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COMMISSION 51: BIOASTRONOMY: SEARCH FOR EXTRATERRESTRIAL LIFE

(BIOASTRONOMIE: RECHERCHE DE LA VIE EXTRATERRESTRE)

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1. Bioastronomy Triennial Meetings

Commission 51 holds a triennial meeting on the subject of Bioastronomy. Active involvement by the IAU in these meetings began at the General Assembly in Montreal in 1979, when a Joint Session was held on *Strategies for the Search for Life in the Universe.* After the establishment of the commission in 1982, the Bioastronomy meetings were held every 3 years beginning in 1984 (1984, *IAU Symp. 112*, Boston, USA; 1987 *IAU Colloq. 99*, Balston, Hungary; 1990, Val Cenis, France; 1993, Santa Cruz, USA; 1996 *IAU Colloq. 161*, Capri, Italy; 1999, Hawaii, USA; 2002 *IAU Symp. 213*, Hamilton Island, Australia).

1.1. Bioastronomy 2002: Life Among the Stars

The 2002 Bioastronomy meeting, IAU Symposium 213, "Bioastronomy 2002: Life Among the Stars", was held on Hamilton Island on the Great Barrier Reef from July 8-12, 2002. One hundred eighty nine participants from 23 countries attended the 5-day meeting. As has been the tradition in the past, the meeting was a mixture of plenary invited and contributed papers, with an additional large selection of poster papers. Proceedings from the meeting will be published through the *Astronomical Society of the Pacific* IAU Symposia Series, volume S-213 (ed. Ray Norris). The chair of the Science Organizing Committee was Ray Norris (Australia), and Carol Oliver (Australia) chaired the Local Organizing Committee.

IAU Symposium 213 was held in tandem with the Australian-American Fulbright Commission 2002 Symposium "Science Education in Partnership", which explored the Australian-US education systems in the context of astrobiology. There were 51 participants attending the education symposium. At various points the Fulbright was in joint session with the Bioastronomy meeting and scientists from the Bioastronomy meeting gave invited talks in the Fulbright sessions. It was thought to be the first attempt to fully integrate a science conference with an education conference at the same venue for an international science symposium.

In addition there was a public event co-hosted by the Australian Museum and the Australian Centre for Astrobiology, Macquarie University, in Sydney just prior to the meeting entitled "Is the Universe Made for Life?" It was attended by around 500 people. The format was a panel discussion with Professor Paul Davies and Professor Malcolm Walter of the Australian Centre for Astrobiology, Dr. Vikki Meadows from NASA JPL and Dr. Seth Shostak, senior astronomer at the SETI Institute in California.

1.2. Future Bioastronomy Meetings

Historically, there have been two main groups dealing with the investigation of extraterrestrial life and habitable worlds. The first is IAU Commission 51, composed of astronomers,

physicists and engineers who focus on the search for extrasolar planets, formation and evolution of planetary systems, and the astronomical search for intelligent signals. The second group, the International Society for the Study of the Origin of Life (ISSOL), is composed largely of biologists and chemists focusing research on the biogenesis and evolution of life on Earth and in the solar system. Now too, there will be large biennial astrobiology conferences hosted by the NASA Astrobiology Institute (the first was held at NASA Ames during April 2001).

Held in years without an IAU General Assemby, originally the Bioastronomy series of meetings was out of phase with meetings hosted by ISSOL. However, in 1992, ISSOL changed the dates of their triennial meetings to avoid the Olympics and they began to hold their meetings in the same year as the Bioastronomy meetings, usually close in time to the Bioastronomy meetings. In an attempt to consolidate meetings, and establish a richer interchange of ideas, French astrobiologists sought to host the 2005 Bioastronomy meeting in France in conjunction with ISSOL. However, Beijing China was announced at the ISSOL 2002 meeting in Mexico as the venue for the 2005 ISSOL meeting, so the French plan didn't materialize.

Nominally, the venue for the next Bioastronomy meeting is announced during the summer meeting, but this left the Commission without a specific offer for 2005. In an effort to avoid the problem of two meetings with similar topics being hosted at the same time, the organising committee members present at the Australian Bioastronomy meeting decided that it would be an opportunity to move out of phase with the ISSOL meetings, and an older proposal from Iceland was re-examined. The proposers, Thor Thorsteinsson and Thor Jakobsson were contacted and quite enthusiastic about hosting a meeting on "Habitable Worlds" during July 2004 in Iceland. It is the intent that during the next few years the Bioastronomy organizing committee will work closely with ISSOL President Antonio Lazcano to investigate future coordination of the two groups.

