

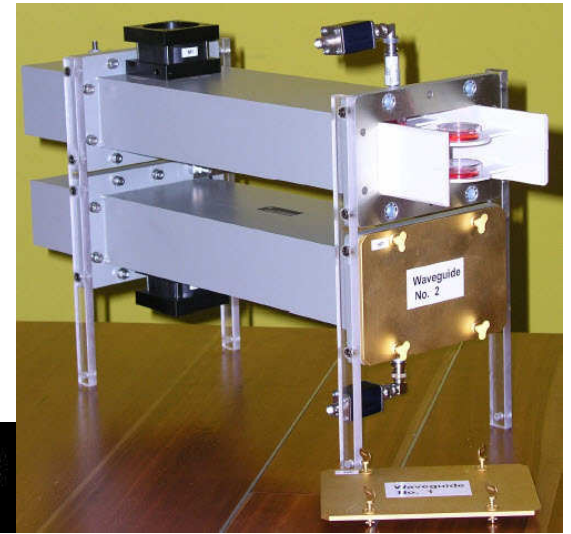
sXc

900
1800
1950

sXc
1800

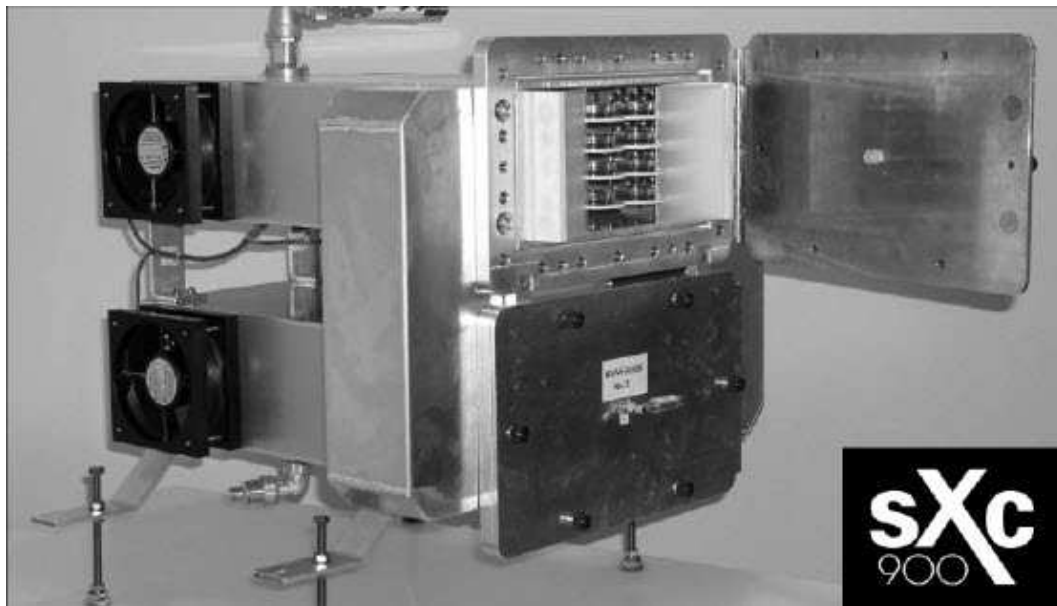


sXc
1950



IT'IS Exposure Systems 暴露評估系統

北京科斯仪器有限公司



sXc
900



介紹概要

- EMF風險評估背景
- 暴露系統類型
 - sXc | sXh | sXv
- 全世界設施
- sXcRF系統
 - 劑量測定概念
- sXcELF系統
- sXv系統
- sXh系統
- 實驗室使用

EMF風險評估背景

- 最近幾十年來，對不電離的電磁場(EMF)暴露已呈現指數性地成長。（40億移動電話用戶，2008-12）
- 電磁場風險評估需要實驗室研究和流行病學
- 實驗室研究可劃分為：
 - 體外研究 sXc – 細胞暴露系統
 - 活體研究 sXv – 脊椎動物暴露系統
 - 人體研究 sXh – 人體暴露系統
- 目前的證據仍矛盾
- 健全的劑量測定評估是重要的

