

The International Union of Radio Science (URSI)



URSI
Scientific Activities

François Lefeuvre

LPCE/CNRS 45071 Orleans cedex 2, France

A. Electromagnetic Metrology

- **Development and refinement of new measurement techniques**
 - **based on EM principles (e.g. precise time and wavelength measurements)**
 - **or used for the characterization of EM properties of materials and electromagnetic dosimetry**

with applications in industry, environment and security, health and safety, communications, etc.
- **Primary standards, including those based on quantum phenomena: realization and diffusion of time and frequency standards**



*LNE &
LNE-SYRTE/OP*

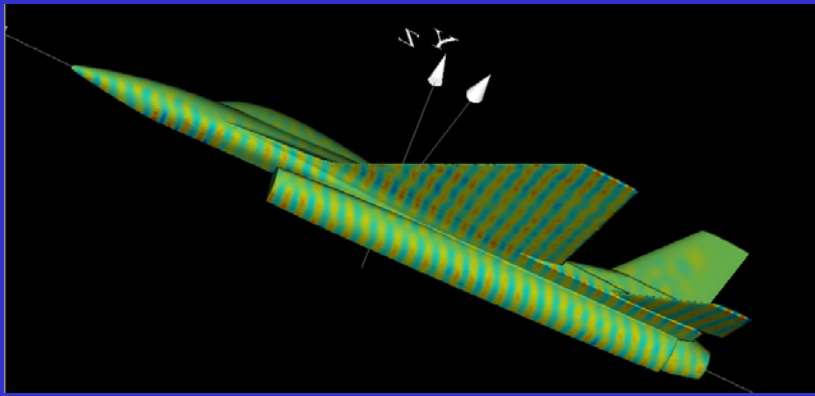
- **References : realisation of frequency standards with Cs cold atoms to realise the second : atomic fountain at 9 GHz with an accuracy of about $5 \cdot 10^{-16}$.**



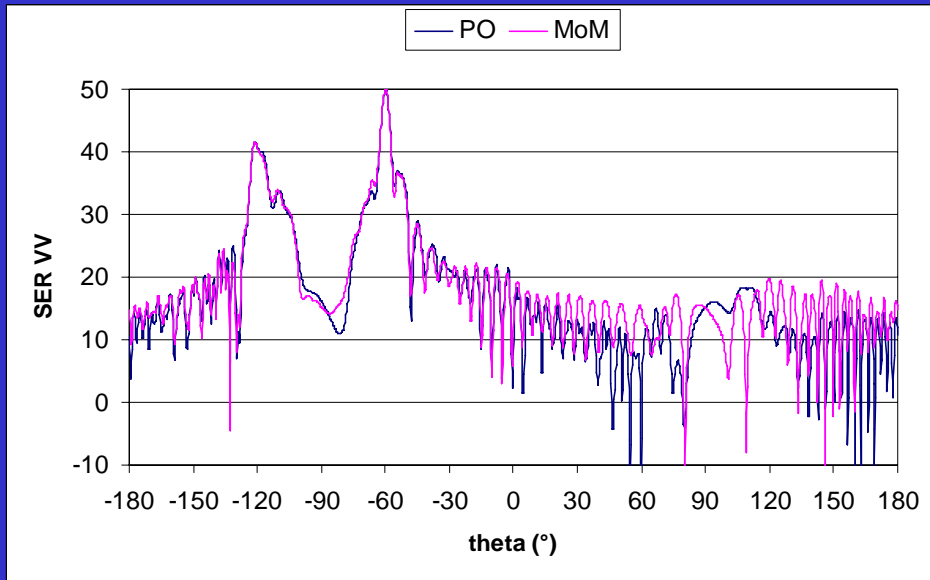
- **Development of clock comparison means via satellite (TWSTFT : Two Way Satellite Time and Frequency Transfer), GPS, etc.**

