

# Radio Astronomy and the Future

Masatoshi Ohishi

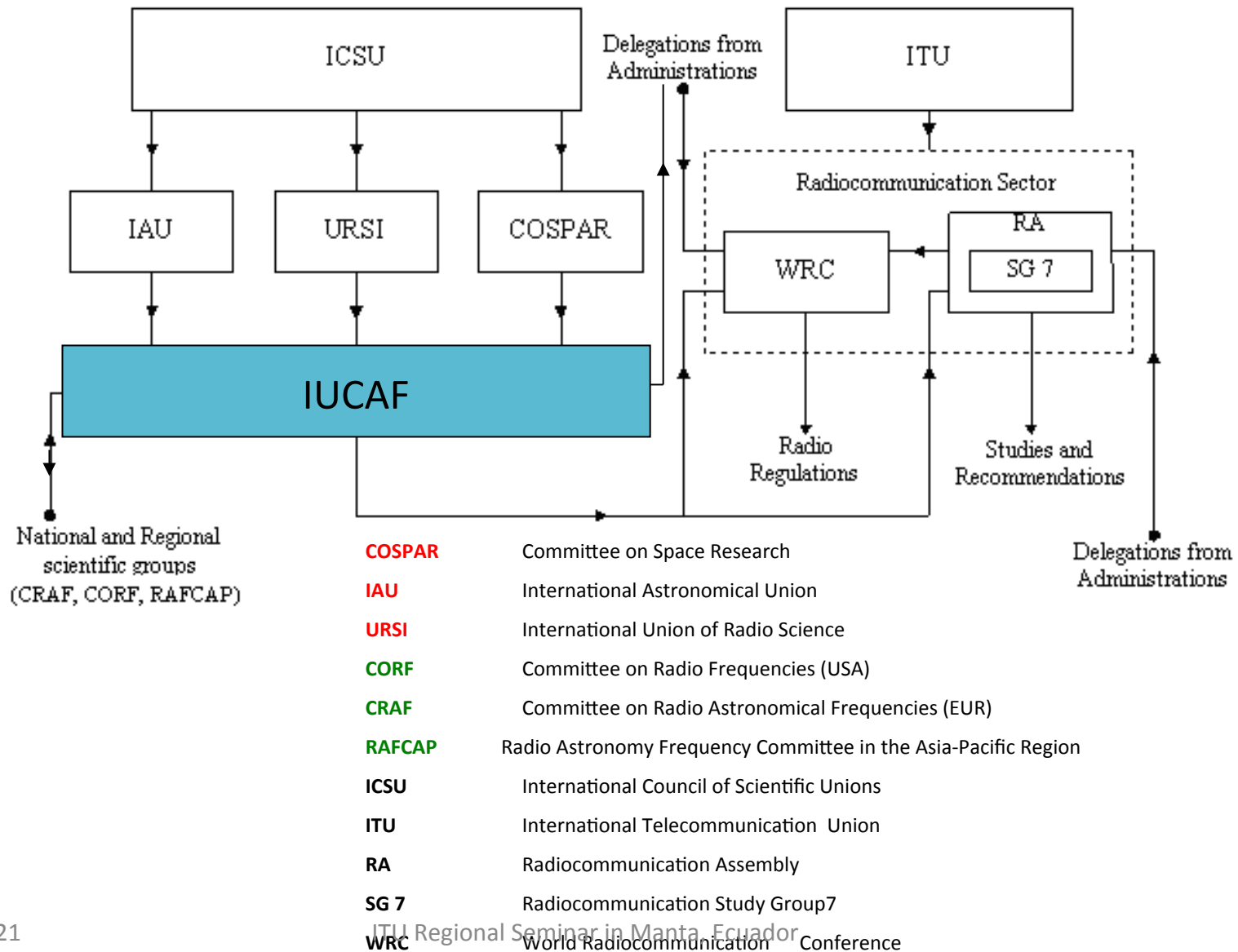
(National Astronomical Observatory  
of Japan; Chairman of IUCAF)

# What is IUCAF ?

# IUCAF

- IUCAF (The Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science)
- Established in 1960, sponsored by URSI, IAU and COSPAR, under ICSU
- Sector member of ITU (International Telecommunication Union) → regular participation to ITU meetings
- to ensure the protection of radio frequencies allocated to astronomy and passive space sciences and minimize interference to these scientific observations and measurements

## IUCAF's place in the worldwide spectrum management circus



## IUCAF in Action (in Geneva)



# Future Radio Telescopes



# ALMA (under construction in Chile)

Atacama Large Millimeter/submillimeter Array  
N. America/Europe/East Asia      30~950 GHz



