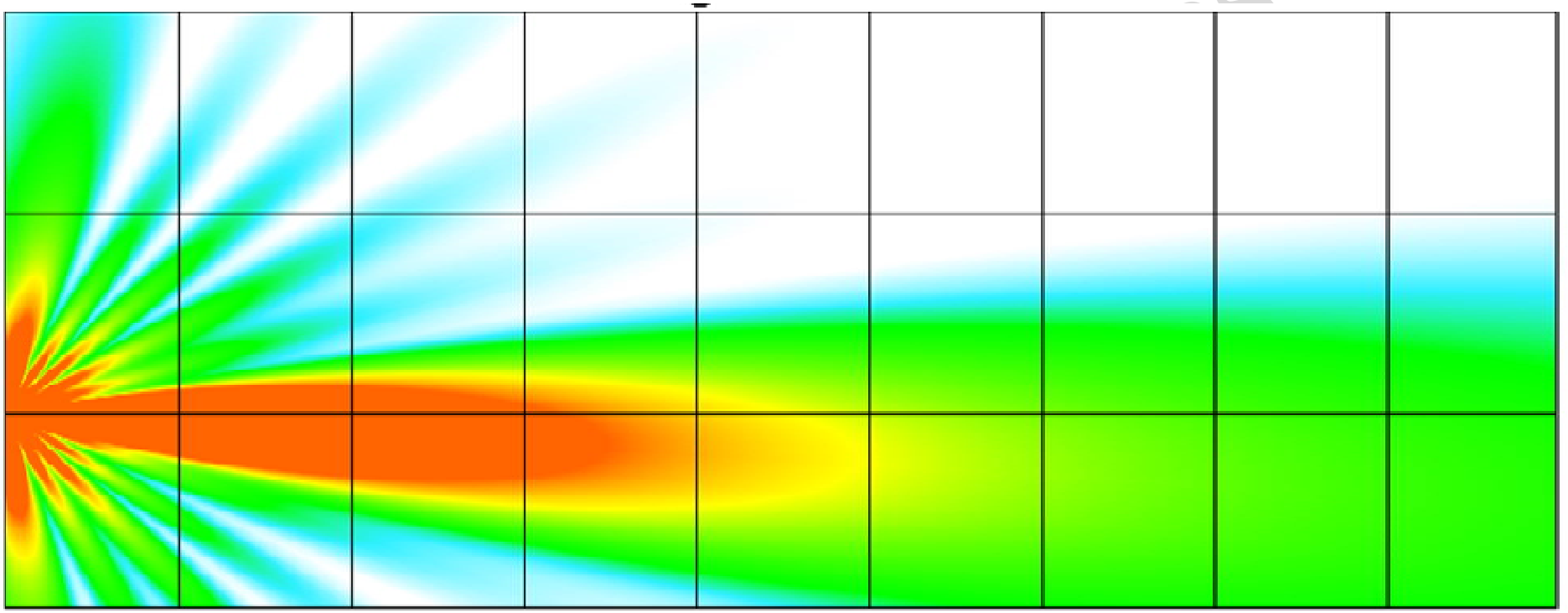