B. Fields and waves, EM theory and applications

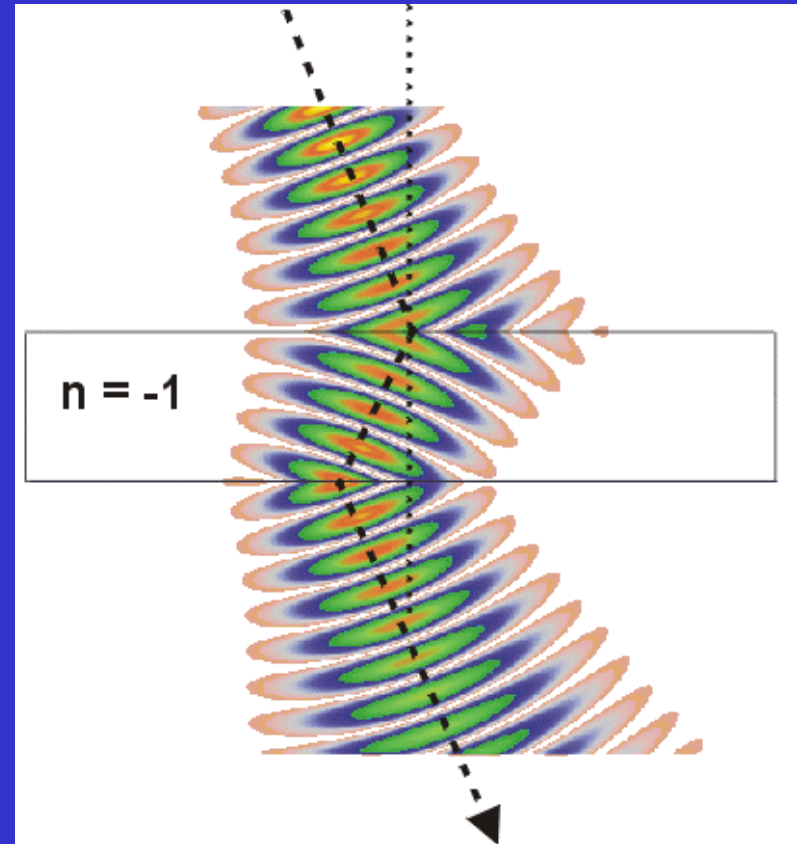
- **Analytical, numerical and measurement techniques to understand electromagnetic phenomena**
 - **development of antennas and antenna arrays**
 - **propagation including waves in specialized media like Metamaterials (MTMs) where n , ϵ and μ can be made <0**
 - **application of EM fields as a non-destructive tool**
- **Inverse scattering and imaging**



Simulation of surface currents (*F Molinet*)



Equivalent radar surface of the plane -
From a Physical Optic (PO) approximation
and from a numerical simulation (*F. Molinet*)