暴露系統類型（項目）

RF-EMF

sXc900
sXc1800
sXc1800XL
sXc1950

sXv900 (Perform A)
sXv1800 (Perform A)
sXv (NIEHS)

sXh900 (Perform C)
sXh2140

體外

活體

人體

ELF-EMF

sXcELF
sXcELF-E
sXcLive

sXhELF

全世界設施

安裝類型	總設施	活動中設施	地點
sXc	34	24 (+8)	奧地利、中國、芬蘭、 法國、德國、義大利、 日本、挪威、西班牙、 瑞士、英國、美國
sXv	10	1 (huge)	芝加哥，美國
sXh	7	2 (+1)	蘇黎世、斯德哥爾摩

sXcRF 機構 – 目標 & 要求

6. 目標

- ✦ 針對手機頻帶 GSM 900/1800 MHz, UMTS 1950 MHz 的 RF 暴露系統
- ✦ 單層細胞、細胞懸浮液、線蟲、重組表皮等（體外）的暴露

6. 要求

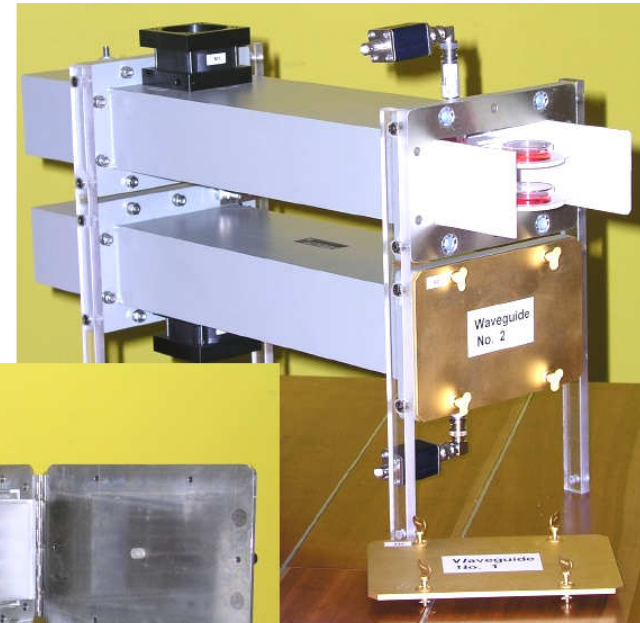
- ✦ 暴露期間溫度上升低
- ✦ 高 SAR 效率和均勻的 SAR 分佈
- ✦ 相同的環境參數對於暴露組和對照組(sham)
- ✦ 雙盲研究設計
- ✦ 暴露和環境的監測
- ✦ 完整的暴露劑量測定評估