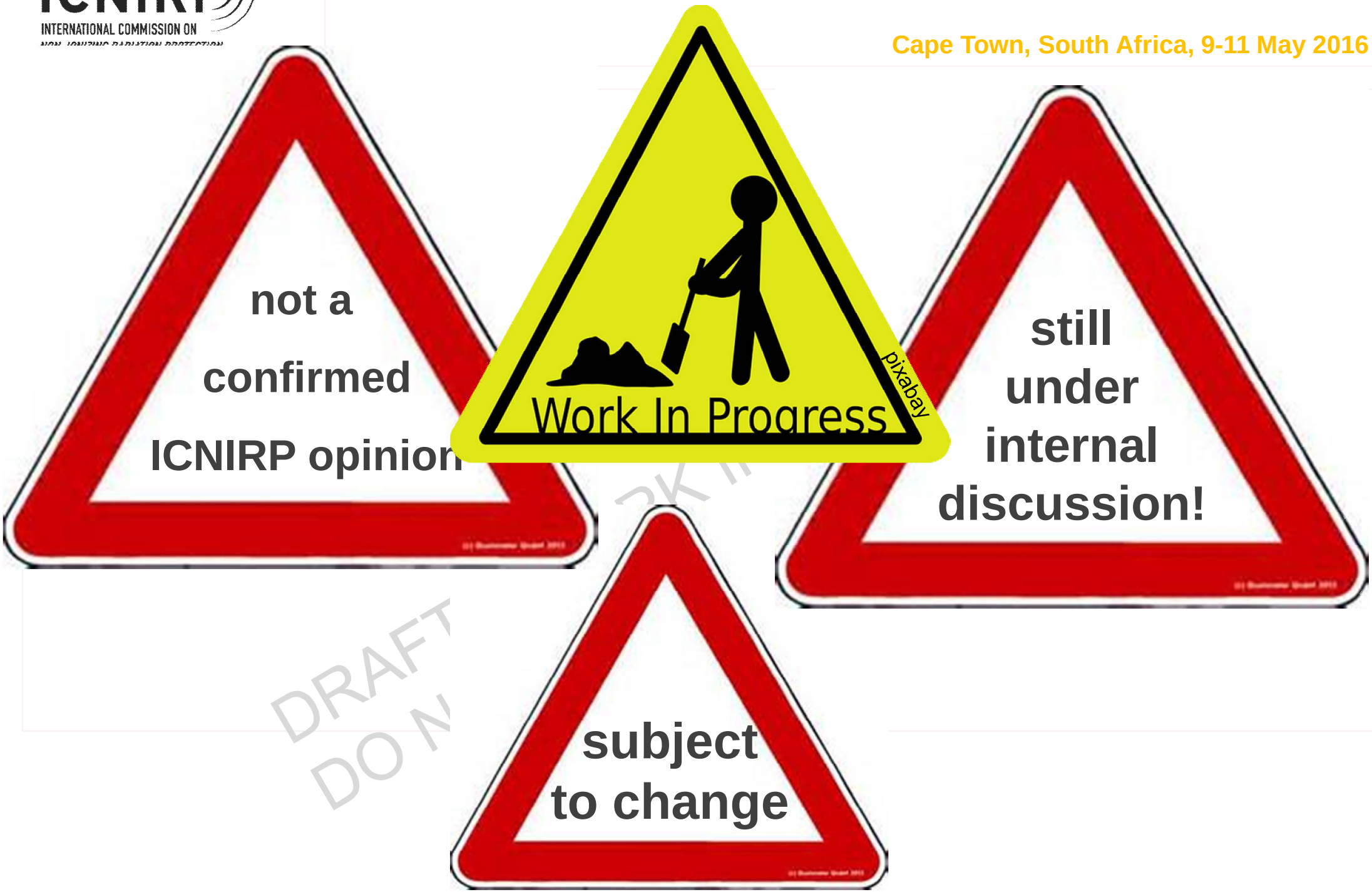
HF guidelines draft



