NASA Astrobiology Conference 2012

April 17, 2012

Some 850 scientists have gathered this week in Atlanta, Georgia for the 2012 NASA Astrobiology Conference hosted by Georgia Tech under the banner of "Exploring Life: Past, Present, Near and Far." On the agenda is everything from the search for distant planets, the origins of terrestrial evolution, and the existence of life in extreme environments--and, of course, the ever-looming, never-resolved question, "What exactly *is* life?"

Here are some Day One highlights:

• In an oral presentation titled "Understanding the Dynamic Relationship of Electromagnetism and Life as an Evolutionary Process, and as a Baseline for Supporting Life in an Extra-Terrestrial Environment" during a panel on *Thermodynamics, Disequilibrium, and Evolution*, LPAC researcher Creighton Jones argued that over evolutionary time scales, the anti-entropic development of the biosphere has been correlated to galactic-scale cycles which produced major changes in the cosmic radiation environment of earth. He also showed that much of the electromagnetic environment which appears to regulate the physiology and behavior of many organisms is itself a product of their activity, as in the case of lightning generated primarily above densely forested, moisture-producing regions of the planet.

In future missions to bring humans and other organisms to planets such as Mars (which, for example, lacks the kind of global magnetic field that the earth enjoys), it may take more than just the right chemicals to keep them alive.

• During a poster session on *Emerging Technologies and Strategies for Prospecting for the Signs of Life on Other Worlds*, Jones' fellow LPAC research team member Meghan Rouillard presented a poster titled "Kepler 22-b and Universal Life", a reference to the first extrasolar planet discovered in the so-called habitable zone of a Sun-like star (where liquid water could exist on the surface) by NASA's planet-hunting Kepler satellite. The poster featured excerpts from Russian biogeochemist Vladimir Vernadsky's 1938 paper on "Problems of Biogeochemistry" in which Vernadsky identifies such molecular-scale properties of living matter such as chirality and isotope fractionation, as well as biospheric-scale processes such as the biogenic migration of atoms, as indicative of unique spatio-temporal manifestations of life. This has raised eyebrows here, especially since the Oparin orthodoxy of "bottom-up" biological constructions from primordial chemical reactions is taken as a virtual first principle in astrobiology.

The detection of signatures of a unique space-time of living matter would require

a new interpretation of spectral data, as indicated, for example, by experiments showing a redshift in the light absorbed by chorophyll pigments in vivo versus in vitro.

• Ionizing radiation is generally considered harmful to organisms, though many have developed resistance and/or repair mechanisms to deal with such high radiation environments such as those in space, or during the early period of earth's history. During a panel on *Understanding the Effects of Space Radiation on Living Organisms and Its Implication for Astrobiology*, NASA Ames scientist Lynn Rothschild presented work on the impressively high UV tolerance of microscopic Tardigrades (a.k.a. water bears), which have survived trips on the outside of the ISS. Such tolerance means that certain microorganisms could survive interplanetary trips on wandering asteroids, for example.

• Beyond mere defense mechanisms against radiation, Ekaterina Dadachova and colleagues have found that some organisms may actually feed off of it. During the same session, Dadachova, who works as a cancer researcher at the Albert Einstein Medical College in New York, showed that the growth of melanized fungi is stimulated by exposure to low levels of gamma and ultraviolet radiation, a process in which the melanin pigment molecule may act analogously to chlorophyll, allowing the fungi to "radiosynthesize" instead of photosynthesize. She reported that melanized fungi have vigorously colonized the inside of the cooling towers of the long-abandoned Chernobyl nuclear plant in the former Soviet Union.

• Monday's plenary session was devoted to the soon-to-land Mars Curiosity rover mission, which has the planetary science and astrobiology community buzzing with anticipation. There's good reason to be excited: Curiosity's Mars Science Laboratory is the most sophisticated instrument package ever sent to another planet, with an exquisite array of instruments for in-situ analysis of the atmosphere, surface, and shallow subsurface. Panelist Dawn Sumner, who is co-investigator for the rover's scientific cameras, said that we still know so little about Mars that just landing there will be a success. "Every time we've landed on Mars we've found something completely unexpected," she said.
–Oyang Teng