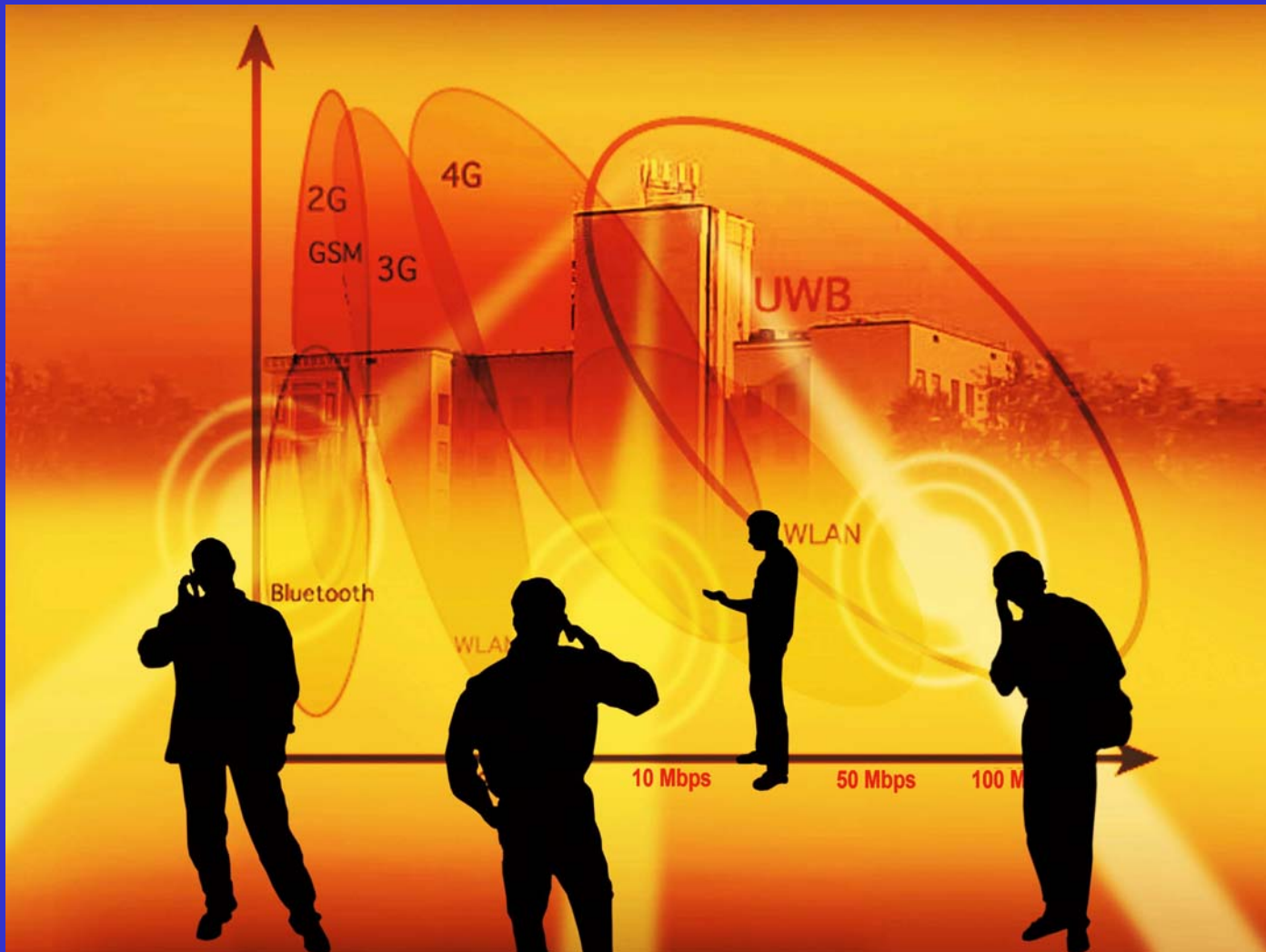


(*R. W. Ziolkowski*)

MTMs may lead to new physics
and engineering concepts MT

C. Radio-Communication systems and signal processing

- **Research and development in:**
 - **Radio-Communication and Telecommunication Systems**
 - **spectrum and medium utilization**
 - **information theory, coding, modulation and detection**
 - **signal and image processing**
- **In order to communicate with anyone, anywhere, any time require new concepts like « reconfigurable radio and cognitive radio ».**



A new vision of the utilization of the spectrum emerges. It sets questions to be discussed at the 2008 GA in an open forum

D. Electronics and photonics

- **Research of the new electronic and photonic devices and systems permitting the development of digital computers, Television and mobile communications, etc.**
 - **semiconductor lasers**
 - **optical fibers,**
 - **microwave integrated circuits**
 - **nano-optics and nano-electronics**
- **Device for generation, detection, storage and processing of EM signals together with their applications from the low frequencies to the optical domain**

JOURNÉES SCIENTIFIQUES DU CNFRS - URSI

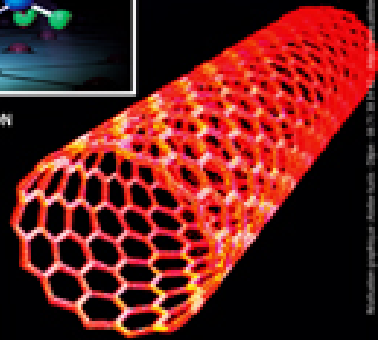
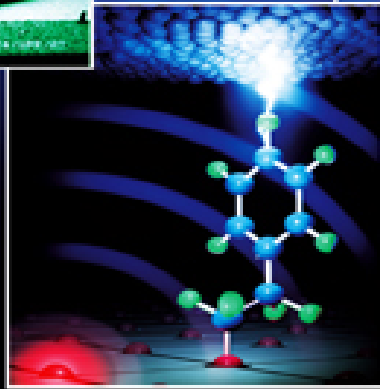
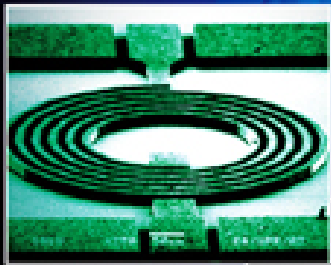
PARIS 20-21 mars 2007

CNAM

292, rue Saint-Martin



NANOSCIENCES ET RADIOÉLECTRICITÉ



COMITE SCIENTIFIQUE

Président :

F. de Fornel, ICB

Membres :

M. Bellanger, CNAM

A. Bravo, SEE

P.-N. Favennec, CNFRS

X. Grosse, DGA

A. le Roy, CEA

D. Lippens, IEMN

D. Maystre, Institut Fresnel

A. Melliton, BLIM

J.-P. Pocholle, Thales

M. Pyrie, LFCB

B. Rousseaux, ONERA

S. Tejdani, EUSAR

P. Senn, France Télécom

B. Picinbono, Académie des Sciences

P. Van Dorle, IMEC

COMITE D'ORGANISATION

F. de Fornel, CNFRS

C. Algan, CNAM

M. Bellanger, CNFRS

P.-N. Favennec, CNFRS

J. Hamelin, CNFRS

H. Sliou, CNFRS

M. Terri, CNAM

J. Wart, CNFRS

<https://cnfrs.get-telecom.fr>



On the announcement of the 2007 Conference of the French URSI Committee :

