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Moon Power

Scientists explore the use of Helium-3 collected from the moon as a source for a global energy supply.

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The Mark II Lunar Volatiles Miner, designed by students, faculty, and scientific staff at UW-Madison, would use solar energy to harvest helium-3 from the moon's surface. *Photo Credit: University of Wisconsin–Madison*

As global energy demands continue to grow and non-renewable energy sources steadily dwindle, human beings will need to turn to new and innovative ways to quench our energy thirst. Nuclear fusion is a promising technology that is destined for the limelight with the completion of the International Thermonuclear Experimental Reactor (ITER) set for 2016. ITER is an international collaborative project which aims to demonstrate the feasibility of sustaining an energy-positive fusion reaction for the first time.

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Professor Gerald Kulcinksi, nuclear engineer and director of the Fusion Technology Institute at the UW-Madison, has been researching fusion reactions involving helium-3 for over thirty years. In the 1980s, Kulcinski began researching D-3He fusion. "The problem is, we didn't have any helium-3, and the only helium-3 on earth comes from the decay of tritium," says Kulcinski. Yet the lure of a D-He3 reaction drove Kulcinski and his colleagues to search for the elusive isotope.

Kulcinski says, "Around 1985, we all sat around and looked at each other and thought about where to find large amounts of helium-3 for civilian use." Helium-3 is ejected from the sun as charged particles in the solar wind. However, the energy is not enough to get through anywhere atmospheric, and the particles will go around anything with a magnetic field.

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There is an estimated one million metric tons of helium-3 on the surface of the moon.

While the majority of the world is studying the D-T cycle for fusion power, Kulcinski and his team of graduate students are experimenting with the fusion of two helium-3 isotopes (He3-He3). The reaction does not produce high-energy neutrons or radioactivity. It creates nuclear energy without nuclear waste.

"We're using a third kind of way to make fusion," says Kulcinski. "Not magnetic or inertial—we're using electrostatic. It's not new. It was invented by Philo Farnsworth who also invented the television. He didn't get very far, but we found his papers and saw that the way he did it was particularly suited for high energy reactions like He3-He3."

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A He3-He3 reaction has been performed in the small reactor which resides in the lower level of the Engineering Research Building. "I have some really great students who have actually run this," said Kulcinski. "However, we have not yet gotten back more energy than we have put in.

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If the He3-He3 fusion reaction can be improved and eventually perfected, it would have massive implications on the global energy supply. It is hypothesized that it would take 40 tons of helium-3 to provide all of the electricity that will be used in the United States in 2011. A space shuttle can carry 20 tons of cargo, so eight of them could theoretically power the world for a year.

The group at the UW-Madison is currently the only ones in the world doing He3-He3 reaction research. The research is paid for almost completely through private funding. Two individuals in particular, Dave Grainger and the late Wilson Greatbach, have made significant contributions. According to Kulcinski, "We couldn't do this research if we didn't have Dave Grainger or Wilson Greatbach. Neither of them wanted any publicity or anything back. They just wanted to support students doing far out work and stretching their minds."

Professor Gerald Kulcinski consults with lab director (Rich Bonomo) and one of the program's graduate students (Gabriel Becerra), over Helios, one of three fusion devices in the UW-Madison Fusion Technology Institute. *Photo Credit: Sara Karraker*