SPACE DAILY | SPACE WAR | TERRA DAILY | MARS DAILY | SPACE MART | SPACE TRAVEL | GPS DAILY

T··Mobile· my Faves for families
Each person gets unlimited calls to their 5 favorite people to any phone in the U.S.
Plans starting at $69.99/month

SPACE DAILY
your portal to space

Get Our Free Newsletters Via Email
your email yes
Space - War - Earth - Energy - China

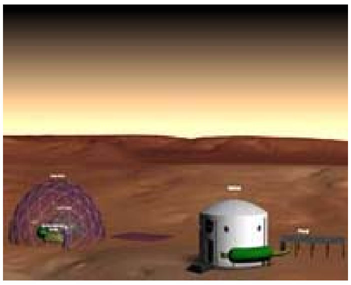
Search All Of Our Sites In One Search
Search
SpaceDaily - SpaceWar - TerraDaily

EXO LIFE

Power In Space: Time For A Biological Solution

by David Tenenbaum
Cambridge MA (SPX) May 15, 2007

Traditional systems for making electricity in space depend on the hardest of hardware: photovoltaics (solar panels), hydrogen fuel cells, radioisotope thermal generators. But at a meeting of the NASA Institute for Advanced Concepts (NIAC) last fall, Matthew Silver, a space systems engineer who heads IntAct Labs in Cambridge, Mass., presented radical ideas for using biology in a new generation of power supplies. These proposed devices would generate electrons using microbes that live in mud, or proteins native to the human ear or in photosynthetic bacteria.



Conceptual drawing of a Mars base based on bio-power. A greenhouse, microbial fuel cells, and algal growing compartments are all visible. Image by Chris Lund. Credit: IntAct Labs

In theory, biological power systems offer a number of advantages. Existing systems based on physical and chemical processes are difficult and costly to manufacture, and difficult to modify once fabricated. Biological systems may offer a high power-to-weight ratio, convenient fuel storage and many of them make useful byproducts like molecular oxygen. But the ultimate promise is this: they might be grown as needed in space.

Two promising areas for biopower are microbial fuel cells, which rely on microbes that release electrons during metabolism, and gadgets that convert kinetic energy or radiation directly into electric current.

The latter concept, dubbed "powerskin" by IntAct Labs, would be a thin film based on biological proteins that respond to movement or light. "The proteins responsible for hearing and eyesight have interesting electrical properties," Silver says.

In the inner ear, the protein prestin plays a key role in converting vibration into the electrical signals that are sent to the brain, Silver

Manage Energy Costs
Manage your costs and usage in real-time.
www.aspentech.com/ecm/

Solar Energy Investing
The Breakout Solar Energy Stock You Must Own Now. New Report
www.DailyReckoning.com/Solar_Report

Finding Solar expensive ?
Simple in home conservation Just plug in & save electricity
www.xpowerenergy.com

Save Energy in Your Home
Lower energy costs in Vermont w/ Home Performance with ENERGY STAR.
www.efficiencyvermont.com

Oean Energy Converter
New invention that will change the way we get ene
WWW.SWELLFUEL.COM

Solar Energy Investing
The Breakout Solar Energy Stock You Must Own
New Free Report
www.DailyReckoning.com/Solar_Report

observes. These proteins could be used "to translate vibrations into charge," he says, and "scavenge energy" from slight winds and vibration on Mars - or even from an astronaut's movement - to power sensors or other remote devices. "The idea is that it could power sensors that do not need wiring, so you would have the ability to generate electricity where you need it in applications that need not weigh very much."

Powerskin could also become the heart of a vibration sensor. "Because prestin converts a mechanical change into electricity, there is the possibility of being able to sense vibration with very high sensitivity," Silver says.

Another use for powerskin could rely on proteins such as rhodopsins, which respond to light. The rhodopsins are made by cyanobacteria and are similar to the molecules that respond to light in the mammalian retina. (Plants perform a more complex type of photosynthesis that would be more difficult to replicate, he adds, although research has begun.) "There has been a lot of research into rhodopsin, which is used for photo activity in simple organisms like cyanobacteria," says Silver. Researchers have genetically altered several types of microbes, including yeast, to express rhodopsins.

If an electric-generating skin were cheap enough, it could be used to coat space habitations.

IntAct Labs also presented ideas for microbial fuel cells that would house anaerobic bacteria to digest organic matter and release electrons to start an electric current.

Most of the interest concerns the genus Geobacter, an anaerobic organism that Derek Lovley, of the University of Massachusetts, discovered in sediment in 1987. To make energy, Geobacter oxidize organic matter, in the process transferring electrons to iron oxide particles in the surrounding soil or muck. In a fuel cell, a graphite electrode would substitute for the iron oxide as the electron acceptor. Because Geobacter and related organisms can create an electric current directly to electrodes, Lovley terms them "electricigens."

Basing a fuel cell on microbes offers many theoretical advantages over the hydrogen or methane fuel cell, Lovley says. "A catalyst is not needed, and catalysts are normally expensive and easily fouled." A second advantage comes from the mucky nature of the fuel itself. "The fuel doesn't have to be clean," says Lovley. "It can actually be dirt, or waste products."

As Silver envisions it, a microbial fuel cell could digest human waste and other organic garbage during a trip to Mars. NASA's Waste Processing and Resource Recovery Workshop estimated that a crew of six would, on a low-carb diet, produce 10.55 kilograms of organic waste per day en route to Mars. That quantity of waste, Silver calculates, could produce up to about 1 kilowatt of constant power in a microbial fuel cell. NASA has estimated that life support systems on such a craft would need roughly 1 kilowatt per person during a cruise to Mars.