- nano device for fast (20-100 μ s) commutation

- light distribution in an hexagonal photonic crystal cavity

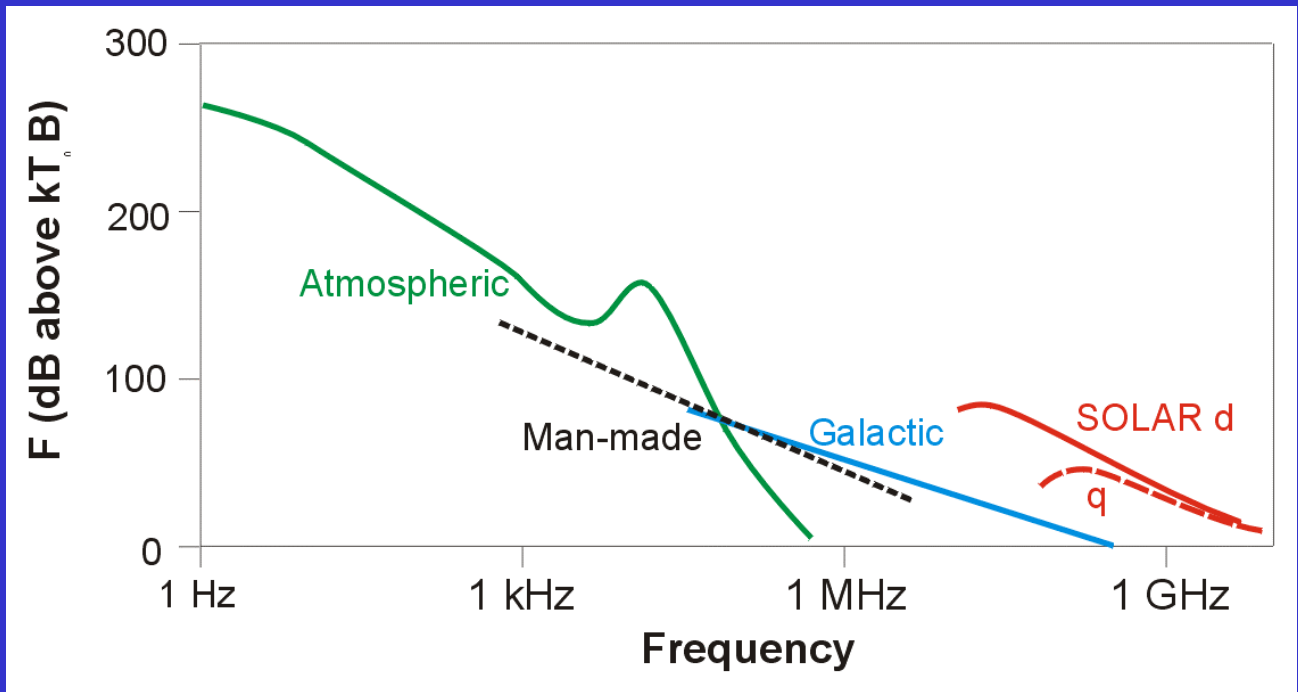
- scale for molecular electronic

-carbon nano-tube (diameter : \sim 10 nanometers), with specific properties (conductivity) to be used for electronic components (e.g. transistors).

E. Electromagnetic Noise and Interference

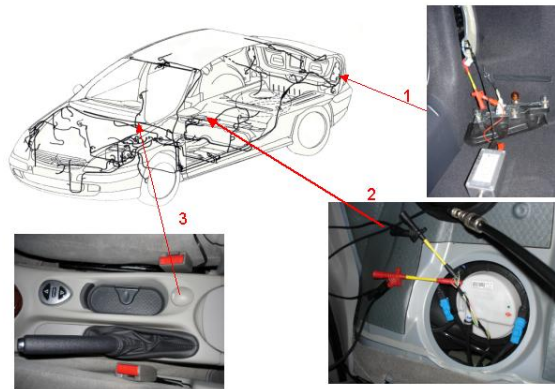
- Investigation of the level and of the effects of natural and man-made noises on the performances of radio, TV, phones, navigation instrument, etc.
 - adaptation of test techniques to impulsive and higher frequency noises
 - questions raised by new concepts like Power Line Communications (PLC)
 - definition of new standards and norms
- Terrestrial and planetary noise of natural origin, seismic associated electromagnetic fields

Spectrum of the EM noise in the Earth environment



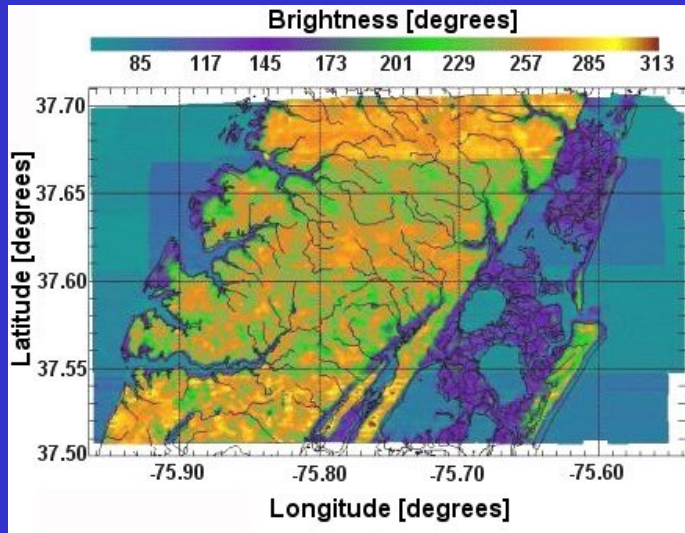
Application of Power Line Communication (PLC) to the transmission of commands within A car

