



Research project:

Effects of pulsed high frequency EMF exposure on selected physiological parameters of rats: effects of exposure close to limit-values (60 W/m²) during pregnancy on the offspring of rats

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Duration: June 1999 – July 2000

Objective

- Investigation of embryo-damaging („teratogenic“) effects of pulsed 900-MHz fields during pregnancy of rats.
- This investigation is a follow-up applying a higher power flux density (60 W/m², close to the thermal threshold of the examined test animals) compared to the preceding study (power flux density 4.6 W/m², which is the set limit value for human exposure).

Results

- As in the pre-study, no definite teratogenic, embryo-lethal or development-inhibiting effects were observed.
- Even though direct comparability of the two studies is limited due to different holding and exposure conditions, the originally used power flux density of 4.6 W/m² may be seen as harmless.

Exposure

Exposure parameters	
Carrier frequency	890 MHz
Pulse modulation („FGF GSM-Cocktail“)	2 Hz, 8 Hz, 217 Hz, 1733 Hz
Duty cycle	7:8
Transmission power	203 W
Power flux density	60 W/m ²
Average SAR value	2.2 W/kg (whole body, 10 g averaged)
Duration of exposure	20 hours per day from day 0 to day 20 after conception



Investigated parameters

Pathological examinations performed in maternal animals and fetuses after removal of fetuses on day 20:

- Dams:
 - body and placental weight
 - number of embryos
 - number of abortions and premature deliveries
 - visible pathological organ alterations
- Fetuses:
 - sex, weight
 - skeletal, visceral and external anomalies

Statistics

- 48 pregnant Wistar rats (24 exposed, 24 sham-exposed)
- calculation of average value, deviation resp. incidence, level of significance $p = 0.05$ resp. 0.01
- Variance analysis, possibly also Dunnett's test (body, fetal und placental weight)
- two-sided Fisher's exact test (incidence data)
- non-parametric ANOVA test according to Kruskal-Wallis, possibly also Dunnett's Test modified according to Kruskal-Wallis (pre- and postimplantation losses)

Summary of results

Parameters

Exposure: 60 W/m²

body weight gain of maternal animals	{<}
clinical symptoms	-
macroscopic pathology	-
number of surviving fetuses	{<}
pre-/postimplantation losses	{>}
fetal/placental weight	{<}
external anomalies	-
Organ anomalies	-
dilated ureters	[>]
skeletal anomalies	-
status of ossification	-

Effects from exposure compared to controls:

- **None** < **Decrease** > **Increase**
- { } **statistically non-significant**
- [] **of limited biological relevance**

