EUROPEAN SCIENCE FOUNDATION
SETTING SCIENCE AGENDAS FOR EUROPE

NEWSLETTER No. 14 September 2006

CRAF NEWS

Expert Committee on Radio Astronomy Frequencies (CRAF)

Editorial

What are the detrimental effects of the loudly proclaimed "digital revolution" on Radio Astronomy? Everybody knows the old fashioned AM (amplitude) and FM (frequency) modulation techniques; nowadays the digital circuits, believe it or not, offer much higher efficiencies by using wideband and noise-like modulation strategies.
Radio astronomers learned this lesson long ago. With precisely this in mind they developed the wideband interferometry scheme and, with others, the digital cross-correlation processing of radio astronomical "signals": in most cases, these are just samples of pure random (white) noise coming from the same source in the sky.
Modern electronic industries have now caught up with those old scientists. The industrial skill in developing marvellous engineering implementations of those principles, mass-produced in billions of units at extremely low cost, is now opening seemingly unlimited markets in a wide variety of applications, in particular under the heading of so-called Ultra Wide Band (UWB) devices.
What then about the frequency protection of Radio Astronomy, over the radio frequency bands internationally and nationally assigned to this purely passive (non-transmitting) service?
The extremely wide frequency bandwidth of those UWB devices can appear, in the opinion of the manufacturers, to overcome the present band limits that have been negotiated after decades of Frequency Management and Radio Regulations. Even the concept of Frequency Management is in doubt today: the (time) impulsive and wideband character of these new devices makes it difficult to precisely define their occupancy of the frequency band.
As the most effective countermeasure against UWB devices, CRAF started long ago to put a lot of effort into trying to define limits to the maximum permitted radiation levels from the devices. As a matter of fact, lower interference levels will offer benefits for all radioastronomical observations, even those that are (regularly) made outside the officially allocated bands.
The ECC of CEPT approved, in document ECC/DEC/(06)04, a harmonised scheme for such devices for radio frequencies below 10.6 GHz. But now the electronic industries propose even newer types of units, each with its specialised application and its own particular technical characteristics. As a logical step towards legalising the new devices, they have recently started regulatory confrontations in the proper CEPT working groups, asking, for each type of device, specific waivers with respect to the general ECC recommendation. Not unexpectedly they generally request higher levels for the maximum radiated energy; another proposal would be to offer some protection distances from the radiotelescope sites (similarly to the case of SRR devices).
It may now be clear what I think is the single most detrimental factor for our future activity.
CRAF sees an endless workload in an infinite number of negotiation processes, each handled case by case. Of course a committee like CRAF, composed almost entirely of volunteers (apart from the frequency manager) cannot handle this. At the same time I really want to thank Dr. Axel Jessner for his very timely development of a prototype software code, suitable to compute the propagation attenuation of a single UWB radiating unit or an ensemble of those devices and then to compare the final aggregate effect with respect to our most respected document, ITU-R Recommendation RA.769, where the detrimental levels for typical radioastronomical observations are listed.
The adoption of Protection Zones at each telescope site could help to reduce the number of such negotiations, but it will require nevertheless more work to get appropriate consensus among the Local Authorities and the National Administrations, as well as proper enforcement power over the manufacturers and the final users. Each of these components has its part to play, if we want to achieve a reasonable level of effectiveness. In conclusion it is very doubtful that such strategy could be of any help to our case.
In a quite different type of environment, the Radio Spectrum Policy Group, under a mandate of the EU Commission, is preparing an Opinion on a coordinated EU spectrum approach for scientific use of radio spectrum. The progress report is now open for a Public Consultation that will close on 14 July. Willem Baan has produced most of the material dealing with radio astronomy. CRAF will give its official support and will try to coordinate individual contributions from all member Institutions. All this work is undertaken in close cooperation with our meteo scientist colleagues and Philippe Tristan in particular.
The list of urgent duties for CRAF does not end here. Our limited number of active contributors therefore remains a serious concern. I personally invite all Observatories to consider on how to offer stronger support to all these activities.

Roberto Ambrosini
Istituto di Radio Astronomia, Bologna

GRAFITAL - Print run: 350 - 10/06

Report from the 42nd CRAF meeting

6-7 April 2006

The 42nd CRAF meeting was held on 6-7 April 2006 at the Observatoire de Bordeaux, France. The following key items were discussed.