2012/09/21

ITU Regional Seminar in Manta, Ecuador

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# ALMA aims to study

- Formation and evolution of galaxies

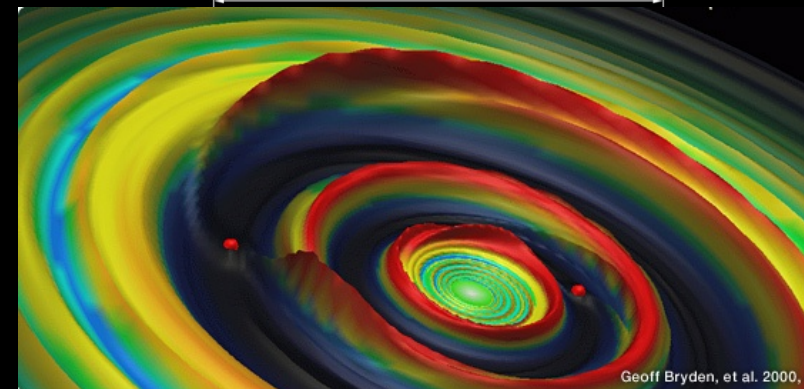
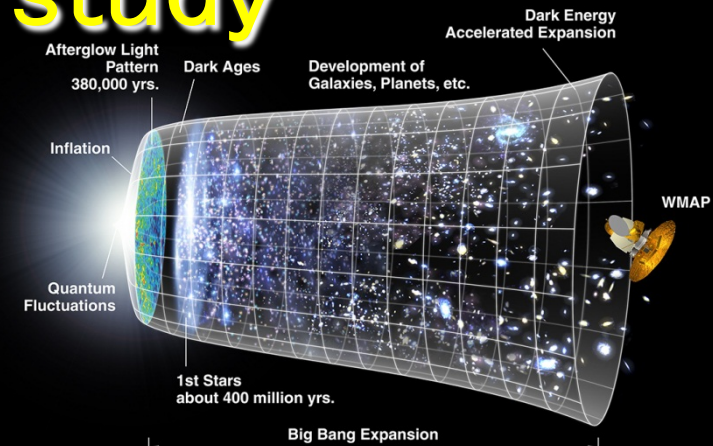
- After the “Dark age”
- Emission from dust particles