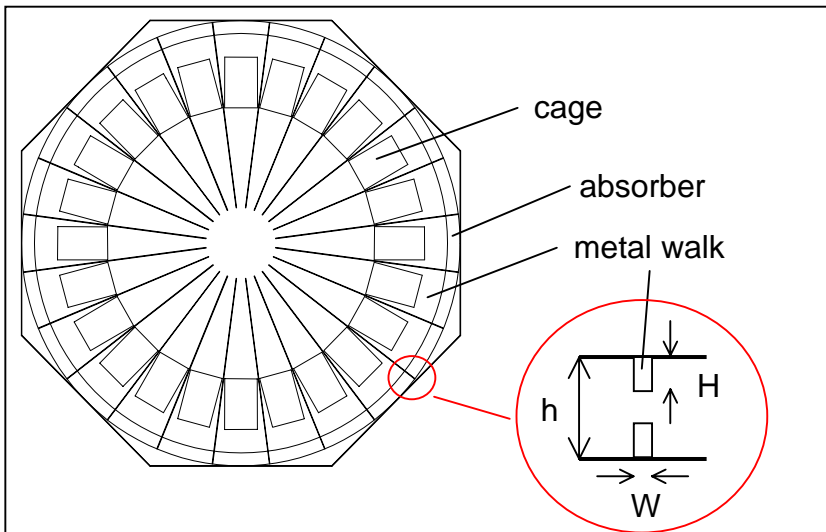


Experimental set-up

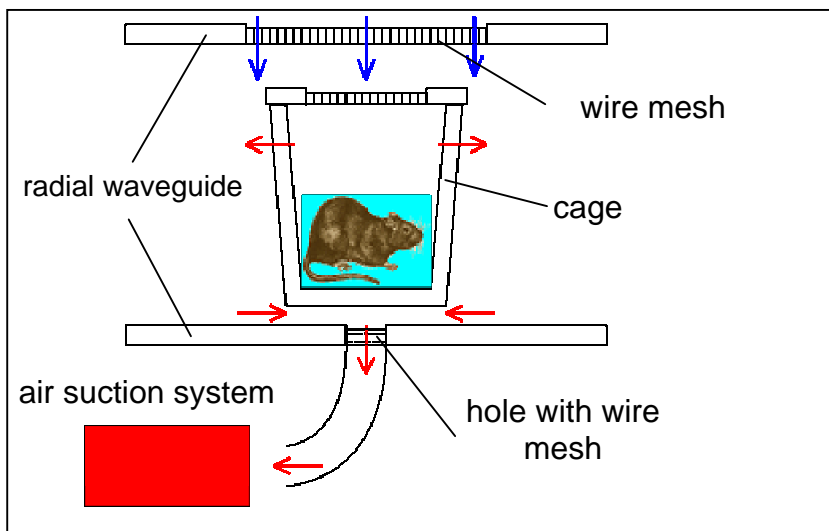


- One of the two radial waveguides (\varnothing approx. 4m) with ventilation system (rear right) for dissipation of accumulated heat:
- The radial waveguides held 24 cages with one animal each. The cage area was separated off by metal wire mesh permeable to air and light

Detailed view of experimental set-up (schematic)



- Metal plates cause shifting of cutoff frequencies of higher wave types to higher frequencies.

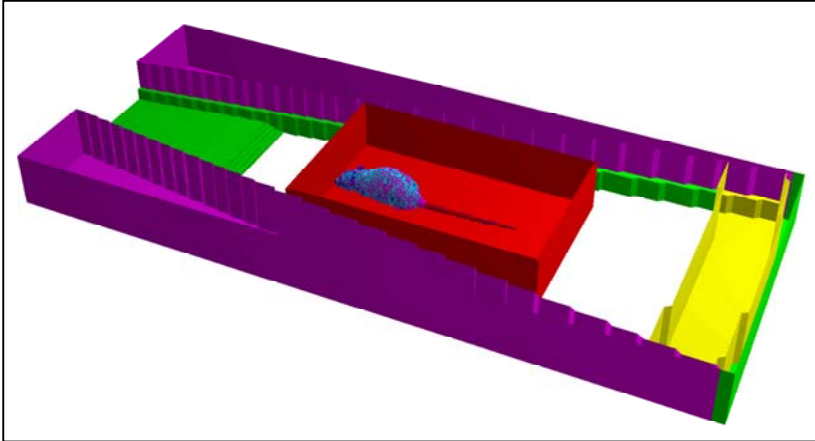


- Ventilation: Section of the radial waveguide with one of the 24 cages. Air and heat flow. The cages' interior is not exposed to air draughts.



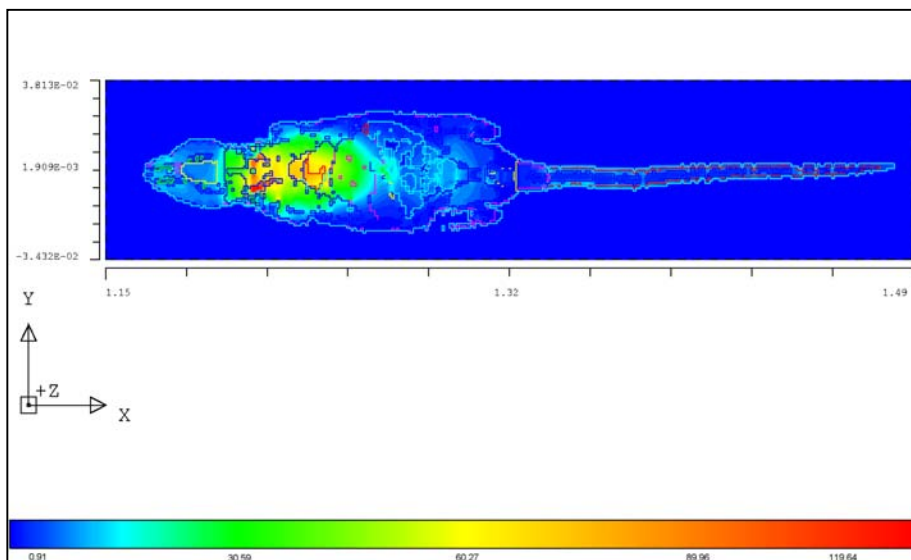
View of the rat's position inside the radial waveguide cage

- Rat lying with its head toward incident wave.



