants to recover and collect the gas from the lunar soil, very fast motion and agitation of that soil is a benefit: Much more gas can potentially be released from the soil and collected. Outside that one section of the "miner," which is equipped to capture the helium-3, in all the rest of the apparatus and processes being used, fast motion and agitation of the soil leads to a loss—what Dr. Schmitt has estimated may have been a 40-45% loss of the helium-3 from the lunar surface by agitation over many millennia.

To quote Aaron Olson in a recent discussion:

> The result that came out of my thesis shows additionally, that increased *speed* also increases the amount of loss. So it would suggest to me, that if you can handle the material as slowly and carefully as possible, before it gets into the area

1. H.H. Schmitt et al., "Revisiting the Field Geology of Taurus-Littrow," *Icarus* Vol. 298 (December 2017), pp. 2-33. Journal homepage: www.elsevier.com/locate/icarus

> where you *want* the release to happen, an area where you have gas tanks and so forth attached to be able to do the collection, then *within* the area where you are doing the collection, you increase the speed and the interaction between the particles by making the path that the particles have to flow through the device as torturous as possible; or, in an area where, particularly, the sheer stress would be as high as possible. So the grains are rubbing against themselves and other grains at as high a speed as possible, therefore trying to release as much [gas] as possible by agitation.

This is years and many steps from the original discovery of a thought while walking the Moon's surface. Scientific progress often moves in this way: A scientist observes something anomalous, unexplained by what he or she knows of science and the environment. A thought-experiment produces an intuition as to what might explain it, which may develop over years as a result of observing what human effort discovers about that environment—such as the finding that helium-3 was present in lunar soil returned to Earth. Eventually experiments are designed which use what has become known, to test the hypothesis about what remains unknown—such as exactly what happens in the lunar soil when something sets it in motion.

Since that soil is constantly bombarded by the solar wind, cosmic radiation, meteorites, etc., and even moved by seismic activity, many such experiments have been devised, from afar and from lunar orbiters and landers, to solve those anomalies before human beings settle on the Moon and develop it. But *this* line of experimentation links that step of space exploration, to the power and propulsion source for many leaps to follow by "Mankind as a Galactic Species."

The Cost of Not 'Being Bold'

But this crucial work at Wisconsin must be reported with the pangs of knowing that such experimentation could have been underway many years ago, and in many, many laboratories, had JFK's Apollo Project been continued, naturally expanded, and naturally become connected with a similar "crash program" for fusion. The Moon is a vital node in space for fusion power, which in turn is vital to travelling from the Moon into the Solar System.

As late as 1986—decades after the first lunar soil samples came back to Earth for testing, and nearly 15 years after Harrison Schmitt's on-site observations about volatile gases in the lunar soil—scientists working on fusion power did not know that there was plentiful helium-3 on the Moon; and NASA engineers and scientists, who did know that, did not realize that helium-3 had any importance for fusion research. There was an intolerable denial of the discovery interchange which crash scientific missions require, and which they also drive. The mutual ignorance only began to be broken when Harrison Schmitt, in 1986, joined Fusion Technology Institute and became a vital human link between two frontiers of science and human endeavor.

But that could not change a situation in which fusion researchers, although gradually learning of plentiful helium-3 on the lunar surface, did not believe NASA *was going to go back to the Moon at all*, let alone mine helium-3 there. And so, few worked on a fusion power reaction, which—however promising—used a fuel available in only vanishingly small, extraordinarily expensive quantities on Earth. And NASA people were not aware that helium-3 fusion experimentation was even competitive with tokamaks and laser fusion in national laboratories using deuterium and tritium.

Yet Aaron Olson says it could "lead to a real fusion power plant—in my opinion—well before the ITER or the NIF program," referring to the International Tokamak Experimental Reactor project under construction in France and the National Ignition Facility, where laser fusion is being tested at Lawrence Livermore National Laboratory.

President Kennedy in 1962 spoke at Rice University of the many astonishing technology breakthroughs which had to be achieved in just a handful of years to get humans safely to the Moon and back—and they were achieved with amazing speed—and said, "We must be bold." He added, "Cost is not a factor."

If the Artemis program, today's new Moon-Mars mission, is funded at the levels really needed to meet its aims, it will become a "crash program" for space exploration that also relaunches advanced nuclear and fusion power development, now virtually abandoned. Let us proliferate such crucial experiments as the one described here.