The carbon dioxide produced by bacterial oxidization of organic waste could be used to grow algae in sunlit chambers, producing molecular oxygen as a byproduct. The algae could also be used to feed the microbial fuel cell and make more electricity. A similar process could create electricity on Mars, Silver suggests.

While prototype microbial fuel cells have used a single strain of microbe, multiple organisms could increase the power output, particularly if the input were organic wastes. "We presented to NIAC the fact that different bacteria metabolize different things," says Silver. "A microbial fuel cell could use cascading chambers," where the output of one cell becomes the feedstock for a successive cell. For example, when bacteria in the genus Clostridium metabolize sugar, they do not use all the energy available in the sugar. Geobacter, however, can metabolize the waste products of some Clostridium, Silver suggests. Even better, Silver adds, through genetic engineering, "a novel organism could be designed that digests a greater range of inputs."

Using organic material as fuel leads to another advantage of microbial fuel cells for space exploration: organic matter is easy to store. While electricity from a photovoltaic panel must be stored in massive batteries or another complicated storage system, storage requirements for bacterial power units would be minimal, because the microbes could be fed to generate electricity as needed.

Another potential advantage of biological power systems is their "homegrown" potential. The complex material conversions needed to manufacture the power systems could be performed by microorganisms; they would not require the heavy industrial processes used to make PV panels. Even the polymers used to encase various elements could be grown, not fabricated, Silver suggests.

Silver says, "If you design it right, you could imagine having the ability to fabricate your technology on the lunar or Martian surface. Imagine looking at power systems not as something that is extremely valuable, but as something that can be grown as needed."

Email This Article

Related Links
NASA Institute for Advanced Concepts (NIAC)
Life Beyond Earth
Lands Beyond Beyond - extra solar planets - news and science

Ads by Google

EXO LIFE

STONEs in Space

Moffett Field CA (SPX) May 11, 2007
Can life travel from planet to planet? When a rocky world is hit by a meteorite, the impact can send pieces of the planetary surface out into space, and eventually these ejected rocks can travel to other planets in the solar

system. Here on Earth we have collected many meteorites that originated from the moon and from Mars, and there are also likely rocks from Earth sitting on the surfaces of our planetary neighbors.

Memory Foam Mattress Review

SPACE MEDIA NETWORK CLASSIFIED ADVERTISING
Solar Energy Solutions ::
Shop for telescopes online :: Tempur-Pedic Mattress Comparison
Myspace Layouts Editor

Newsletters :: SpaceDaily Express :: SpaceWar Express :: TerraDaily Express
XML Feeds :: Space News :: Earth News :: War News :: China News

SPACE TRAVEL

- Conference Highlights Space Safety As A Global Concern
- Preventing Sick Spaceships From Killing Spaceman
- Cudady And Glendale Schools Join Unique Partnership With NASA
- Raytheon To Pursue Avionics Contract For NASA Ares I Crew Launch Vehicle

LAUNCH PAD

- Ariane 5 Achieves Record Performance With Geostationary Transfer Orbit
- Ariane 5 Launches Twin GEO Birds
- Lockheed Martin-Built Astra 1L Satellite Ready For Launch
- Arianespace And Japan Continue To Build Long-Term Relationship

OUTER PLANETS

- Continuing Our Jovian Journey
- Rosetta And New Horizons Watch Jupiter In Joint Campaign
- New Horizons Shows Off Its Color Camera In Io Image
- Alice Views Jupiter And Io

MOON DAILY

- US Rejected Russian Request For Joint Moon Program
- Longest Holiday In Space Ends As Russia Touts Lunar Tour Within Five Years
- Back To The Moon For Some Reconnaissance
- Rochester Triumphs In NASA Great Moonbuggy Race

MARSDAILY

- Spirit Studies Dust Devils In Concert With The MRO
- Spirit Examined Light - Colored Material Near Home Plate
- Next Mars Lander Crosses The Mississippi
- Opportunity Conducts Path Planning Test And Gets Another Energy Boost

EARTH OBSERVATION

- ESA Presents The Sharpest Ever Satellite Map Of Earth
- Transcontinental Wildfire Emissions Monitored From Space
- Volcanic Eruptions In Kamchatka
- NASA Satellite Captures Image Of Georgia Wildfires

STELLAR CHEMISTRY

- When Galaxies Collide Our Solar System Will Go for A Ride
- Missing Mass Found In Recycled Dwarf Galaxies
- X-Rays Provide A New Way To Investigate Exploding Stars
- The Brightest Supernova Ever

GPS NEWS

- Hyper-Accurate Clocks - The Beating Heart Of Galileo
- EU Sees Public Money Saving Galileo From Drifting Off Course
- Germany Confident EU Will Take Over Galileo Project
- GIOVE-A Transmits First Navigation Message

The content herein, unless otherwise known to be public domain, are Copyright 1995-2006 - SpaceDaily.AFP and UPI Wire Stories are copyright Agence France-Presse and United Press International. ESA PortalReports are copyright European Space Agency. All NASA sourced material is public domain. Additionalcopyrights may apply in whole or part to other bona fide parties. Advertising does not imply endorsement,agreement or approval of any opinions, statements or information provided by SpaceDaily on any Web page published or hosted by SpaceDaily. Privacy Statement