2. Supported Meetings

There have been several IAU topical meetings since the 2000 GA which have been either endorsed by Commission 51 or were relevant to the commission. These include:

- Symposium 213 – Bioastronomy 2002: Life Among the Stars, Australia July 2002
- Symposium 211 – Brown Dwarfs, Hawaii, May 2002
- Symposium 202 – Planetary Systems in the Universe: Observation, Formation and Evolution, Manchester UK, Aug. 2000
- Colloquium 186 – Cometary Science After Hale-Bopp, Tenerife, Jan. 2002

3. A New IAU Commission Name?

Commission 51 was established in 1982 with the objectives of searching for planets around other stars, to determine the formation and evolution of planets and their atmospheres, to investigate the ability of these planets to sustain life over cosmic timescales, and to search for radio transmissions, intentional or unintentional of extraterrestrial origin. In addition, part of the objectives included the search for biologically relevant interstellar molecules and the study of their formation processes, the detection methods for biological activity, and the coordination of these multi-disciplinary efforts at the international level. Because of the wide-ranging focus of the Commission, many OC members felt that it was time to change the Commission name from "Bioastronomy: Search for Extraterrestrial Life" to something less specific and encompassing the broader interests of the commission.

This was debated at some length at the 2000 General Assembly, and it was clear that there were some sensitive issues, especially given the discussion by the Working Group on Extra Solar Planets (WGESP) concerning the formation of a separate commission on

extrasolar planet research. Nothing has been resolved on this issue and it will require further discussion with the WGESP.

4. Science Highlights

Although the organizing committee felt that a short report version was appropriate at this time, a few science topics highlighted at recent meetings are presented below.

4.1. Extrasolar Planet Discoveries

As part of an effort to expand our Commission's strong interest in the area of the search for extrasolar planets, Commission President S. Bowyer proposed to the IAU Executive Committee that the Commission develop a website of extra solar planets. This idea has evolved into the Working Group on Extrasolar Planets, which is debating topics concerning the definitions of planets and keeping track of the detection of planetary companions to solar-type stars. See their report in this volume for the status of extrasolar planet detections.

4.2. New SETI Programs

There are currently 5 ongoing radio SETI surveys, including META II (1990-), Project Argus (1995-), SERENDIP IV (1996-), So. SERENDIP (1998-), and SETItalia (2000-). In addition, there are 7 ongoing targeted surveys, including Project Phoenix (radio; 1998-) and 5 optical SETI programs: Harvard OSETI (1998-), Princeton (2001-), Berkeley (1998-), Lick (2001-), and OZ Seti (2000-) at the University of Western Sydney. Considering also the unique distributed SETI search of SETI@home (Anderson et al. 2000), which analyzes data from the SERENDIP IV project, there are 4 major new programs which have come on line since the last report.

In addition an exciting new instrument is currently under development, called the Allen Telescope Array (ATA, formerly the 1hT array), a joint effort by the SETI Institute and the University of California, Berkeley. This facility will be simultaneously used for SETI and radio astronomy research.

4.3. Brown Dwarfs

Observations of Brown Dwarfs have recently been emerging as new astronomical objects. Deep surveys for Brown Dwarfs in star-forming regions and young open clusters are finding extremely low-mass objects. The luminosities of these faint free-floaters overlap with those expected for recently formed giant planets. These discoveries are opening challenging new questions about the origin and evolution of Brown Dwarfs and their relation to star and planet formation. High-resolution imaging and spectroscopy are being applied to the search for Brown Dwarf companions to stars, and for Brown Dwarf binaries. The statistics of binary systems as a function of age and mass will constrain formation scenarios.

4.4. Life Biomarkers

As extrasolar planet detections become routine, investigators are looking toward the ability to detect biosignatures in the atmospheres of planets in habitable zones. Atmosphere models have been developed to make predictions of spectra. An interesting proof of concept of a biosignature detection was made using the Earthshine spectrum (Ford, et al., 2001), which clearly showed spectral signatures of life.

The NASA Mars Odyssey mission has been extremely successful and has recently indicated from the GRS and neutron spectrometer experiments that there is substantial sub-surface ice buried beneath tens of cm of regolith (Feldman et al. 2002; Mitrofanov et al. 2002).

Recent work on Earth has been looking for biosignatures from ancient hydrothermal vents, by extracting information from ore precipitates and carbon isotopic signatures. This work has been starting to put time markers on the tree of life (Walker & Pace, 2001). In addition, oxygen isotopic ratios are indicating a very early hydrosphere on Earth (4.3 billion years ago), pushing back the existence of liquid water on Earth some 400 million years (Mojzsis et al., 2001). Searching for mineral deposits from possible ancient hydrothermal systems on Mars may provide clues to the existence of early life on that world.

While the excitement from the possible discovery of biogenic signatures in Mars meteorite ALH84001, has died down, there is still debate concerning the interpretation of the magnetite signature in the meteorite, especially given the robustness of magnetite as a biosignature on Earth (Gibson et al., 2000).

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