

## COMMISSION 50: PROTECTION OF EXISTING AND POTENTIAL OBSERVING SITES

*(PROTECTION DES SITES D'OBSERVATOIRES EXISTANTS ET POTENTIELS)*

**PRESIDENT: Malcom Smith**  
**VICE-PRESIDENT: Michelle Storey**

### 1. Introduction

The business meeting of Commission 50<sup>3</sup> was held on 18th July 2003. The meeting was chaired by the retiring President, Jim Cohen (Jodrell Bank Observatory, UK). The incoming President is Malcolm Smith (AURA, Chile). He proposed that the new Organizing Committee should be elected by the full membership, by means of an email ballot to be held after the General Assembly. This has been recommended to Commissions under the new Statutes and Bye-Laws.

### 2. New Statutes and Bye-Laws

Under Number 23 of the new Bye-Laws, a Commission is initially created for a period of six years, after which it may be renewed for further periods of three years, if sufficient justification for its continued activity is presented. Commission 50 may expect a long lifetime, since the work of protecting observatory sites is ongoing. We will need to draw up new Terms of Reference, based on a standard model published by the Executive Committee. Commission 50 now comes under a new Division XII: Union- Wide Activities, made up of Commissions formerly under the Executive Committee. Our first Division President is Virginia Trimble and the Vice-President is Johannes Andersen.

### 3. World Radiocommunication Conference WRC-03

WRC-03 was held between 6 June and 4 July 2003 in Geneva, Switzerland, with more than 2,200 delegates from 138 countries, including 17 radio astronomers. Ten of the 50 agenda items were of direct interest to radio astronomers. Most of the m involved satellite down-link transmissions.

One of the most controversial agenda items was 1.8.2, concerning unwanted emissions from satellites into passive frequency bands. This issue has been studied by ITU-R for many years, within Task Groups 1/3, 1/5 and 1/7. Given the large amount of work done, the outcome was very disappointing. There is to be no mandatory protection of passive bands from unwanted emissions from satellites, beyond the general limits already set at WRC-00, which fall far short of what is required to fully protect radio astronomy. However there is a new recommendation that certain satellite services in particular frequency bands try hard to meet tighter limits across four particular frequency bands allocated for radio astronomy. The new limits were derived in TG1/7. If

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the limits are not met then there will be mandatory consultation. Further studies of 13 satellite-radioastronomy band pairs will continue in a new Task Group 1/9, under Resolution 740 (WRC-03).

Under agenda item 1.16, WRC-03 allocated the frequency band 1430-1432 MHz for satellite down-links. This is close to the passive band 1400-1427 MHz that contains the 21-cm line of neutral atomic hydrogen, arguably the single most important spectral line in radio astronomy. The new allocation was made before ITU-R studies on its impact were concluded. The satellite allocation has only secondary status and under Resolution 745 (WRC-03) it may not be used until 2007, when the ongoing studies have been reviewed by WRC-07.

Under agenda item 1.30, two new data elements were added to the information that must be sent to ITU when officially registering radio astronomy stations. The first is the type of radio astronomy station, either single-dish (S) telescope (or connected array), or very-long-baseline-interferometry (V) stations, used only for VLBI. The protection criteria for dedicated VLBI arrays, such as the VLBA and VERA, are less stringent than the single-dish criteria, so by having this new information sharing issues with satellite down-links may be eased. The second new data element is the minimum elevation angle  $\theta_{min}$  at which the telescope operates. This information is also needed for sharing studies. These data elements must be submitted for all radio telescopes that are already registered, as well as for new radio telescopes.

Registration is important, since only those telescopes officially notified to ITU can claim protection from interference. Telescopes do not need to be fully operational to be registered; indeed there are now strong reasons to register telescopes before first light. Following WRC-03, protection from some satellite systems operating in bands outside radio astronomy bands will apply only to those radio telescopes registered by particular dates. That is to say, future radio telescopes may have to live with any interference from satellite systems already notified to ITU.

The preliminary agendas of WRC-07 and WRC-2010 agreed at WRC-03 contain three major items for radio astronomy. Under agenda item 1.17, WRC-07 will review the studies of compatibility between the satellite down-link at 1430-1432 MHz and affected services, including radio astronomy in the band 1400-1427 MHz. Under WRC-07 agenda item 1.21, there will be the opportunity to add new limits to the tables of threshold levels on unwanted emissions from satellites (triggering consultation). Agenda item 2.2 of the preliminary agenda for WRC-2010 concerns frequency allocations between 275-3000 GHz, a region not yet allocated by the ITU-R, and one of prime interest for sub-mm radio astronomy. Resolution 950 (WRC-03) allows administrations to register systems that already operate between 275 and 3,000 GHz.

Protection of large multinational facilities such as ALMA, LOFAR and SKA, that will operate outside the frequency bands allocated for radio astronomy, is a key issue for twenty-first century astronomers. Radio-quiet zones can be set up under national law, as is happening in Chile for ALMA, but international agreements will be needed to deal with satellites. At its 2002 General Assembly, URSI called for the matter of International Radio-Quiet Zones to be placed on the agenda of the next WRC. Unfortunately this was not possible at WRC-03. A European proposal on IRQZs was withdrawn, despite strong support from Asia-Pacific countries, because of strong opposition from the USA and other countries. We will need to prepare a better case next time.

#### 4. Future Meetings

Two IUCAF -sponsored meetings are planned in the forthcoming triennium, a Workshop on Radio Frequency Interference Mitigation in 2004, and a Summer School on Spectrum Management and Radio Astronomy in 2005.

## 5. Laser telemetry from space and protection of optical observatories

A special session involving Commissions 9, 40 and 50 was held on 18th July 2003, following the Commission 50 business meeting, to consider laser transmissions from space.

