

Rio de Janeiro
**6th International Non-Ionizing
Radiation Workshop of ICNIRP**



Biological studies on RF fields

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Complementary approaches:

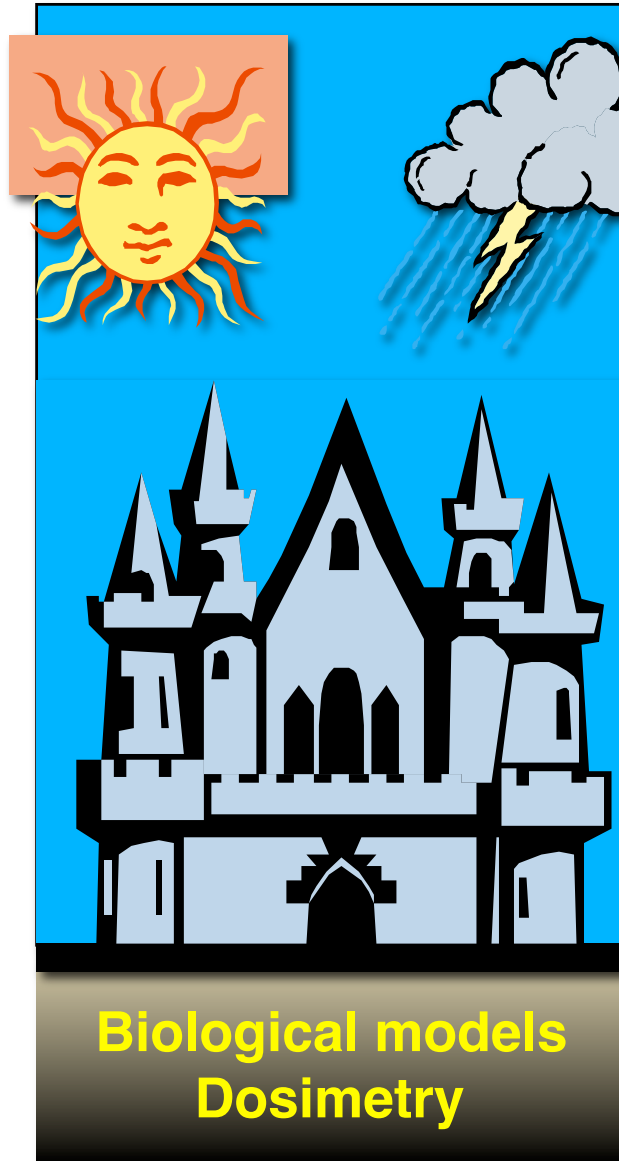
Context

human

animal

cell

Foundations



RF laboratory research

- Research related mainly to wireless communication devices
- Frequency range 400-2450 MHz



RF studies

(WHO database, Oct 08)

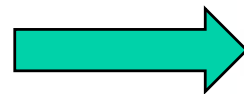
Type of study	Ongoing	Not-yet published	Published
Physics	83	14	535
Epidemiology	42	12	289
Human	45	15	243
Animal	44	29	819
Cellular	65	29	485
Total	290	102	2 377

Specific absorption rate

- SAR is the metric for local or whole-body deposition of microwave power



1 kg



1000 W

$$\text{SAR} = 1000 \text{ W/kg}$$

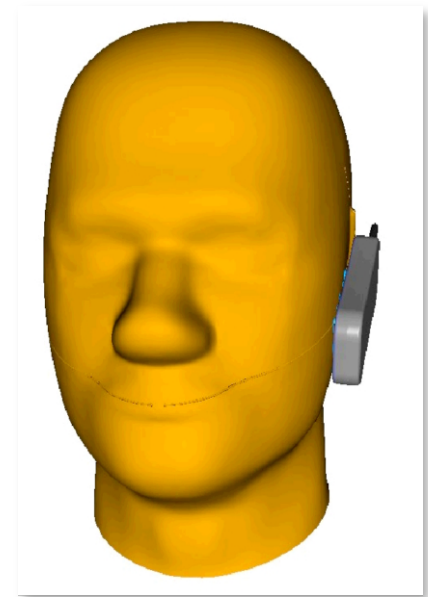
Human studies



Human studies

- CNS
 - Sleep/EEG
 - Cognitive and behavioural functions
- Auditory system
- Cardiovascular system
- Hypersensitivity (EHS)