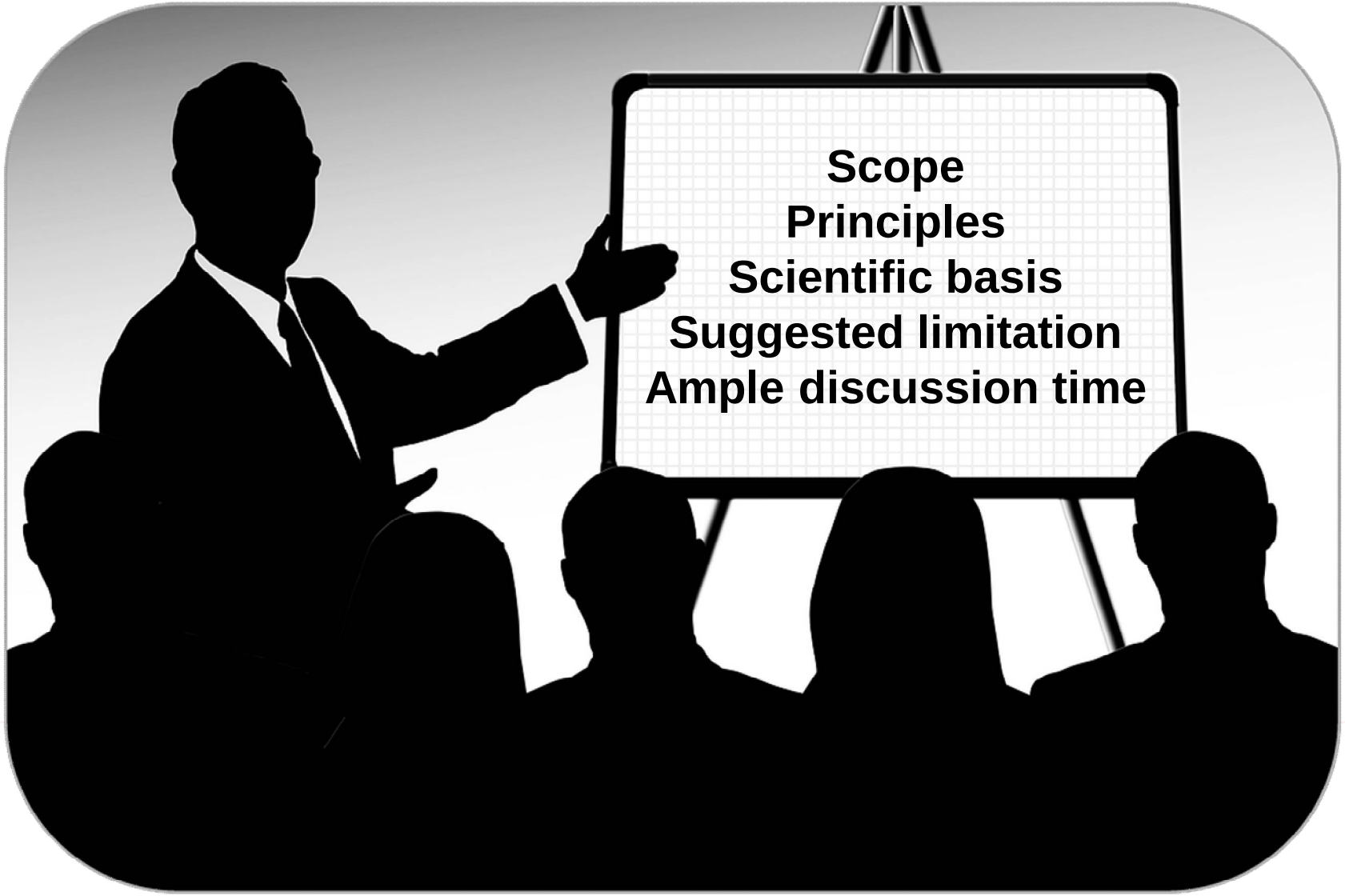
ICNIRP
INTERNATIONAL COMMISSION ON

ICNIRP 8th INTERNATIONAL NIR WORKSHOP

Cape Town, South Africa, 9-11 May 2016



What to expect



Scope

- to limit exposure to high-frequency EMFs (100 kHz – 300 GHz)
- to provide protection against adverse health effects to humans
- consider occupational and general public exposure
- consider direct and indirect exposure (but only contact with charged objects)

- Electromagnetic interference
- Exposure for medical purposes
- Compliance issues (e.g. measurement)

Principles

- identification of scientific data re effects of exposure on biological systems
- determination of effects considered both
  - adverse to humans and
  - scientifically substantiated

  (independent replication, sufficient quality, scientifically explicable generally)
- identification of the 'health effect threshold' (needs sufficient data)
- alternatively set an 'operational threshold' (based on exposure-effect relation)
  - provide an criterion for a reasonable level of protection
- application of reduction factors to thresholds
  - account for scientific uncertainty, relative importance of the health effect, variation across the population; reduction factors may differ based on these parameters

ICNIRP incorporates conservatism at a number of stages of the guideline setting process. All restrictions are considered conservative estimates that will remain protective unless they are exceeded by a substantial margin.