- Principle of the experimental set up for testing PLC onboard a vehicle



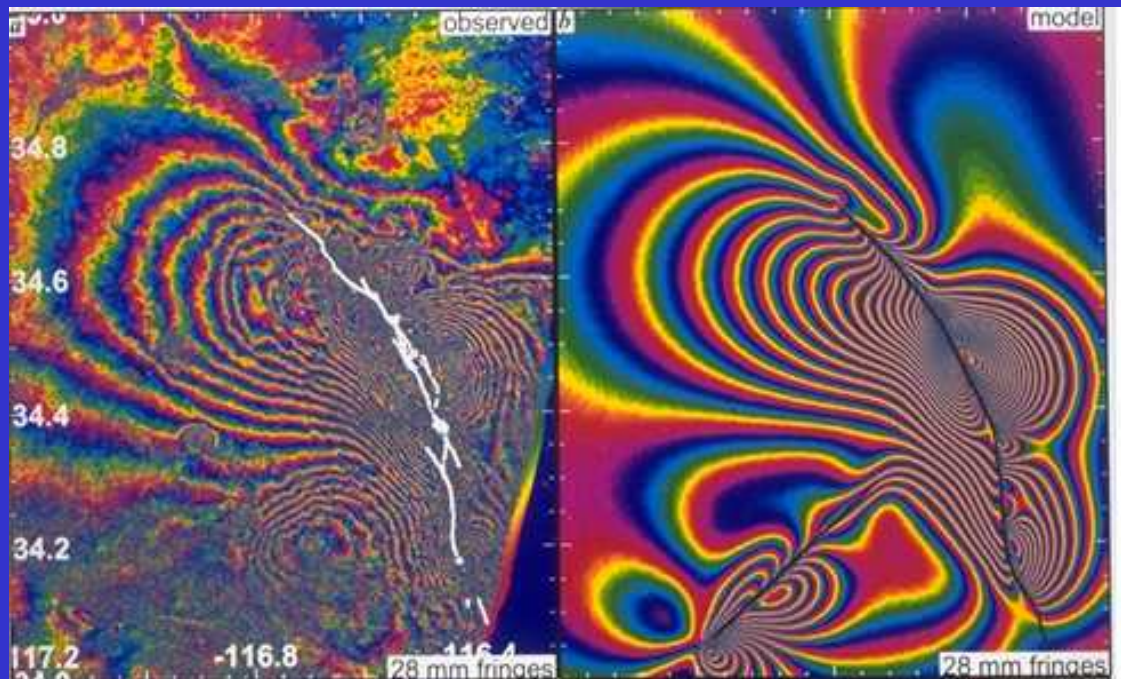
F. Wave propagation and remote sensing

- **Study of wave propagation and of wave interactions in non ionized media**
 - **neutral atmosphere**
 - **planetary surfaces and subsurfaces (including land, ocean and ice)**
- **Applications in the areas of remote sensing and communications**



**Soil moisture from brightness
obtained with the ESTAR L-band
Radiometer (*Camp and Swift*)**

**Use of radio-interferometry
to identify ground movements
(e.g. after earthquakes),
accurate topography, etc.**



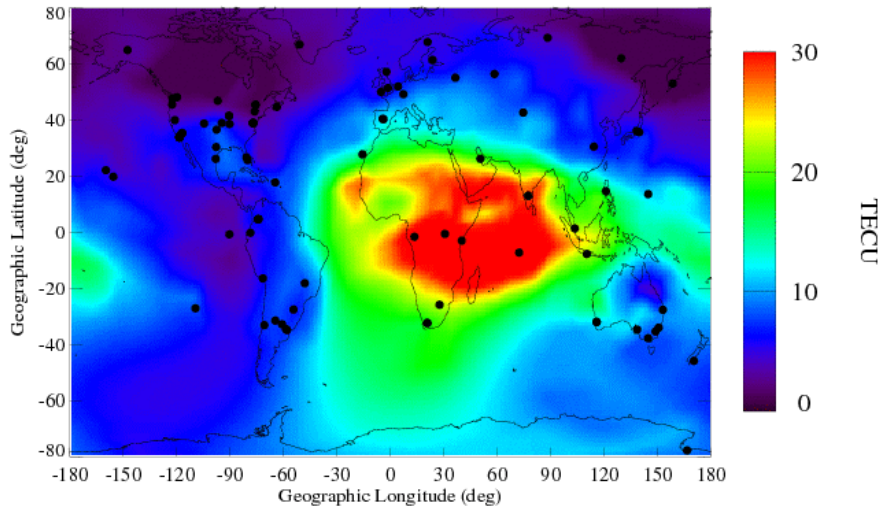
**Here, use of ESR1 data at
18 months difference to
Point out displacements after
The 1992 Landers quake.
Comparisons with a model
To remove uncertainties
(*D. Massonnet*)**

