



Research project:

Influence of high frequency electromagnetic fields on DNA and proteins (37°C)

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Duration: April 1994 – March 1995

Objective

- Database recherche (1980 - 1994):
 actual state of knowledge, identification of potential hypotheses
- Experimental investigations:
 potential effects of RF-fields on DNA and proteins in five experimental variations; exposure for one to several weeks or 3 up to 10 minutes.

Results

- Identification and listing of different hypotheses from a total of 517 publications (recherche limited to 1993-1994)
- No in vitro effects by RF EMF-exposure on DNA and proteins were observed:
 No damage of DNA-molecules (single- or double strand break, relaxations)
 No increased reverse mutation rates in exposed bacteria cultures
 No decreased survival rate of the investigated viruses
 No change of reaction rate of the tested enzyme

Experimental approaches

Type of experiment	Object	Exposure-Frequency	
Long term experiment with rectangular waveguide	Plasmid DNA T4-phages	900 MHz	CW
One week experiment with rectangular waveguide	T4-phages Bacteria	900 MHz 1750 MHz	pulsed* CW
3-10 min. experiment with coplanar waveguide	T4-phage DNA Enzyme	900 MHz 1750 MHz	pulsed* pulsed*

* 2 Hz, 8.3 Hz, 217 Hz, 730.2 Hz

Target structure		Object
DNA	Double stranded, free	Plasmid DNA
	Double stranded, densely packed	T4-phages
	Single stranded, self replicating	Bacteria
Proteins	Viral coat	T4-phages



Enzyme

β -galactosidase



Long term experiments

Object

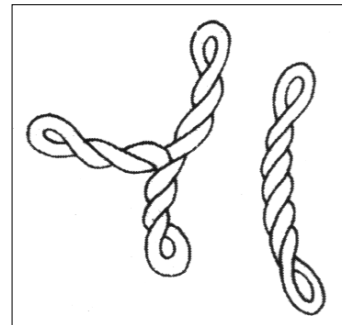
- Plasmid-DNA (pBluescript, 2961 bp)
- T4-phages

Investigation parameters

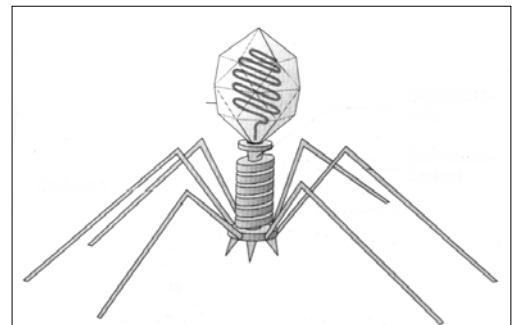
- Structural changes in plasmid DNA by agarose gel electrophoresis
- Determination of phage survival rate after incubation on 4 different repair-negative bacterial strains (to avoid usually present DNA-repair mechanisms)

Statistics

- DNA: analysis of one exposed and one control sample per week; 4-week exposure
- T4-phages: analysis of two exposed and two control samples per week for each bacterial strain; 15-week exposure



Free plasmid DNA, double stranded, supercoiled



T4-phage head with double stranded, densely packed DNA; viral coat built from proteins

1-week experiments

Objective

- Continuation of the long term phage-experiments under varied field parameters (900 MHz with four, 1750 MHz with one modulation frequency(ies))
- Evidence of mutations in single stranded, replicating DNA from two bacterial strains (900 MHz with four, 1750 MHz with one modulation frequency(ies))

Object

- T4-phages
- 2 bacterial strains (E.coli WP2 & WP2uvrA) with defective Tryptophan synthesis

Investigation parameters

- Determination of phage survival rates after incubation on 4 different repair-negative bacterial strains
- Determination of the reverse mutation rate of the bacteria (recovering the ability of Tryptophan synthesis)

Statistics

- Analysis of one exposed and one control sample for each exposure adjustment



3 or 10 minutes experiments

Objective

- Evidence of potential influences of the field in a coplanar waveguide at 900 MHz and 1750 MHz on isolated phage DNA and on enzyme activity of β -galactosidase

Object

- DNA, isolated from T4- phages
- Enzyme β -galactosidase, isolated from E. coli-cultures (W575, lac-repressor-negative, R⁻)

Investigation parameters

- Evidence of structural changes in double-stranded DNA molecules by measuring their optical density in a photometer
- Determination of the enzyme activity of β -galactosidase measured as substrate turnover