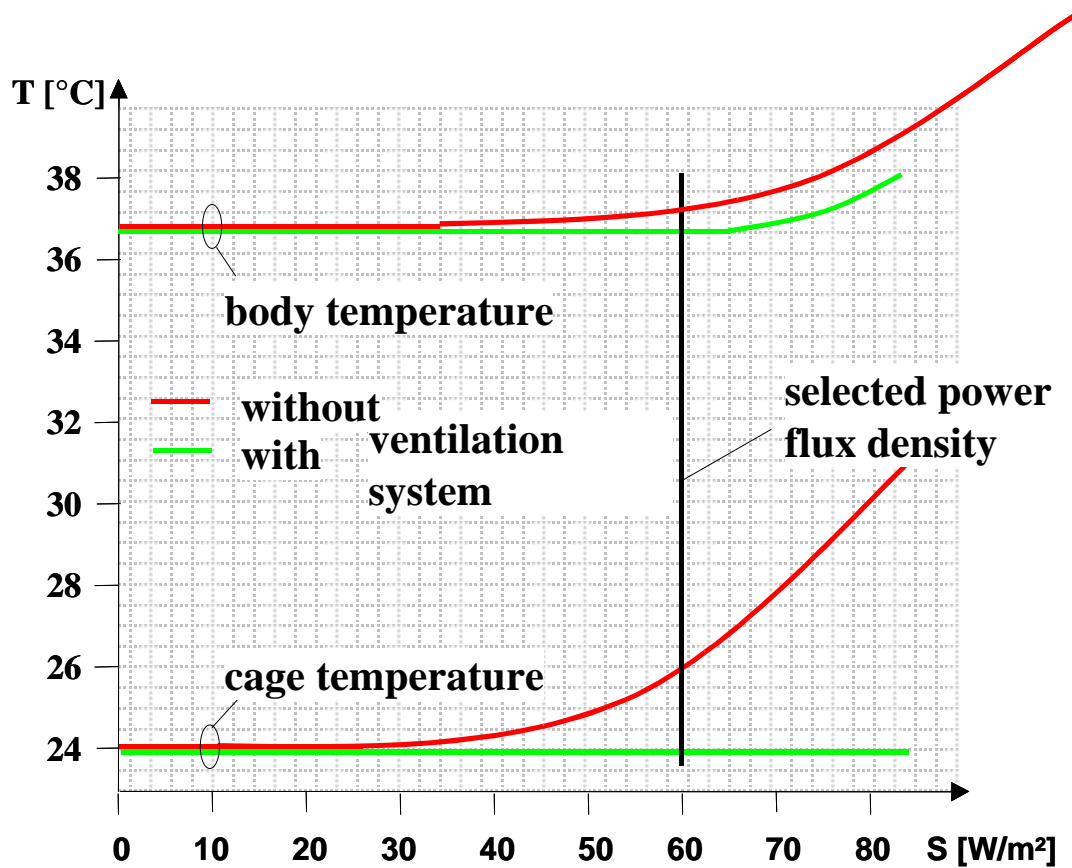
Local SAR distribution

- (averaged over 1mm³)
- In this position, maximum SARs occur in the region between the rat's head and the rest of the body.





Thermal effects of EM fields on the test animal and its environment



- Determination of the highest possible power flux density at which temperature increases are neither observed in the cage nor in the test object after exposure.

Publications

“RF exposure of non restrained animals in an overmoded radial waveguide.”

Bitz, A.K., Streckert, J.R., Hansen, V.W., Buschmann, J.:

22nd BEMS Annual Meeting, Munich, Abstract Book p. 63 - 64 (2000)

Untersuchung der Auswirkung einer Exposition gegenüber einer höheren Leistungsflußdichte während der Trächtigkeit auf die Nachkommen.

Buschmann, J.:

FGF-Newsletter Nr. 3/01, S. 2-3 (2001)