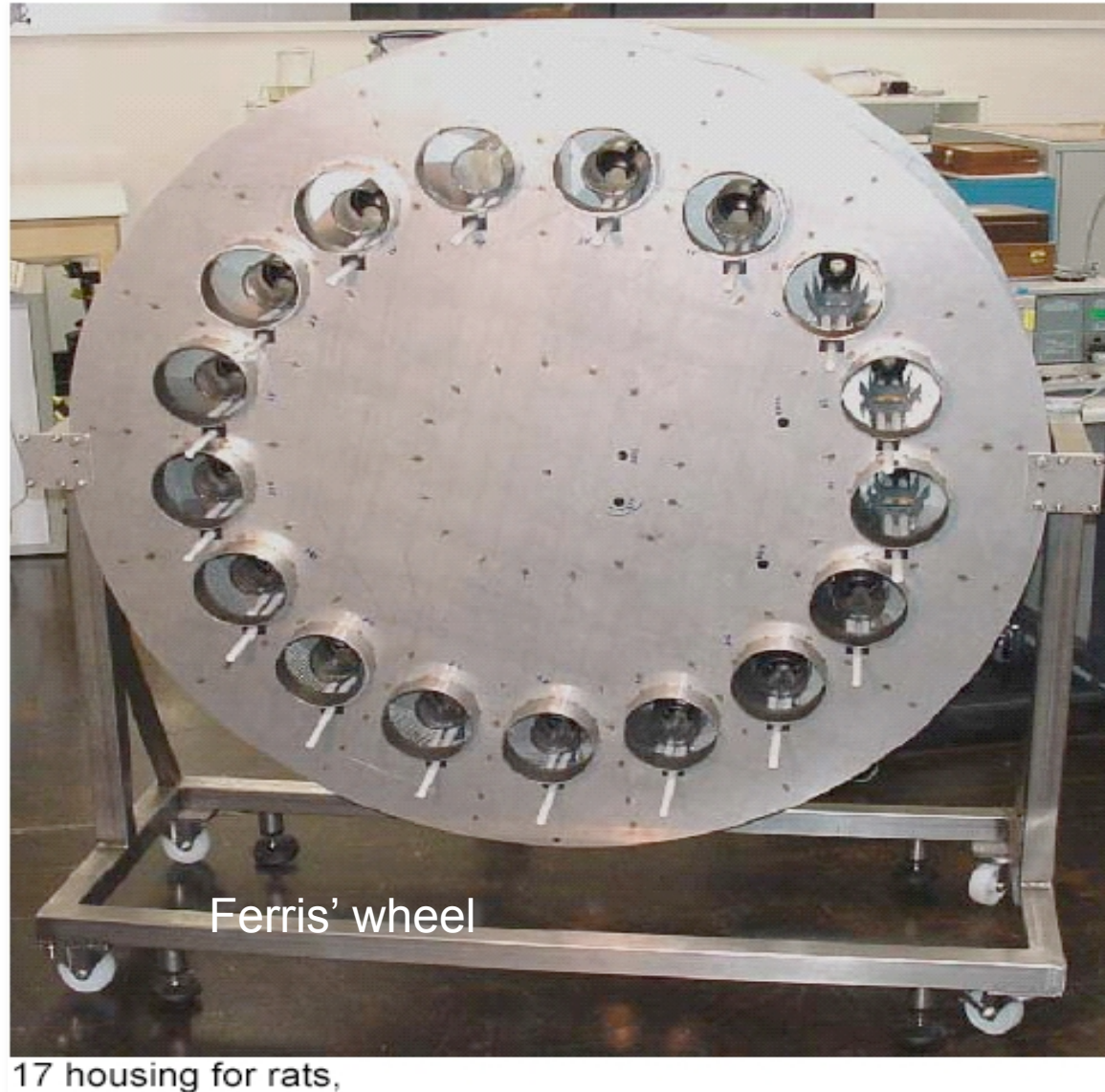
- ***Children?***



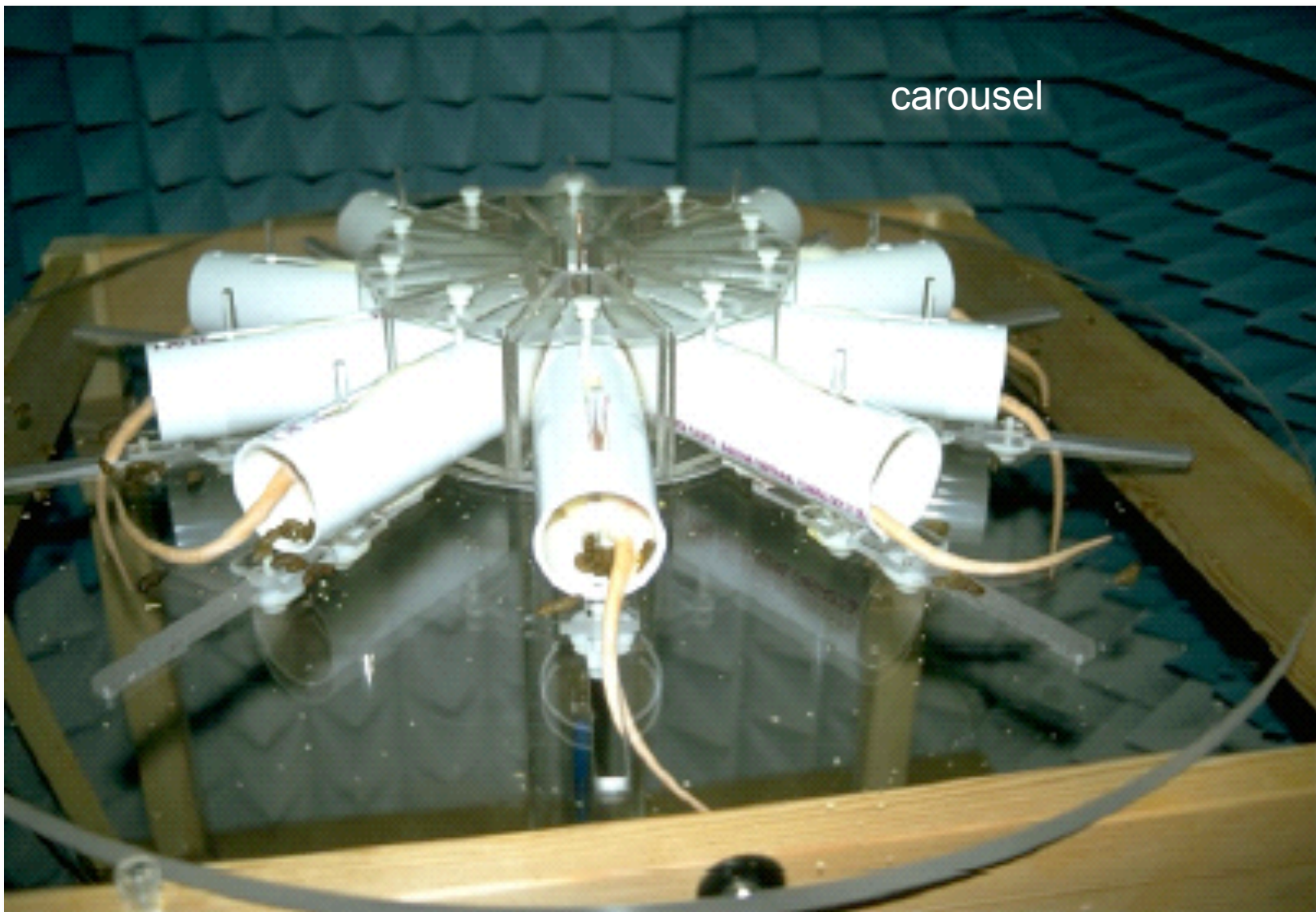