G. Ionospheric Radio and Propagation

- **Use of passive and active (radars) radio techniques to study, model and monitor the global morphology of the ionosphere and its variations in particular in the auroral and low latitude regions**
- **Application of ionospheric information to Space Weather and in particular to HF and VHF radio systems**

02/17/07
10:50 UT

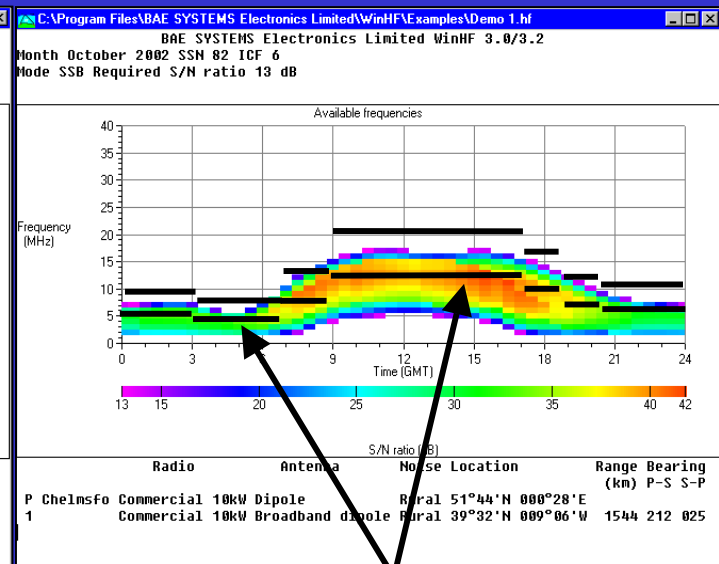
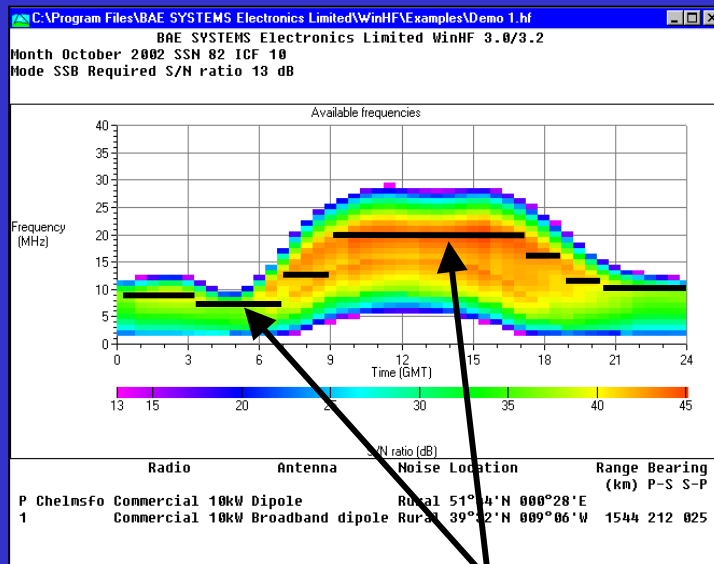
Ionospheric TEC Map