- Internal guidelines on how to produce CRAF reports, in order to harmonize the four types of CRAF written deliverables (newsletter, progress report, summary report, CRAF Meeting Minutes), with a better definition of their content, spirit and targeted audiences.

- RadioNet has recently started working on the next FP7 edition, while asking for new ideas. CRAF members have proposed to study the experimental configuration of a monitoring station suitable to cope with modern types of modulation used by present and forecast radio interfering signals and to develop in-house software, tailored to predict in particular the cumulative effects produced by a random distribution of such interferers.

- ECC has approved the document ECC/DEC/(06)04 on the harmonised conditions for devices using UWB technology in bands below 10.6GHz. All studies made by CRAF have clearly shown that UWB technology is not compatible with Radio Astronomy. CRAF had great difficulties when asked to comment on a study submitted by the UK administration, showing that coexistence between UWB and Radio Astronomy might be feasible in some circumstances.

- This year Iridium has submitted requests to 35 CEPT administrations to permit operations in an extended band (1618.25-1621.35 MHz), closer to the radio astronomy band 1610.6-1613.8 MHz. ECC approved a new measurement campaign to be made by the Monitoring Satellite Station in Leeheim, Germany, covering all emissions of the Iridium system, including the extended band. CRAF was requested to provide data about interference cases to the next meetings of WG SE (beginning of May) and ECC (beginning of July).

- A revision of the European Common Allocation is foreseen. This will require a full analysis band-by-band and a big and careful work by CRAF.

- It was decided to buy several licenses of MATHCAD 8 and to distribute them among CRAF members interested; these packages allow the user to run MATHCAD sheets developed by CRAF members (in particular by Dr. A. Jessner) for the evaluation of the electromagnetic signal propagation and radioastronomical RFI.

- The ITU-R question “Technical and operational characteristics of applications of science services operating above 275 GHz” has been approved by Study Group 7. It was suggested to send to all CRAF members the common list of frequencies for Radioastronomy (provided by Wim Van Driel) and completed by Jérome de la Noë for Earth atmosphere, asking for comments by interested scientists at each observatory.

- The Radio Spectrum Policy Group is working on “a coordinated EU spectrum approach for scientific use of radio spectrum” and has asked for the following actions: to fill out a questionnaire with detailed information on the use of the spectrum allocated to the scientific community in the member states and to prepare a document to be submitted to the EC this summer.

Next CRAF meeting is scheduled for 16-17 November 2006 in Bonn.

Regulatory protection of frequencies above 275 GHz

A workshop on “Active Protection of Passive Radio Services: towards a concerted strategy” was held in Cagliari, Sardinia, Italy, on 28 and 29 October 2004. The workshop was sponsored by the European Science Foundation, with additional support from RadioNet. The meeting addressed the threats to scientific use of passive radio frequency bands from rapidly increasing use of the radio spectrum, from growing levels of radio pollution, and from commercial pressures to relax regulatory control. Deregulation is used as a method to increase competition in the market, but how can passive users compete? The meeting brought together for the first time the radio astronomical and remote sensing communities. It was decided that three contact points for the three areas should be Dr. Wim van Driel (Radioastronomy), Dr. Jérome de la Noë (Passive sensing of the middle atmosphere from the ground and satellites) and Dr. Guy Rochard (Passive sensing from satellites).

At the end of March 2006, Valery Timofeev, Director of the Radiocommunication Bureau of the International Telecommunication Union, issued four draft new ITU-R Questions and a draft revised ITU-R Question which were submitted for approval. One of them deals with “Technical and operational characteristics of applications of science services operating above 275 GHz”:

The ITU Radiocommunication Assembly, considering

a) that the spectrum in many of the frequency bands used for space radiocommunication is increasingly congested and this problem is expected to get worse;

b) that some current space research, Earth exploration, meteorological and astronomical systems utilise frequencies above 275 GHz and additional ones are planned;

c) that communication links are being used or planned for some satellite systems for inter-satellite communications at frequencies above 275 GHz;

d) that extensive research has already been done and standards established on the hazards of radiation at frequencies above 275 GHz through the International Electrotechnical Commission in standard IEC 60825-1 and the American National Standards Institute in standard ANSI Z136.1-1993;

e) that at frequencies above 275 GHz, sharing between services is not precluded;

f) that the study of Questions by Radio-communication Study Groups includes the following:
- use of the radio-frequency spectrum in space radiocommunication;
- characteristics and performance of radio systems;
- operation of radio systems;

decides that the following Questions should be studied:

1 What are the technical and operational characteristics of systems operating at frequencies above 275 GHz within the science services?