Animal studies: Exposure systems



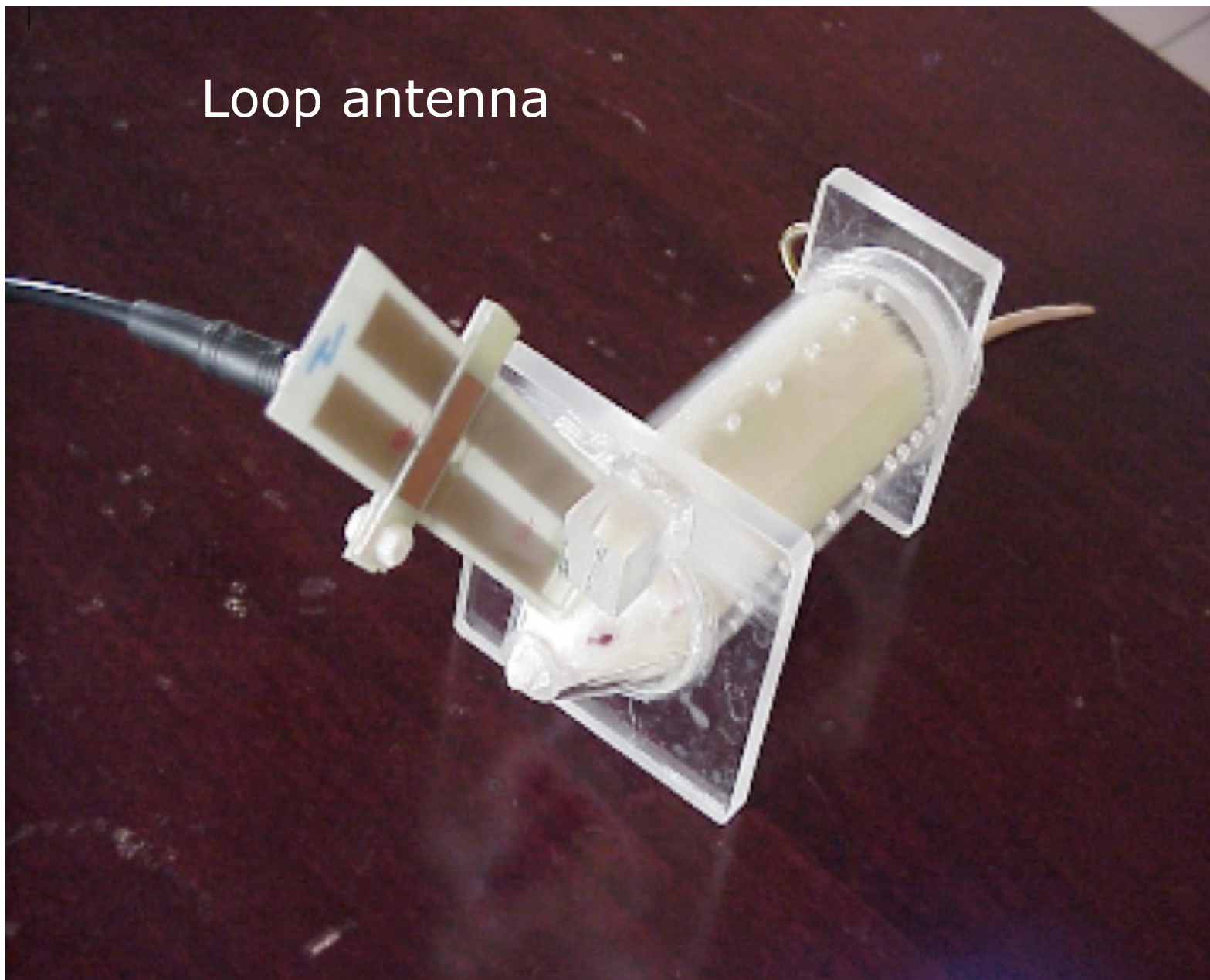