GPS receiver

Median Conditions

Storm Conditions



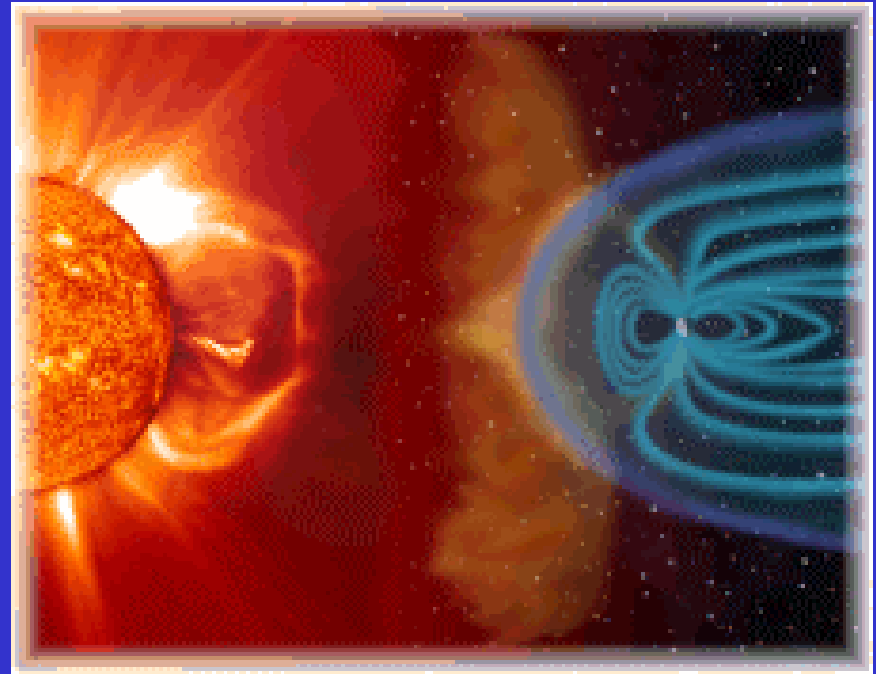
Channel Assignment

Modified Channel Assignment

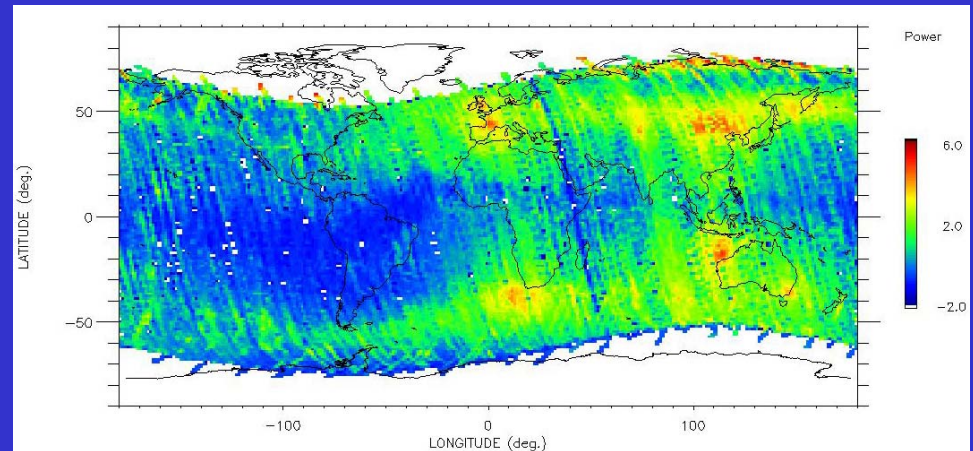
H. Waves in Plasmas

- **Study of the generation, propagation and interactions of EM (and ES) waves with space and laboratory plasmas and with other waves**
- **Applications**
 - **in the study of the variations of the environment of the Earth and of the planets, and of other astrophysical objects**
 - **in Space Weather (spacecraft-plasma interactions, modeling of the radiation belts)**

Waves and turbulences play a fundamental role in the dynamics of particles in the sun corona, the solar wind, the planetary and Earth environment, etc.



Electromagnetic waves in plasma may be the signature of man-made noise (in red, effects of ground based transmitters in the frequency range : 18 – 22 Hz)



J. Radio Astronomy

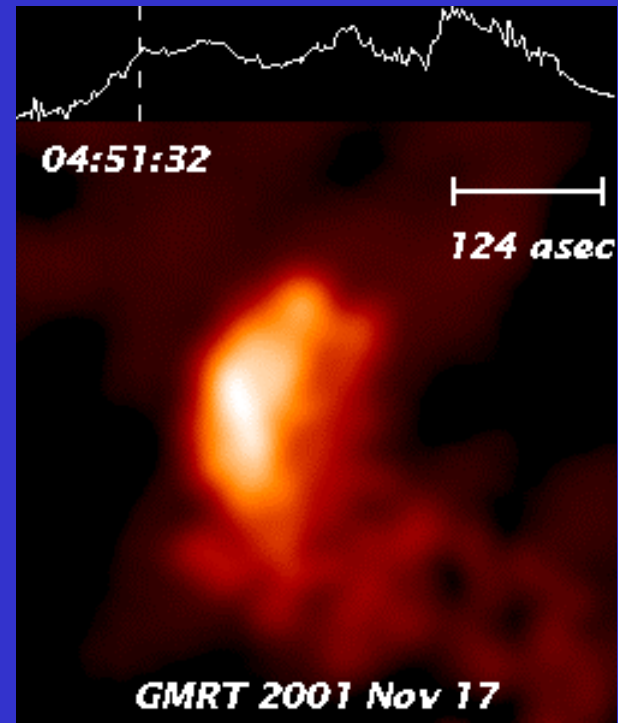
- **Observation and interpretation of all radio emissions and reflections from celestial objects**
- **Emphasis is placed on:**
 - **the promotion of technical means for making radio-astronomical observations and data analysis**
 - **support of activities to protect radio-astronomical observations from harmful interference**



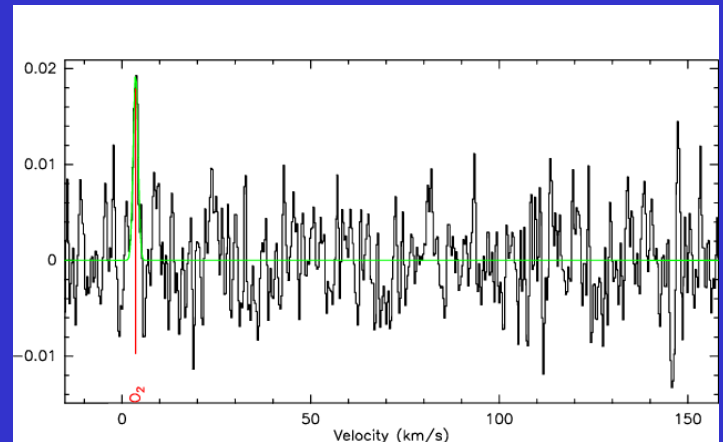
NRAO/AUI/NSF, NOAO/AURA/NST

Radio/optical image of M33, subsatellite of the Andromeda Galaxy

First detection of molecular oxygen (?) in the interstellar medium (Odin satellite)