2 Are sharing studies required for systems operating at frequencies above 275 GHz within the science services?

For the WRC-10 agenda, we need good coordination on the agenda item for frequencies above 275 GHz, to ensure that we have a compelling case before the WRC-10 agenda is decided at WRC-07.

Consequently a common list of frequencies above 275 GHz has to be prepared. As a starting base, it is proposed to merge a list of frequencies of interest to the radioastronomy service (established by the Working Party 7D) and a list of frequencies of interest to the Earth middle atmosphere exploration from the ground and from satellites. This is why one of the CRAF members is commissioned to participate to the second NOAA Passive Sensing Workshop to be held on 13-14 June 2006 in Washington DC, to review and assess the specific bands required for specific passive sensing functions.

Jérôme de la Noë
Observatoire de Bordeaux

A site for the SKA

The unprecedented sensitivity of the next generation radio telescope, the Square Kilometre Array, requires an excellent site, which, above all, should be extremely quiet in the part of the radio spectrum that matters.

Man-made radio-noise is everywhere. Transmissions for FM-radio, television, communication (stationary or mobile), data transport, etcetera don't stop at borders of countries or communities, but all combine to create a racket for sensitive radio-ears. Just as it is impossible to hear a whispered conversation on the other platform in a busy train station, so a radio telescope is unable to detect faint cosmic murmurs amidst all that radio-noise. Fortunately, some areas on the globe are significantly quieter than others. Regions with a low population density, as far away from human activities as possible, can be pinpointed on the map. Adding to the requirements the wish to have a site close to the 30th parallel, either North or South, for reasons of sky coverage and avoidance of the geomagnetic equator, has led to a small list of candidate sites where the SKA might be built: the Karoo desert in South Africa, the Karst region in Southern China, the outback in Western Australia and the high plains near the Andes in Argentina.

To investigate how candidate sites for the new radio telescope compare in radio-quietness a monitoring station was designed and constructed by ASTRON. The challenge was to design and construct a system that is suited for performing the measurements at the required sensitivity and frequency range, within a relatively short time, and make it robust enough to survive rough handling while travelling the world and the sometimes harsh conditions at the four sites. A team of capable engineers came up with a system that was up to the task. Ranging from the antennas at the front of the system, via low noise receiver technology, to a high quality spectrum analyzer and powerful computer system, a monitoring instrument was created that met all the requirements.

Part of the challenge was to build a system that prevents self-pollution of the data. A system with digital elements usually generates radio interference that will be picked up by other parts of the receiver, thus obstructing a clear “view” of the radio environment at the site. At high sensitivities this is quite a difficult issue. The measures taken and the procedures used for taking the measurements at the sites have proven to be adequate in dealing with this hazard. Supplementing the hardware instrumentation is a suite of software tools. First the required measurements need to be specified and scheduled, using a tool that allows this and that produces information ready to be used by the hardware control package. This control software tool takes the information and sends appropriate instructions to the frontend electronics and the spectrum analyzer. It takes care of reading the measured data from the spectrum analyzer and of storing the files on disk in the computer system. Finally, a data processing package reads the files and performs the calculations needed to produce the graphs that show the signal strength across the frequency range, and many more properties of the signals measured at the site. When everything was tested and ready, the instrumentation was packed into two crates for shipment, together weighing about 1100 kilograms.

The mission of the monitoring project is to execute a predefined set of measurements lasting about one month at all four sites in succession, while local monitoring teams are doing the same for one whole year. The independent ASTRON measurements will form the common ground on which the local monitoring data can be judged. The data are generally more sensitive than the local data and are acquired at all sites in the same way and with the same instrumentation. For this purpose each session included dedicated cross-calibration measurements that allow linking the system parameters of all monitoring systems.