Exposure systems: *in vivo*

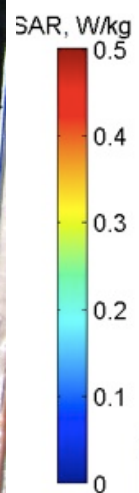
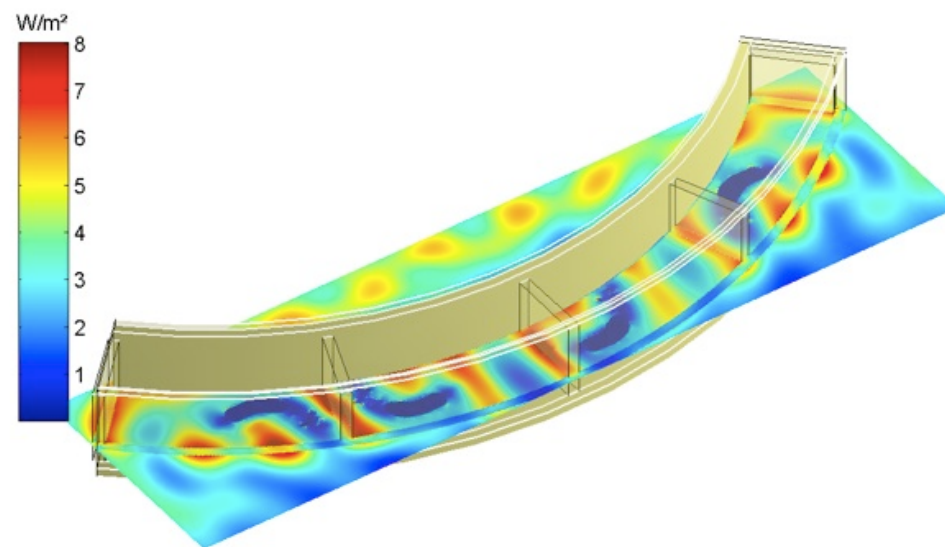
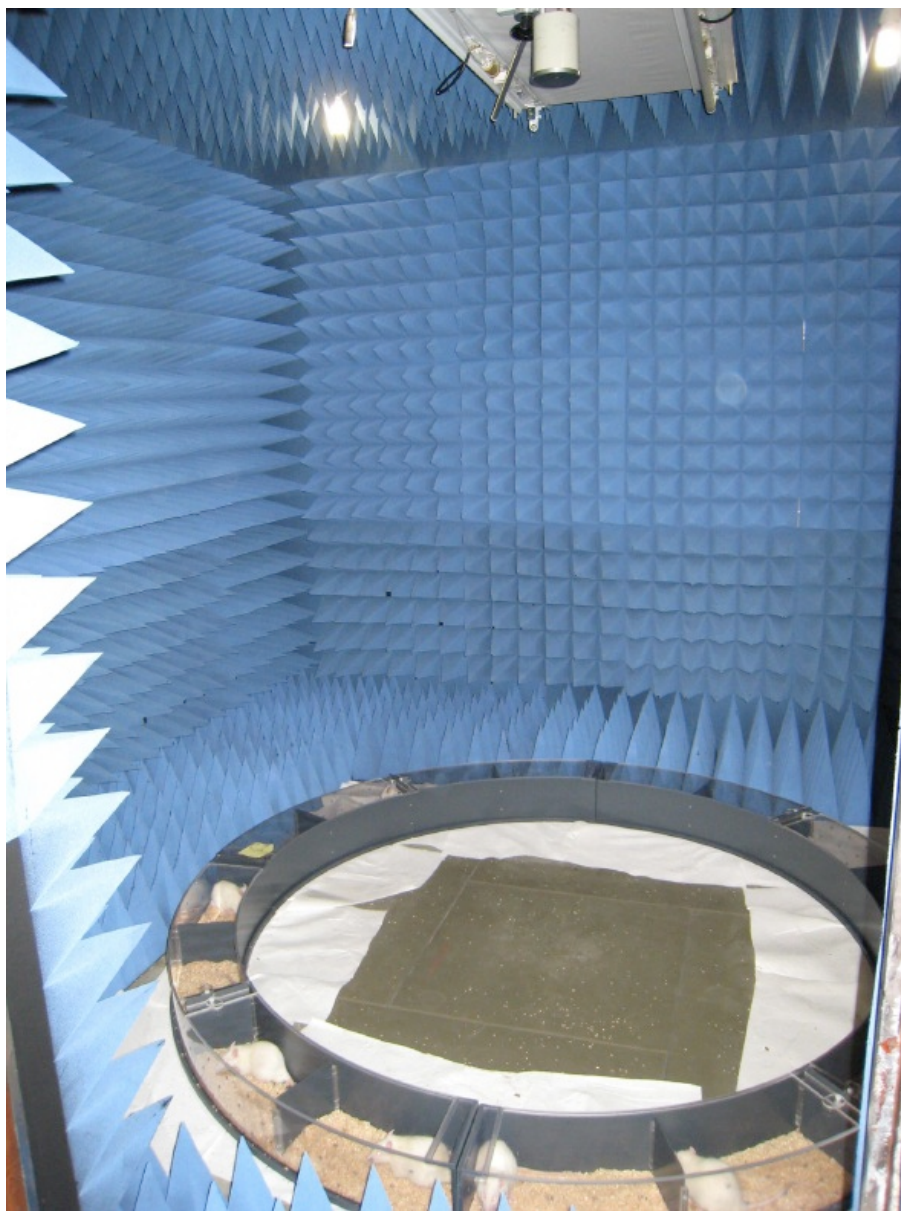