Scientific basis

- available major EMF reviews + original papers not included in the reviews
  - there is an extensive body of relevant literature, ranging from cellular research to cancer epidemiology
  - research has only found evidence of potentially harmful effects from:
    - electrostimulation
    - electroporation
    - microwave hearing
    - temperature elevations above thresholds
    - no evidence that HF-EMF causes such diseases as cancer
- no evidence that HF-EMF impairs health beyond effects that are basically suggested by the established mechanisms of interaction
- in addition the thermo-biology literature was considered

Interaction mechanisms (temperature elevation)

Temperature increases that are taken to represent health effects, and restrictions set to avoid these.

Whereas health effects are primarily related to T, it is suggested by ICNIRP to treat levels of ΔT as indicative of health effects assuming a thermonormal baseline state.

This strategy is used because T is dependent on many factors that are independent of EMF, such as environmental temperature and work rate.

Body core temperature

Mean body core temperature (approximately 37 °C within the 'thermonormal' range) typically varies over the day by 0.5 °C.
Thermoregulatory functions such as vasodilation and sweating can be engaged to keep the body core temperature in that range.
Although most health effects induced by hyperthermia (> 38°C) resolve readily and have no lasting effects, risk of accident increases with hyperthermia.

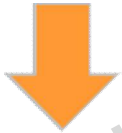
- ΔT > 1 °C in body core is defined as potentially harmful
- Modelling predicts:
  - 4 W kg^{-1} WBA SAR over 2 hours induce ΔT ≈ 0.5 °C
  - 8 W kg^{-1} WBA SAR may results in ΔT ≈ 1 °C (scaled based on models) (consistent with the limited human research)

ICNIRP suggests an operational threshold of 8 W kg^{-1} (6-minute avg.)

Local temperature

Excessive localized heat can cause pain and damage cells. There is a substantial body of literature showing that tissue damage can occur at temperatures > 41-43 °C (time dependent).

Thermonormal brain and abdomen temperature is typically < 38 °C, and that of the extremities (including skin and pinna) < 36 °C



- Local temperatures > 41 °C should be avoided.
- ΔT > 2 °C in the trunk (head, torso, testes, eyes) considered potentially harmful.
- ΔT > 4 °C in the extremities (limbs, skin, pinna) considered potentially harmful.
- Modelling/extrapolation suggests:
  - ≤ 10 GHz a SAR10g of 10 W kg^{-1} results in ΔT ≤ 2 °C (20 W kg^{-1} / ≤ 4°C)
  - at 10 GHz, 800 W m^{-2} results in ΔT ≈ 4 °C
  - Preliminary data (rabbit eye) suggest a lower health threshold (500 W m^{-2})

ICNIRP suggests an operational threshold of 10 W kg^{-1} for the trunk and 20 W kg^{-1} for the extremities (up to 10 GHz), 500 Wm^{-2} above 10 GHz

Electrostimulation , Electroporation, Microwave hearing

Electrostimulation effects are described in the ICNIRP ELF Guidelines (2010) and are not considered further here.
Exposure to intense electric field pulses of short duration may cause an either reversible or permanent dielectric breakdown of cell membranes.
Microwave hearing can result from brief HF pulses (300 MHz-10 GHz)

Under laboratory conditions, the threshold for electroporation is approximately 10 kV m^{-1}, (tp > 0.1) and 10 tp/0.1 kV m^{-1} below (tp = pulse duration in µs).
ICNIRP considers 4mJ kg^{-1} (0.1 sec) as threshold for microwave hearing

ICNIRP suggests an operational threshold of 10 kV m^{-1}, for tp > 0.1 µs and 10 tp/0.1 kV m^{-1} for tp < 0,1µs and 4 mJ kg^{-1}.

Dosimetry etc.

Once the basic restrictions are confirmed, reference levels will be derived for far field exposure such that all basic restrictions are kept. Based on numerical dosimetry

Averaging mass is under discussion. Possibly a smaler mass for short exposure durations. The shape is under discussion too. It has been suggested to keep as it is, include multiple tissue types, to have a compact shape (e.g. a cube) inside the body, to follow flexibly the external surfaces, and or to limit the surface to volume ratio.

Averaging time of 6 minutes seems a good choice for all tissues up to approximately 10 GHz. Above a decrease for local SAR is possible.

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Many thanks for listening!