- Formation of Planetary Systems

- Protoplanets, planetary disks
- Search for other “Earth”s

- Evolution of Molecules

- Forest of Molecular lines
- Molecules toward “Life” in the Universe



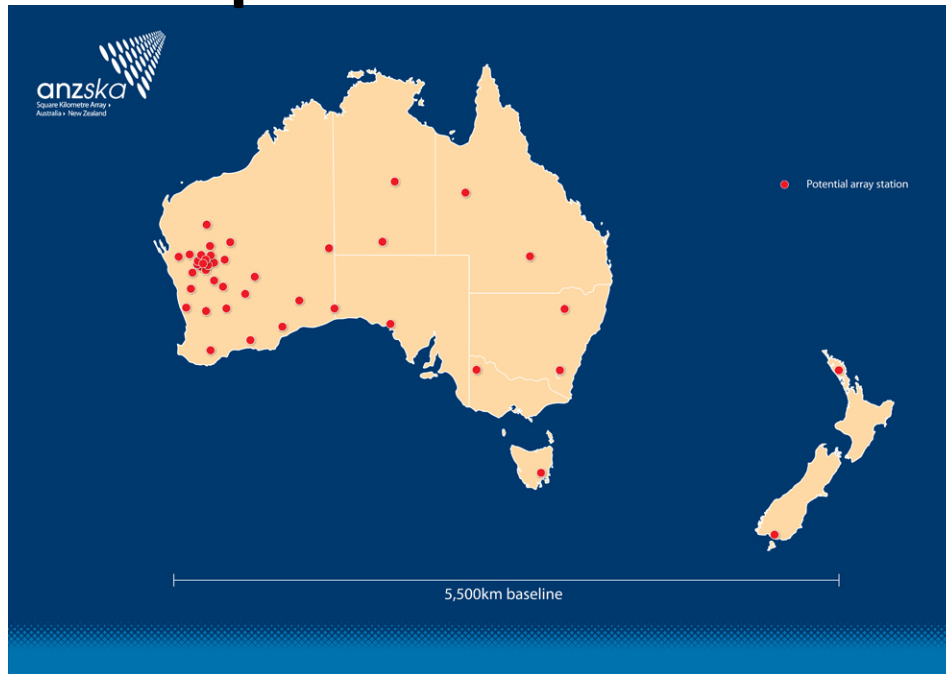


# LOFAR

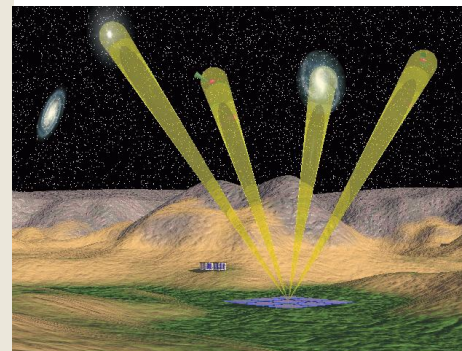
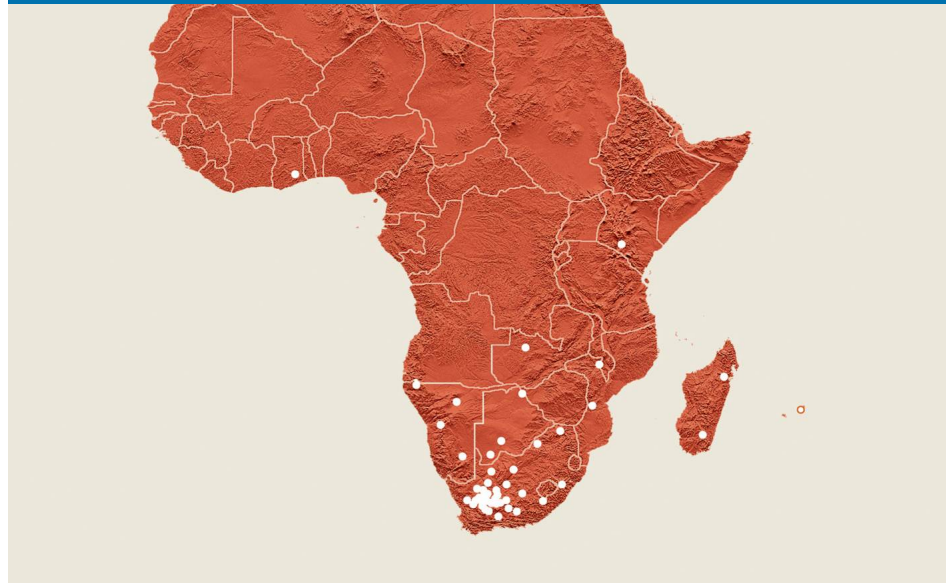


- 10-240 MHz
- Radio interferometer under international collaboration
- Phased array: multiple beams can be formed simultaneously
- Data production: 240 Terabytes /day !

# Square Kilometre Array (SKA)



- 1km<sup>2</sup> collecting area
- Aperture synthesis radio telescope
- 70 MHz ~ 10 GHz
- Completion ~2020 ??
- Aus & S. Africa
  - ASKAP & MeerKAT
  - “1% SKA” prototypes