Early in 2005 the first site was visited in the South African Karoo. Getting the equipment installed and up and running at the site was easily done. It was discovered however that on this first trip not everything had been packed right, as one of the antennas showed some damage. Repairing this was not a problem, but a bad low noise amplifier that was also discovered forced a change of plan until a replacement could arrive at the site. These two issues and some impressive thunderstorms in the area caused a loss of one week. Nevertheless, this first session was very successful and the lessons learned were of great importance. The South African team leader Gerhard Petrick is thanked for his never ending efforts to make this a success. The Karoo desert looks very “deserted”, but has a special stark beauty that was much appreciated by the ASTRON team.

The next session on the programme was China. South of the provincal capital Guiyang a monitoring site next to the Dawodang Karst depression had been prepared. Getting the equipment through customs and on the site took a bit more effort here and some time was lost. But once the monitoring system was set up at the site, it started routine operations quickly and efficiently. The ASTRON team held many fruitful discussions on the monitoring effort

with the local team members. The support by this wonderful team of people was great; problems in the mains power supply were effectively dealt with, allowing the session to proceed smoothly. There was just one mishap, when a nearby thunder strike caused damage to an amplifier. The problem could be fixed within hours, so not much time was lost by this event. The team owes many thanks to Bo Peng and his people for taking care of the support. Working amidst the local population in this area of stunning beauty has been a privilege.

The third session on the list was in Western Australia. Near the Mileura station a location was set aside as a candidate for the SKA core. This is outback country. Red soil and low bushes and trees, and an occasional kangaroo, emu, cow or sheep. This time there were no delays in getting the equipment to the site. Furthermore, no mishaps occurred and the session was completed as scheduled. The team thanks Ron Beresford and his staff for doing an outstanding job and to ensure a successful mission.

Finally, the ASTRON team travelled to the fourth continent, to Argentina. A high valley, surrounded by mountains and hills, with a view of the Andes mountain range was the location of the measurements, at a site near the CASLEO optical telescope facility in the West of the country. This is mountain and big sky country. This time customs provided an obstacle to a quick transfer of equipment, and consequently the mission had to be split to allow for the Christmas period. The split didn't cause too many problems, and eventually the session proceeded well. The problems that did pop up were related to the very dry and windy conditions that were experienced at the site. Static electricity buildup on an antenna caused two amplifiers to fail during the session. These could be quickly replaced by spares and eventually a remedy was found to prevent this happening again. The ASTRON team was deeply impressed by the beauty of the scenery. Team leader Marcelo Arnal must be thanked for providing the indispensable support; also Hugo Levato and his crew at CASLEO were instrumental in the success of the mission.

After the travelling was over and done, a huge task remained in preparing the reports to conclude the project. Uncountable graphs have been produced at various levels of detail. The concept of performing site measurement around the world with one instrument and one measuring method has resulted in a valuable data set that can be mined for more information than extracted thus far in the framework of the SKA site suitability assessment.

Rob Millenaar
ASTRON

RadioNet support for CRAF activities

It has become routine to ask RadioNet to support the travel of CRAF members and some other radioastronomers. We have also been able to offer new members (Latvia for example) the real opportunity to participate for the first time in our meetings.

Looking into the future and then to the call for proposals for 7th Framework Programme (expected in November 2006) from the European Commission, the Board of RadioNet issued a call for expressions of interest for new ideas. CRAF answered, asking first for a continuation of the present Network Activity on Spectrum Management, summarizing all requests as follows:

1) support for travel expenses of CRAF meetings by CRAF members and astronomer scientists;
2) extension of CRAF meetings to 2 full days in order to include a seminar at the local hosting institutions;
3) support for mission expenses of the CRAF chair and national delegates, when common European issues are involved;
4) partial support for RFI2007 (mostly concerned with RFI mitigation plus some regulatory matters);
5) partial support for SS2008 (Summer School on Spectrum Management).

Also some new ideas were proposed:

a) design study of a system configuration suitable for monitoring RFI at each European observatory with cost estimates and possibly the assembly of a small prototype;
b) development and distribution to all EU observatories of software packages suitable to model general propagation mechanisms as well as to predict the aggregate strength of many different RF sources in the Radioastronomy bands. This will be very useful as a tool for mixed scenarios and a cross check against professional packages.