sXcRF 機構 – sXc900, sXc1800, sXc1950

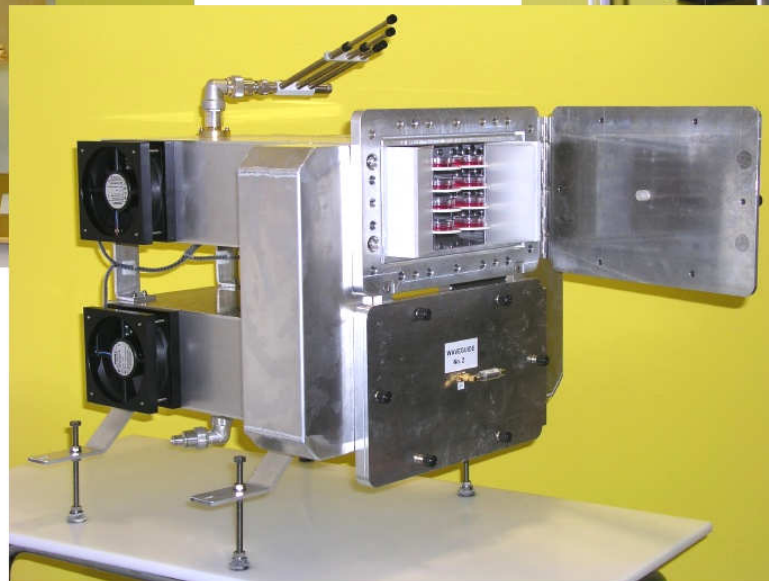


sXc1800

sXc900



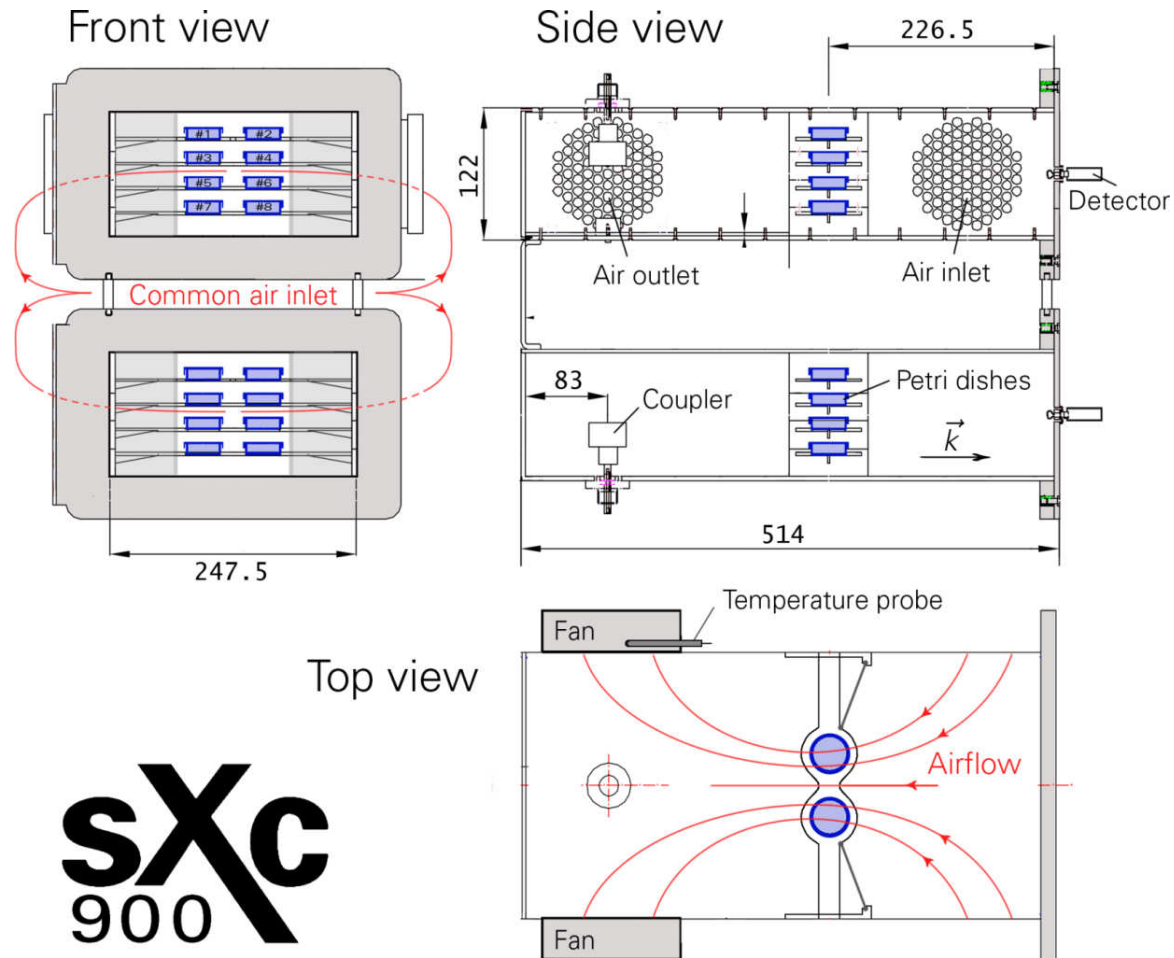