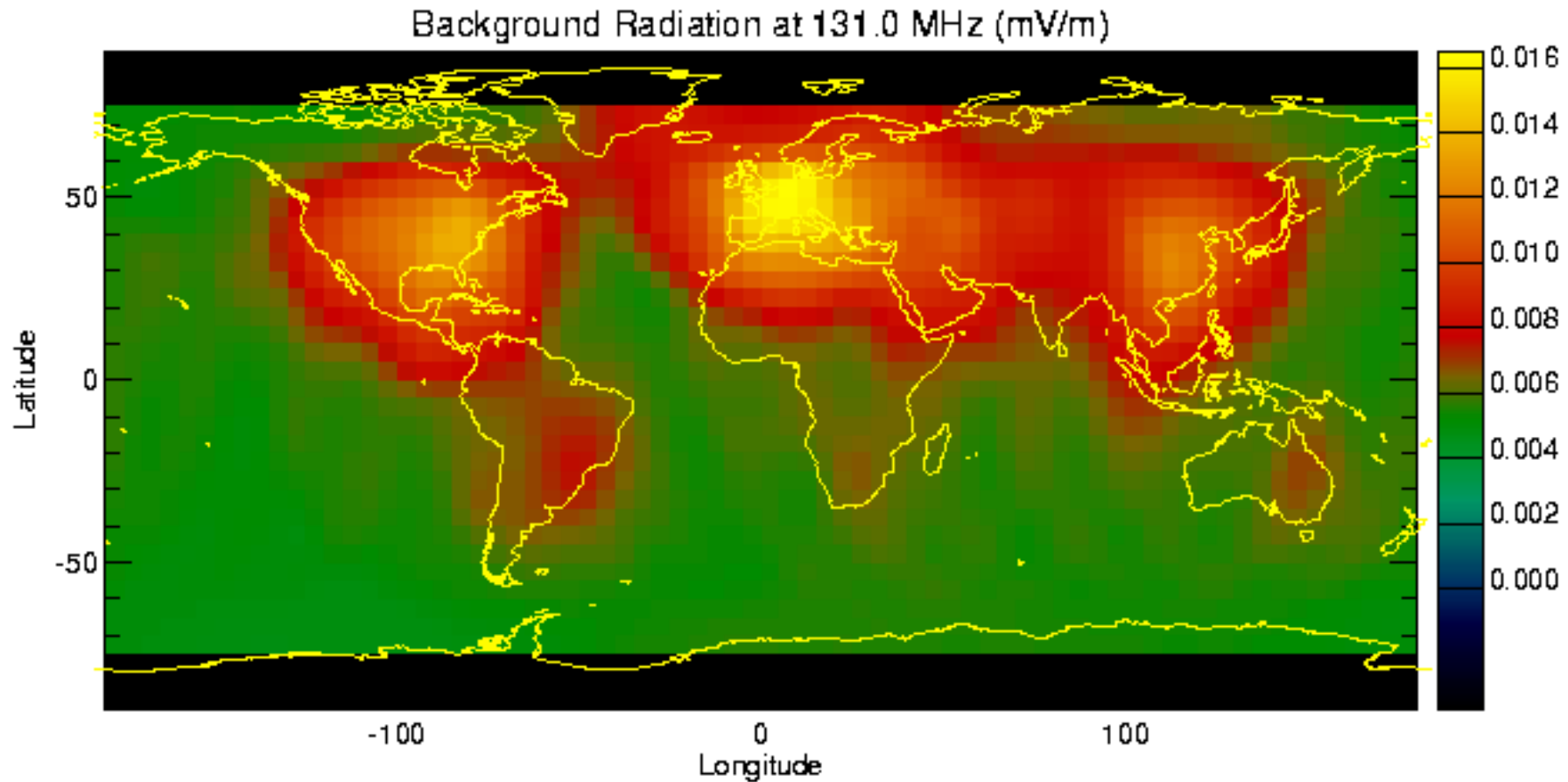
# Radio Quiet Zone

# Why? -- Need for RQZ?

- RA systems extremely sensitive
    - very susceptible to RFI
  - RA allocated very little spectrum (~2% at cm  $\lambda\lambda$ )
    - Still RFI from out-of-band (OoB) emissions
  - RA operates over full radio spectrum
    - RFI from radiocommunication services
  - “prevention better than cure”
- ⇒ RQZ is 1<sup>st</sup> step of mitigation**



# Where are the Quiet areas?



**RQZ -- prevent “harmful” (detrimental) RFI**

RFI mitigation – minimize “harm”

may influence RQZ limits & area

# RQZ History

- National RQZ
  - Within an administration
  - Sovereign rule – can depart from ITU
  - Regulate terrestrial services
  - Little or no impact on satellite services
- International RQZ
  - Moon & L2 point

## ALMA Quiet Zone -- Chile

- **Central Quiet zone:** 30 km radius, no transmitters in ALMA bands (variously 31 to 950 GHz)
- **120 km radius coordination zone**
  - AUI/ESO may comment on xmit applications
    - > 31 GHz, comply with 769 at site boundary
    - < 31 GHz, 769 + limit on transmitter power
      - Eirp such that pfd at ALMA border  $< 2 \times 10^{-6} \text{ W/m}^2$
- Formal recognition is needed to avoid future changes in policy.
- Need to advertise to the general public and politicians about radio astronomy and the need for radio quiet zone.

# 3<sup>rd</sup> IUCAF Summer School

- May 31 – June 4, 2010
- Program
  - Procedure and structure of ITU and regional regulatory bodies
  - Radio receivers, spectrometers, propagation models
  - Actual RFI cases
  - Radio Quiet Zones
  -

[http://www.iucsf.org/SSS2010/presentations/SS2010\\_presentations.htm](http://www.iucsf.org/SSS2010/presentations/SS2010_presentations.htm)



Summer School 2013 is planned in Chile



# Summary

- IUCAF has been active in tackling RFI issues for the sustainability of the RAS.
- Many future RA projects are going on, which have much higher sensitivities and data production rates than before.
- RQZ could be a solution to protect future RA telescopes.