Statistics

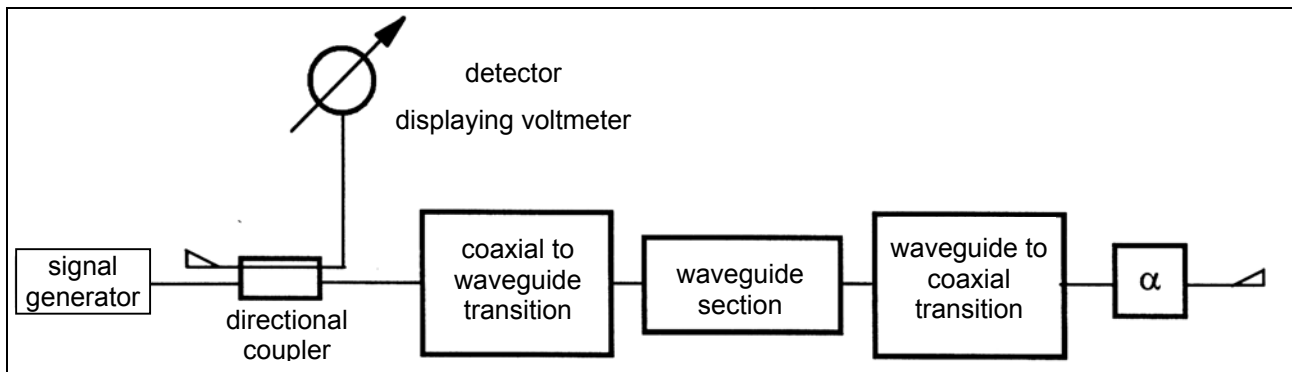
- Analysis of one exposed sample, one control sample and one sample with solvent medium per minute for each exposure adjustment

Exposure

Frequency / Exposure device	Sample holders	Field strength (middle of probe volume)	Power	SAR-value	
900 MHz rectangular waveguide	Plasmid DNA	16.96 V/m	8 W _{burst} 8 W _{mean}	47 mW/kg 5.93 mW/kg	
	T4-phages (glass vial)	8.48 V/m	2 W _{burst} 2 W _{mean}	11.75 mW/kg 1.48 mW/kg	
			Bacteria (Petri dish)	33.0 V/m	8 W _{burst} 8 W _{mean}
	Bacteria (Petri dish)	16.5 V/m			2 W _{burst} 2 W _{mean}
			1750 MHz rectangular waveguide	T4-phages (glass vial)	14.68 V/m
	Bacteria (Petri dish)	484.5 V/m (without sample)			
900 MHz 1750 MHz coplanar waveguide	Phage DNA, Enzyme (measuring cuvette)	666 V/m (without sample)			

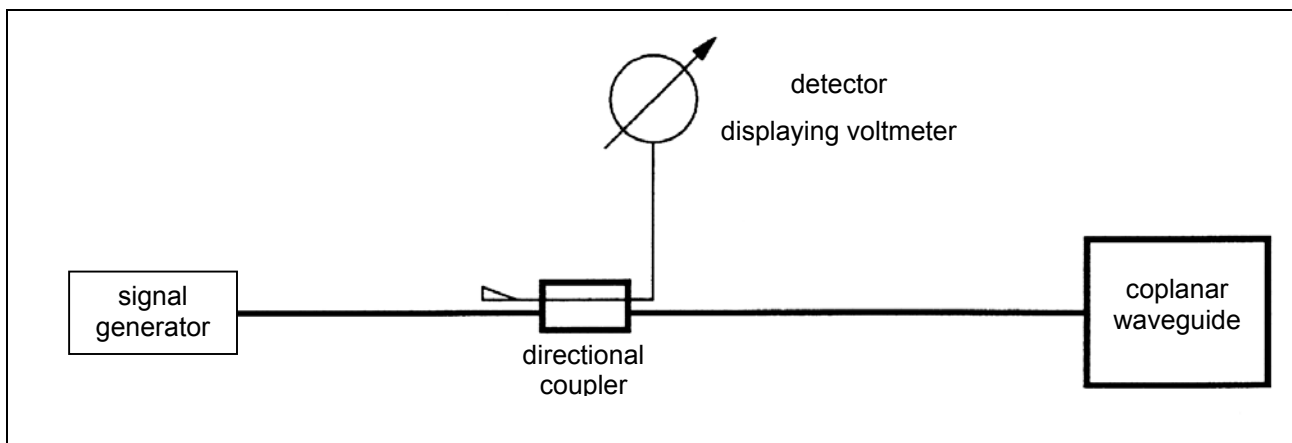


RF-Exposure system: rectangular waveguide



- Carrier frequencies: 900 or 1750 MHz
- Burst length: 0.577 ms
- Pulse modulation frequencies: 2 Hz, 8.3 Hz, 217 Hz, 730.2 Hz

RF-Exposure system: coplanar waveguide



- Carrier frequencies 900 or 1750 MHz
- Burst length: 0.577 ms
- Pulse modulation frequencies: 2 Hz, 8.3 Hz, 217 Hz, 730.2 Hz