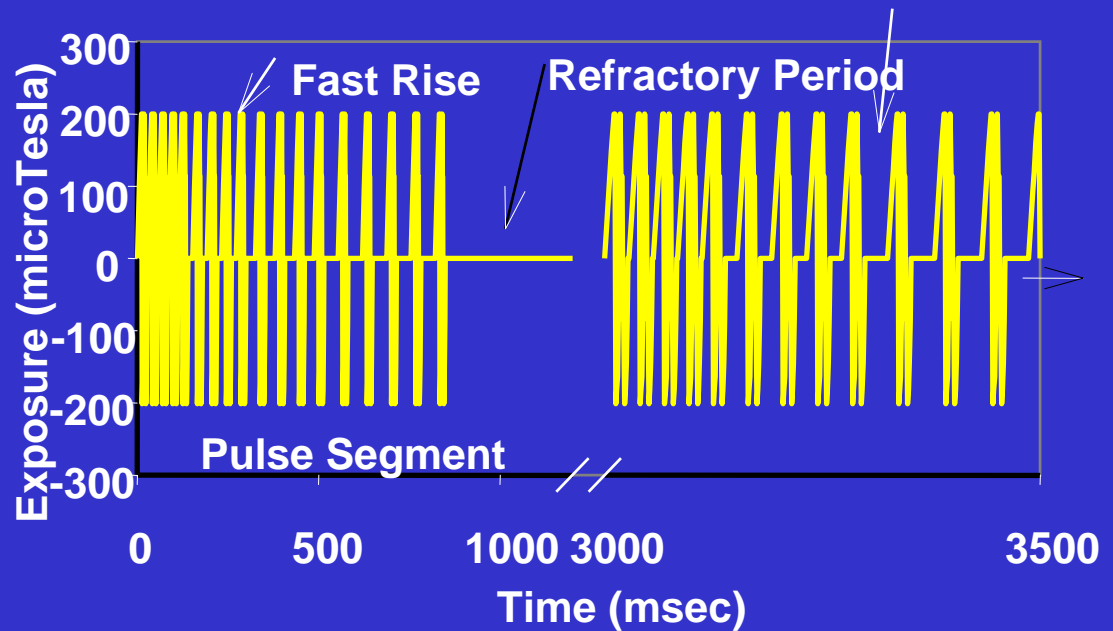
Flare observed at 1060 MHz with the GMRT (prominence eruption observed by the Nobeyama radioheliograph at 17 GHz, etc.)



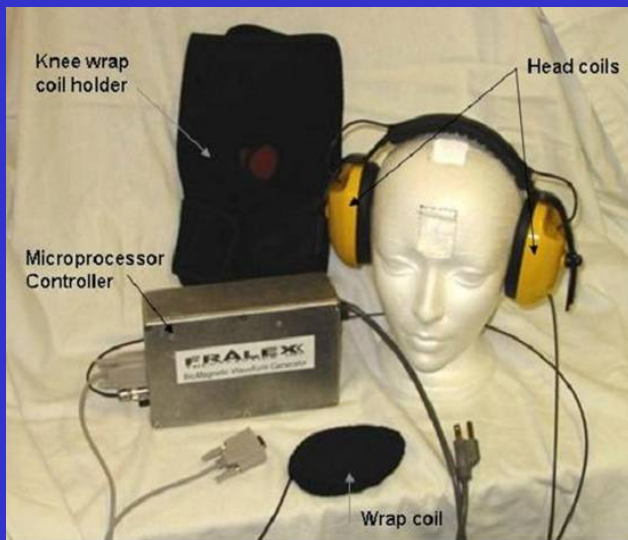
K. Electromagnetics in biology and medicine

- **effects of and mechanisms involved with exposure of biological systems (in general) and of humans (in particular) to EM waves**
- **Applications to**
 - **studies on effects of radars, power lines, cell phones**
 - **medical use of exposures to EM**

EM Pulses from 0.1 to a few 100 Hz are non-ionizing but are able to induce significant biological currents in tissues.



Some treatments: Bone formation / fractures, Cancer , (tumour growth), congenital pseudarthrosis, depression, joint disorders, nerve regeneration, osteoarthritis, Pain



(Thomas et al.)

Portable
Magnetic
Field Exposure
Unit

Dedicated devices and models are used to simulate phenomena produced by the interaction of EM fields with surrounding objects, human tissues, ...