carousel

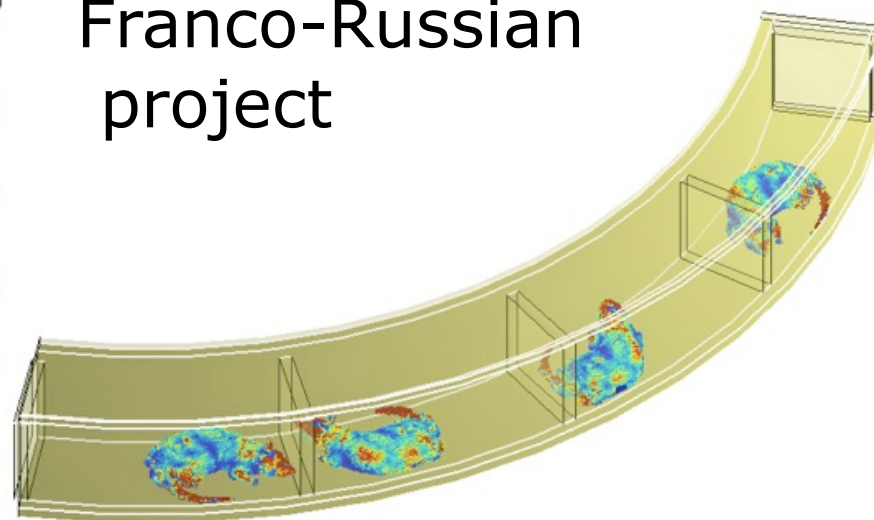


Loop antenna





Franco-Russian
project



Reverberation chamber

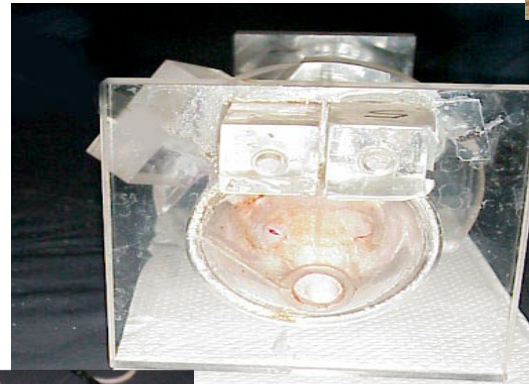


Example: rat skin

Hairless rats
1-week acclimatation

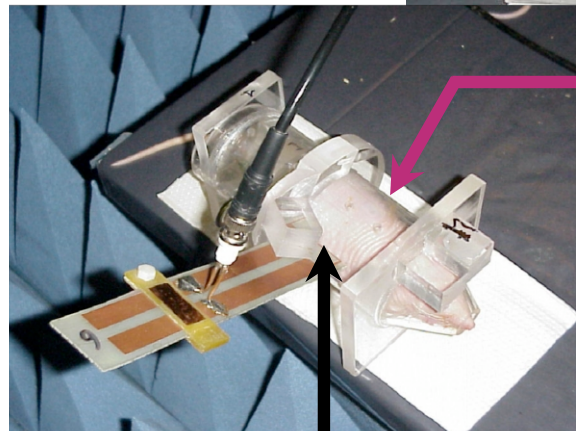


2-weeks
rocket habituation



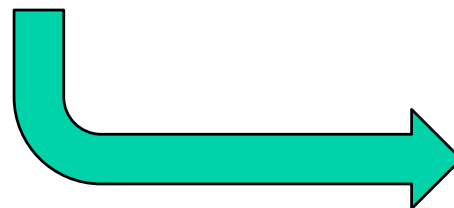
GSM-900 or
GSM-1800
SAR=2 or 4 W/kg

2 hours / day,
5 days / week,
12 weeks



Non-exposed left side

Exposed right side



Skin biopsies

Animal studies

- **Cancer models**

- Long-term bioassays
 - Co-promotion studies

- **Non-cancer models**

- Behaviour
 - Reproduction and development
 - Skin
 - Genotoxicity
 - Blood-brain barrier (BBB)
 - Hearing

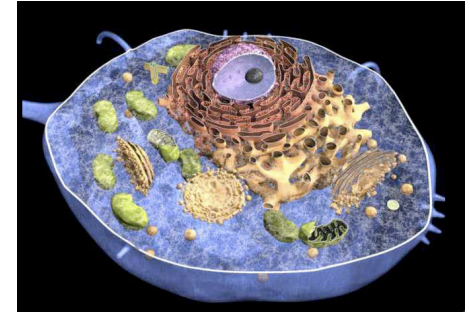


Cell studies

waveguides



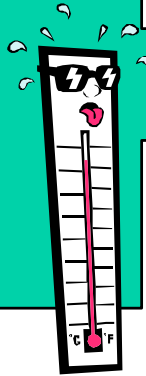
Cell studies



- Genotoxicity (DNA damage, etc.)
- Apoptosis, Proliferation, Transformation
- Gene & protein expression
 - Heat shock proteins (HSP)
- ***role of genomics & proteomics?***

Mechanisms

RF bioeffects are known to be induced by temperature elevation



This is a threshold mechanism

Most of the research activity deals with potential non-thermal effects

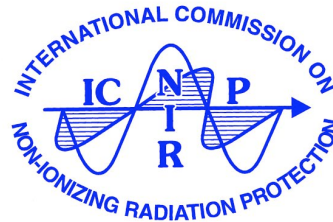
Under low-level wireless communication conditions, there is no temperature elevation

Conclusions

- Most of WHO's recommendations addressed, but not enough international collaboration and harmonization
- Most recent and ongoing studies "in time" for the major coming evaluations
- No health risk foreseen associated with wireless communications (below guidelines)
- Extrapolation to new signals?
- Health risk assessment for children?



Blue book of ICNIRP on RF



- **Review of Experimental Studies of RF Biological Effects (100 kHz – 300 GHz)**
- ICNIRP Standing Committee II:
Jukka Juutilainen, Junji Miyakoshi, Eric van Rongen, Richard Saunders, René de Seze, Thomas Tenforde, Luc Verschaeve, Bernard Veyret, Zhengping Xu; and Isabelle Lagroye