U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
FULL COMMITTEE

Astrobiology and the Search for Life in the Universe

Wednesday, May 21, 2014
10 a.m. – 11:30 p.m.
2318 Rayburn House Office Building

Purpose

The purpose of this hearing is to review the current state of the science related to the search for life in the universe.

Witnesses

- **Dr. Seth Shostak**, Senior Astronomer, SETI Institute
- **Dr. Dan Werthimer**, Director of SETI Research at the University of California Berkeley

Background

Discoveries made by the Kepler space telescope of more than 1,700 planets within the Milky Way galaxy renewed interest in the search for life in the universe. In May 2013, the Space and Research subcommittees held a joint hearing titled *Exoplanet Discoveries: Have We Found Other Earths?* to explore this search for other worlds that have the necessary conditions for life.[1]

In December 2013, the Committee held a hearing titled *Astrobiology: Search for Biosignatures in our Solar System and Beyond*. [2] Witnesses described the different methods astrobiologists use to search for microbial life, including the study of extremophiles on Earth and the search for biosignatures in the atmospheres of planets.

This hearing will explore the scientific methods being employed in the search for life in the universe. Specifically, the hearing will review radio and optical astronomy techniques used in this search.

Radio Astronomy

[1] http://science.house.gov/hearing/subcommittee-space-and-subcommittee-research-joint-hearing-exoplanet-discoveries-have-we
[2] http://science.house.gov/hearing/full-committee-hearing-astrobiology-search-biosignatures-our-solar-system-and-beyond

Radio astronomy studies the radio frequencies of celestial bodies. Astronomical phenomenon, such as stars, galaxies, pulsars and quasars, emit radio waves of varying lengths. Additionally, the cosmic background, or space in between celestial bodies, emits microwave radiation. Radio telescopes detect these different frequencies, and astronomers use this data to characterize bodies and take scientific measurements used to understand the formation and expansion of the universe.

To search for emitted signals, scientists conduct either targeted searches or sky surveys. Targeted searches are longer searches in a fixed location. Sky surveys are brief sweeps of the entire sky.

Natural radio frequencies can sometimes suffer from interference by manmade satellites and spacecraft. Astronomers must be able to differentiate between frequency sources.

Radio telescopes can be found around the globe. Some of the best known telescopes include the Atacama Large Millimeter Array in Chile, the Very Large Array in Mexico, the Arecibo telescope in Puerto Rico, the South Pole Telescope in Antarctica, and the Allen Telescope Array in northern California.

Optical Astronomy

Optical or visible-light astronomy uses a variety of light sensitive telescopes to find specific celestial bodies. Some telescopes take a direct image of an object; others use photometry to measure the amount of light coming from an object, and some telescopes use spectroscopy to measure the wavelength of light. They can either refract or reflect images and light. Optical telescopes are used to measure the light emitted by pulsars and supernovae.

Most optical telescopes are physically located in places where light pollution and water in the atmosphere are low and will not obstruct viewing. Consequently, many optical telescopes are located in high deserts or on mountain tops. The Keck Observatory in Hawaii, the Lick Observatory near San Jose, California, and the SETI Optical Telescope in Massachusetts (located at the Harvard Smithsonian Center for Astrophysics Oak Ridge Observatory) are some optical observatories used in the search for life on other worlds.

Overarching Questions

1. What is the likelihood of finding life in the universe?
2. What are the resources, technologies, and methods involved in using radio and optical astronomy for this search?
3. What progress and evolution has occurred in the field?
4. What resources are most important to success in the field?
5. What is the public interest in the topic?