Joss Bland-Hawthorn presented the keynote paper, "Laser telemetry from space: an overview", by J. Bland-Hawthorn, A.J. McGrath and J.A. Bailey (AAO). The fundamental problem of bandwidth and information carrying capacity is one that faces not only the telecommunications community, but also the community involved in the study of other planets. For example, only a few percent of data capable of collection at Mars can be transmitted back to Earth because the data rates supported by the available communications links are much too low. Missions currently planned will further exceed communications limitations, such that within five years only 0.3

Optical communication offers several advantages over the microwave links presently used. Most obviously, the higher carrier frequencies allow higher modulation rates. Additionally, the shorter wavelengths spread the transmitted power over a smaller area for reception after hundreds of millions of kilometers of travel, providing an efficiency gain. The situation is analogous to the proliferation of optical fibre network links due to their superiority over coaxial copper cables.

The system envisioned for a Martian probe would involve a communications relay satellite in Martian orbit, with UHF receivers collecting data from local exploration platforms, and a laser transmitter providing a high data rate to receivers on or near Earth. Various technological approaches for the development of such a laser system can be conceived. In all such concepts, a laser transmitter, large aperture telescopes, and low-noise high-speed detectors are common elements.

Preliminary analysis shows 100 Gps rates to be a reasonable goal, for a system deployed on a 10 to 20 year timescale. We envisage the use of scalable technologies allowing a system to be scaled up as needed and capability grow into the further future. While such a system is not likely to be operational for one or more decades, we need to start development now in order to be ready on these time scales.

Tomas E. Gergely (NSF, USA) spoke on "Regulation of optical wavebands by the ITU". The Radio Regulations (RR), a treaty that covers international uses of the radio spectrum, are maintained by the International Telecommunication Union (ITU), a specialized agency of the United Nations. At present, the RR allocate the spectrum in the 9,000 kHz to 275 GHz range to various applications or services, radio astronomy being one of them. While the ITU claims jurisdiction over the electromagnetic spectrum up to 3,000 GHz, there has been little interest in regulations above 275 GHz, with exception of a footnote covering scientific uses of the spectrum up to 1,000 GHz.

This situation is changing, driven by the increasing demand for frequencies below 275 GHz, and by the extremely broadband data transmission requirements found in many fields, including astronomy. At the Plenipotentiary Conference of the ITU, Marrakesh, 2002, a Resolution (COM 5/4) was passed that encourages studies above 3,000 GHz, and implicitly broadens the ITU's claim to regulate the spectrum without any specific upper limit. It is not too early to begin thinking about how IR/Optical astronomy might have to operate in such a regulated environment.

Wim van Driel (Meudon, France), the incoming Chairman of IUCAF, then spoke about "The ITU and protection of radio astronomy". The International Telecommunication Union (ITU) was created to facilitate the development of telecommunications, and its Radiocommunication Sector (ITU-R) deals with wireless telecommunications. One of the basic functions of the ITU-R is the process of spectrum management, which aims to ensure rational, equitable, efficient and economical use of the spectrum/orbit resource by all radio services. Radio astronomers have a formal place in this process

through ITU-R Working Party 7D (Radio Astronomy), and through the UNSECO Scientific Commission on Frequency Allocations for Radio Astronomy and Space Science, IUCAF (formerly the Inter-Union Commission on the Allocation of Frequencies for Space Research and Radio Astronomy). IUCAF members are elected from three international scientific unions, the IAU, URSI and COSPAR. IUCAF represents world radio astronomy in frequency management matters. Since it is possible that ITU-R Regulations will be extended to the optical domain, it is timely to consider how IUCAF should respond.

Three issues 100m large for IUCAF at the present time.

**Satellites:** down-link transmissions can legally produce potentially very high levels of unwanted emissions into adjacent radio astronomy bands. The satellite operators are powerful adversaries.

**Coordination:** protection of "our bands" everywhere on the globe is no longer assured. Protection may be provided only for RA stations registered at the ITU before a specified date.

**Quiet Zones:** International Radio Quiet Zones for future large instruments like SKA, ALMA and LOFAR, including protection outside the officially allocated frequency bands, even from satellites.

Jim Cohen (Jodrell Bank Observatory, UK) led the discussion on "What the IAU should do". Doing nothing will not work. The new technology is coming; indeed it has already been demonstrated. In the present climate of de-regulation astronomers need to take an active part in the regulatory process and argue their own case. Astronomers are involved both as active and as passive users of the optical/IR spectrum. We already transmit laser beams as artificial "guide stars" for image-sharpening. We want to use the laser technology for wide-band links from space missions. And on the other hand, we need to ensure that our observatories receive regulatory protection from other people's lasers.

Technical studies on the protection requirements of optical-IR observatories have already begun within ITU Working Party 7D. In order to handle such studies properly, WP7D needs at the very least a contact group of optical-IR astronomers who can provide expert information during the ITU meetings, at very short notice. Late papers can be submitted without warning at the start of a 3-4 day meeting, and answers to technical questions may be needed urgently. IUCAF needs an optical-IR "hotline". At this stage it does not appear to be necessary for the contact group to attend the relevant meetings in person, but we need to watch how things develop and be prepared for this eventuality. In time it may be appropriate to appoint new IUCAF members from the optical-IR community. IUCAF is the original voice for astronomy within ITU and it would be natural for IUCAF to expand its brief in this way. This has already happened for remote sensing, which was added to IUCAF's terms of reference in 1996.

The IUCAF Chairman Wim van Driel undertook to establish an optical-IR contact group, based on the nucleus of interested astronomers who had attended this joint discussion meeting.

Jim Cohen

*Retiring President of the Commission*