We want to thank the RadioNet secretariat and management for their efficiency and kindness in helping us to solve day by day problems, which, on the other hand, can have an even larger impact than the fundamental ones.

Attempted removal of "All emissions are prohibited" (RR 5.340) clause from national radio regulations

In January 2006 the German ministry for commerce and technology published a draft for a new frequency allocation table without the protection clause (D 340) "all emissions are prohibited" (RR No. 5.340) for the Band 23.6-24.0 GHz. This was meant as a "temporary measure" to remove any legal grounds for possible court action by the affected services should they be suffering unduly from RFI created by SRR (short range radar) devices on cars. The protected frequency band 23.6-24.0 Hz contains important spectral lines of ammonia and is used extensively for the study of conditions in interstellar molecular clouds. Measurements made with the Effelsberg 100-m Telescope have enabled radioastronomers to determine temperatures and densities in star forming regions, vital parameters for understanding how our own solar system came into being.

Removing the protection from the 24-GHz band would have created an international precedent. There are indications that the same procedure was planned for 1.4, 2.7 and 4.85 GHz to cater for possible future ultrawideband (UWB) devices. The ministry and the administration (BNetzA) did not consult or inform the Max-Planck Institut für Radio Astronomie (MPIfR) or CRAF about the matter. The plans were published quite obscurely, hidden under a layer of web pages. Fortunately they came to our attention just three days before the deadline for possible objections expired. The MPIfR registered their objection in a letter to the minister and a delegation from the earth sensing services had a meeting with those in charge in the ministry. From what we know at present, the intention is to keep the RR 5.340 footnote and to add another national one allowing SRR transmissions until the year 2013. We are curious to see what the next draft of the national frequency allocation table will contain.

Axel Jessner
Effelsberg, Germany

Abbreviations used in this Newsletter

AM: amplitude modulation
ANSI: American National Standards Institute (USA)
ASTRON: Netherlands Foundation for Research in Astronomy
BNetzA: Bundesnetzagentur (German federal network agency)
CASLEO: Complejo Astronómico el Leoncito (Argentina)
CEPT: Conference of European Post and Telecommunication administrations
CRAF: Committee on Radio Astronomy Frequencies (ESF)
ECC: Electronics Communications Committee (CEPT)
EC: European Commission
ESF: European Science Foundation
EU: European Union
FM: Frequency modulation
FP7: 7th Framework Programme (EC)
IEC: International Electrotechnical Commission
ITU-R: International Telecommunication Union - Radiocommunication Sector
MPIfR: Max-Planck Institut für Radio Astronomie (Germany)
NOOA: National Oceanographic and Atmospheric Administration (USA)
NSF: National Science Foundation (USA)
RR: Radio Regulations (ITU-R)
RSPG: Radio Spectrum Policy Group (EU)
SKA: Square Kilometre Array
SRR: Short Range Radar
UWB: Ultra Wide Band
WGSE: Working Group on Spectrum Engineering (ECC)
WRC: World Radiocommunication Conference (ITU)

Editorial Group:
R. J. Cohen, R. Ambrosini and W. van Driel.

Committee on Radio Astronomy Frequencies (CRAF)
CRAF is an Expert Committee of the European Science Foundation. Established in 1988, it represents all the major radio astronomical observatories in Europe. Its mission is to coordinate activities to keep the frequency bands used by radio astronomers in Europe free from interference.
Chair: Dr. Roberto Ambrosini (Italy)
ESF Physical and Engineering Sciences Unit:
Head of Unit: Patrick Bressler
ESF Administrative Assistant: Carole Mabrouk
Tel: 33 (0)3 88 76 71 69
Fax: 33 (0)3 88 37 05 32
Email: cmabrouk@esf.org
www.astron.nl/craf or www.esf.org/craf

The European Science Foundation (ESF) provides a platform for its Member Organisations to advance European research and explore new directions for research at the European level.
Established in 1974 as an independent non-governmental organisation, the ESF currently serves 78 member organisations across 30 countries.

EUROPEAN SCIENCE FOUNDATION
SETTING SCIENCE AGENDAS FOR EUROPE

1 quai Lezay-Marnésia I BP 90015
67080 Strasbourg cedex I France
Tel: +33 (0)3 88 76 71 00 I Fax: +33 (0)3 88 37 05 32
www.esf.org