

REPORT ON THE RADIONET3 NETWORKING ACTIVITY

TITLE: 4TH SCHOOL ON SPECTRUM MANAGEMENT FOR RADIO ASTRONOMY

DATE: *7 -11 APRIL 2014* **TIME:** (WHOLE DAY)

LOCATION: *SANTIAGO, CHILE*

MEETING WEBPAGE [*http://www.iucaf.org/sms2014/*](http://www.iucaf.org/sms2014/)

HOST INSTITUTE: *JOINT ALMA OBSERVATORY*

PARTICIPANTS NO: *33*

MAIN LEADER: *UMAN*

REPORT:

1. Programme of the meeting

Monday, 7 April 2014

08:30 – 09:00 Registration

09:00 Introduction

Greetings.....	Tzioumis Pierre Cox (Director, JAO) 5
Welcome: ALMA/ESO.....	F. Comeron (ESO) 10
ALMA/NRAO	E. Hardy (NRAO) ...10
ALMA (NAOJ)	T. Hasegawa (NAOJ) 10
IUCAF	M. Ohishi (NAOJ) 10
Spectrum Management: View from the Chilean Administration.	M. Rodriguez(SUBTEL) 20
Introduction of participants:	
Why am I here? What do I expect to get out of it?	(All) 30
Administrative Details	10

10:45-11:00 Coffee Break

11:00 Radio Astronomy and the Spectrum School

ALMA: Description and details.....	Ohishi P. Cox (Director, JAO) 45
The Primary Purpose of the School	T. Gergely (NSF) 15
Radio astronomy and radio telescopes	A. Tzioumis (CSIRO) 30

12:30-14:00 Lunch

14:00 Radio Science & Technology— I

Radio science and engineering basics.....	Van der Marel A. Clegg (Google) 90
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15:30- 15:45 Break

15:45 – 17:15 Radio Science & Technology— II

Mm-wave Propagation: fundamentals and models	Van der Marel H. Suzuki (CSIRO) 30
Mm-Wave Instrumentation.....	D. Rabanus (ALMA) 60

Tuesday, 8 April 2014

9:00 Remote Sensing & Space RA Observations

Earth Exploration Satellite Service: Frequency Allocation and Remote Sensing of our Changing Earth from 1 GHz to 3 THz.....	Gergely S. Reising (Colo State U) /
EESS– passive and active.	T. Gaier (JPL) 40
Space RA observations, Far Side of the Moon, L2 point	V.Meens (CNES) 25
Active remote sensing from space: a constructive use	G. Langston (NSF) 25
of the radio spectrumP. Siqueira (U Mass) 25

10:45-11:00 Coffee Break

11:00 Compatibility Studies

Compatibility and aggregate interference	Gergely H.van der Marel (Astron) (90)
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12:30 -14:00 Lunch

14:00 Interference to Radio Astronomy I

The RAS protected bands and use by RA
Interference to RA and RFI mitigation techniques.....
Destructive Interference in RA

Chung

T. Tzioumis (CSIRO) 30
K. Warnick (BYU) 60
H. Liszt (NRAO) 30

16:00-16:15 Break

16:15 Interference to Radio Astronomy II

Harmful (Detrimental) levels/Non-linearities.....
Mm-wave Interference issues
Low Frequencies: RFI's Playground.....

Chung

D. DeBoer (U Berkeley) 45
H. Liszt (NRAO) 30
D. DeBoer (U Berkeley) 45

Wednesday, 9 April 2014

09:00 The International Regulatory Structure

International spectrum management system
The ITU-D and the SMTP Program.....
WRC's and WRC preparation
IUCAF's role.M.

Clegg

V. Nozdrin (ITU) 30
(pres. By T. Gergely)(ITU-D) 15
T. Gergely (NSF) 45
M. Ohishi (NAOJ) 15

10:45-11:00 Coffee Break

11:00 National and Regional Regulatory Structures and how they feed into the International structure

USA, FCC, NTIA, CORF
Americas, CITEL
CORF Initiatives.
Asia-Pacific Region, APT, RAFCAP
RAS Protection in China.....

Clegg

G. Langston (NSF) 15
T. Gergely (NSF) 10
D. Lang (CORF) 15
K. Chung (KASI) 15
H. Zhang (Chinese Academy of Sciences) 20
Matlhane (SKA S. Africa) 15
H. Van der Marel (ASTRON) 30

Developments in the African Region.....
Europe, CEPT, CRAFT.....

13:00-14:00 Lunch

Afternoon: Free

20:00-22:00 Spectrum School Dinner

Thursday, 10 April 2014

9:00 The Regulatory Structure in Practice

ITU-R Recommendations, RA series.....
ITU-R Reports, RA series
The ITU-R Radio Astronomy Handbook

DeBoer

M. Ohishi (NAOJ) 60
M. Ohishi (NAOJ) 60
A. Tzioumis (CSIRO) 15

10:45-11:00 Break

11:00 The Regulatory Structure in Practice II

ITU Registration
Coordination with Satellites (CLOUDSAT, LEOs, etc).....
Radio Quiet Zones and SKA.....
Dynamic scheduling and coordination agreements

DeBoer

T. Gergely (NSF) 15
H. Liszt (NRAO) 30
R. Millenaar (ASTRON) 30
A. Clegg (Google) 20

12:35-14:00 Lunch

14:00 New Technologies and Unlicensed Devices

Software-defined & Cognitive Radio
EMC.....

Liszt

R. Millenaar (ASTRON) 20
M. Ohishi (NAOJ) 20

608 MHz issues (TV Channel 37)
 MSS – Iridium issues- Europe
 MSS – Iridium issues- USA
 Vehicular Radar

A. Clegg (Google) 20
 H. van der Marel (ASTRON) 20
 A. Clegg (Google) 20
 G. Langston (NSF) 20

16:00-16:15 Break

16:15 RFI Monitoring

Liszt

RFI monitoring: requirements, techniques, recent campaigns
 and results for the SKA
 Radio Frequency Interference: Equipment and Measurements.....

H. Millenaar (ASTRON) 45
 G. Gancio (IAR) 20

Friday, 11 April 2014

09:30 Conclusion

Gergely/Ohishi/Tzioumis

Spectrum management and radio astronomy: The future.
 A view from the other side
 Open discussion: How to ensure the protection of the RA.....

A. Clegg (Google) 30
 All 60

2. Scientific Summary

Rationale

The 4th IUCAF School on Spectrum Management offered a comprehensive view of both technical and regulatory issues related to radio astronomers' use of the spectrum. Spectrum management is a task of rapidly growing importance, for radio astronomy as well as for other radio services; however, it is not part of any academic curriculum; radio astronomers have to learn it by doing it. The IUCAF School in Spectrum Management was an opportunity to profit from the experience of colleagues.

The expected audience were members of the radio astronomy and related radio engineering community, who are becoming active in this area at the local, national or international level, and regulators whose task is to protect passive services and science services. These skills have critical application to science, commerce and government.

Purpose

The School trained the next generation of Scientists, Engineers and Administrators in the skills enabling discoveries via observations using the radio spectrum.

Over 80 years have passed since K. G. Jansky first detected radio emission from the Galaxy, while searching for the origin of the weak static that was causing interference to communications. Since then, radio astronomy has revolutionized our view of the Universe through the discovery of quasars, pulsars, the Cosmic Microwave Background, surveys of our Galaxy in the 21-cm hydrogen line, molecular lines, and many other phenomena. The radio window was the first non-optical window in the electromagnetic spectrum explored by astronomers, and radio techniques continue to be a prime tool in the exploration of the Universe. At the same time, radio astronomy retains close ties to the world of radio communications, adopting some of its leading technologies, and sometimes giving rise to technologies of its own adopted by radio engineers for commercial applications.

During the 20th century, radio astronomers enjoyed relatively easy and interference free access to large portions of the spectrum, by locating telescopes far from potential sources of man-made noise. A small number of specialists took care of regulatory issues that arose in national and international fora that rarely required attention from the broader astronomy community. This state of affairs has been changing rapidly in the 21st century, as demands on the spectrum increase due to huge increases in the demand and availability of wireless applications (mobile phones, Wireless LANs, and many others), communication satellites and marketing of new technologies, such as ultra-wide band systems, power line telecommunication systems, cognitive radio systems and dynamic spectrum access (DSA). The development and health of radio astronomy depend critically on astronomers' continued access to the radio spectrum, and this in turn demands that astronomers and particularly radio observatories pay closer attention to the technical and regulatory issues that arise in relation to managing the radio spectrum, particularly as they relate to radio astronomy.

Spectrum management is critical for the future of radio astronomy. It is also interesting and even challenging, as it requires a combination of scientific motivation, technical background, legal knowledge and diplomatic skills. These skills are normally not taught as part of science curricula. The IUCAF Spectrum Management School provided an introduction to a unique combination of technology, science and international diplomacy by experts in this field. At this school, special emphasis was given to millimeter-wave technologies and spectrum issues.

3. Attendance list



Last Name	First Name	email	Affiliation	Country
Chung	HyunSoo	hschung@kasi.re.kr	Korea Astronomy and Space Science Institute	Republic of Korea
Clegg	Andrew	w4je@w4je.com	Google	USA
DeBoer	David	ddeboer@berkeley.edu	University of California	USA
Gaier	Todd	todd.gaier@jpl.nasa.gov	JPL/CORF	USA
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Gergely	Tomas	tgergely@verizon.net	NSF	USA
Hase	Hayo	hayo.hase@bkg.bund.de	Bundesamt für Kartographie und Geodäsie	Germany
HASEGAWA	TETSUO	tetsuo.hasegawa@nao.ac.jp	Director, NAOJ Chile Observatory	Japan
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Lang	David	dlang@nas.edu	U.S. National Academy of Sciences	USA
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MEENS	Vincent	vincent.meens@cnes.fr	CNES French space Agency	France
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Millenaar	Rob	millenaar@astron.nl	ASTRON	Netherlands
Neupane	Sudeep	sneupane@das.uchile.cl	University of Chile, Department of Astronomy	Chile
Nozdrin	Vadim	vadim.nozdrin@itu.int	ITU	Russia
Ohishi	Masatoshi	masatoshi.ohishi@nao.ac.jp	National Astronomical Observatory of Japan	Japan
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Warnick	Karl	warnick@ee.byu.edu	Brigham Young University	USA
Zhang	Haiyan	hyzhang@bao.ac.cn	National Astronomical Observatories of CAS	China
Zorzi Avendano	Pablo	pzorzi@alma.cl	ALMA	Chile

4. Financial Report / RadioNet3 contribution

RadioNet3 has provided a contribution to the Spectrum School dinner of 392 700 Chilean Pesos (€ 594.57).

5. Conference Proceedings and Web page

The presentations of the School will be placed at the web page of the School:
<http://www.iucaf.org/sms2014/>.