sXc1950



sXcRF 機構 – sXc900 安裝的系統



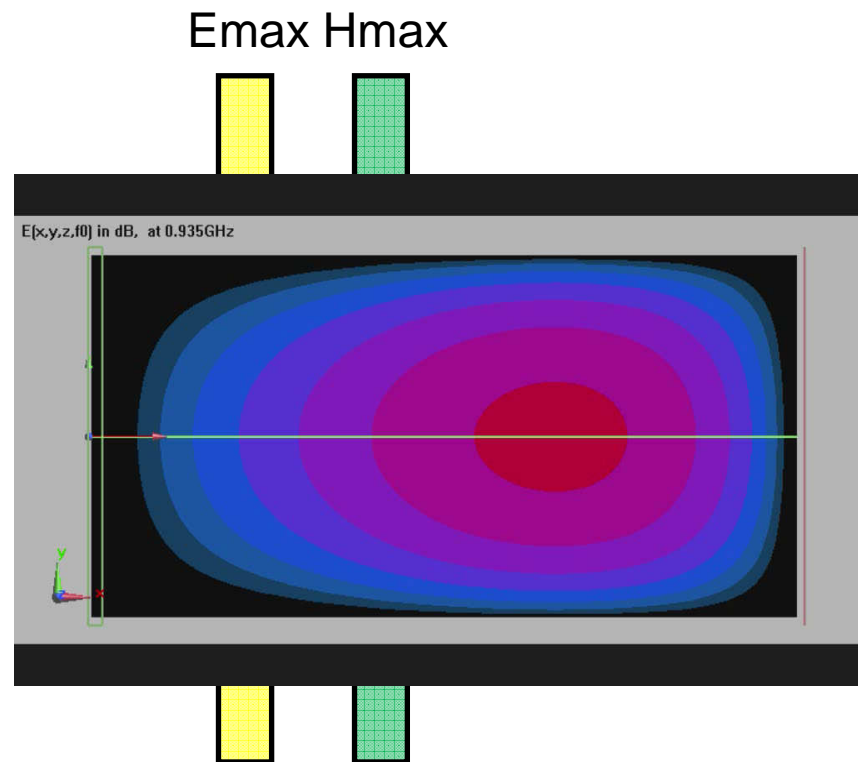
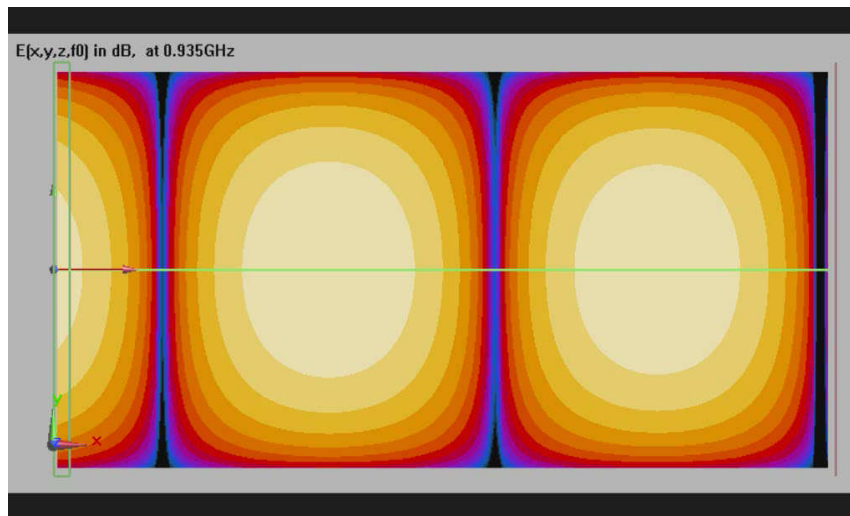
sXcRF 機構 – sXc900 機械設計



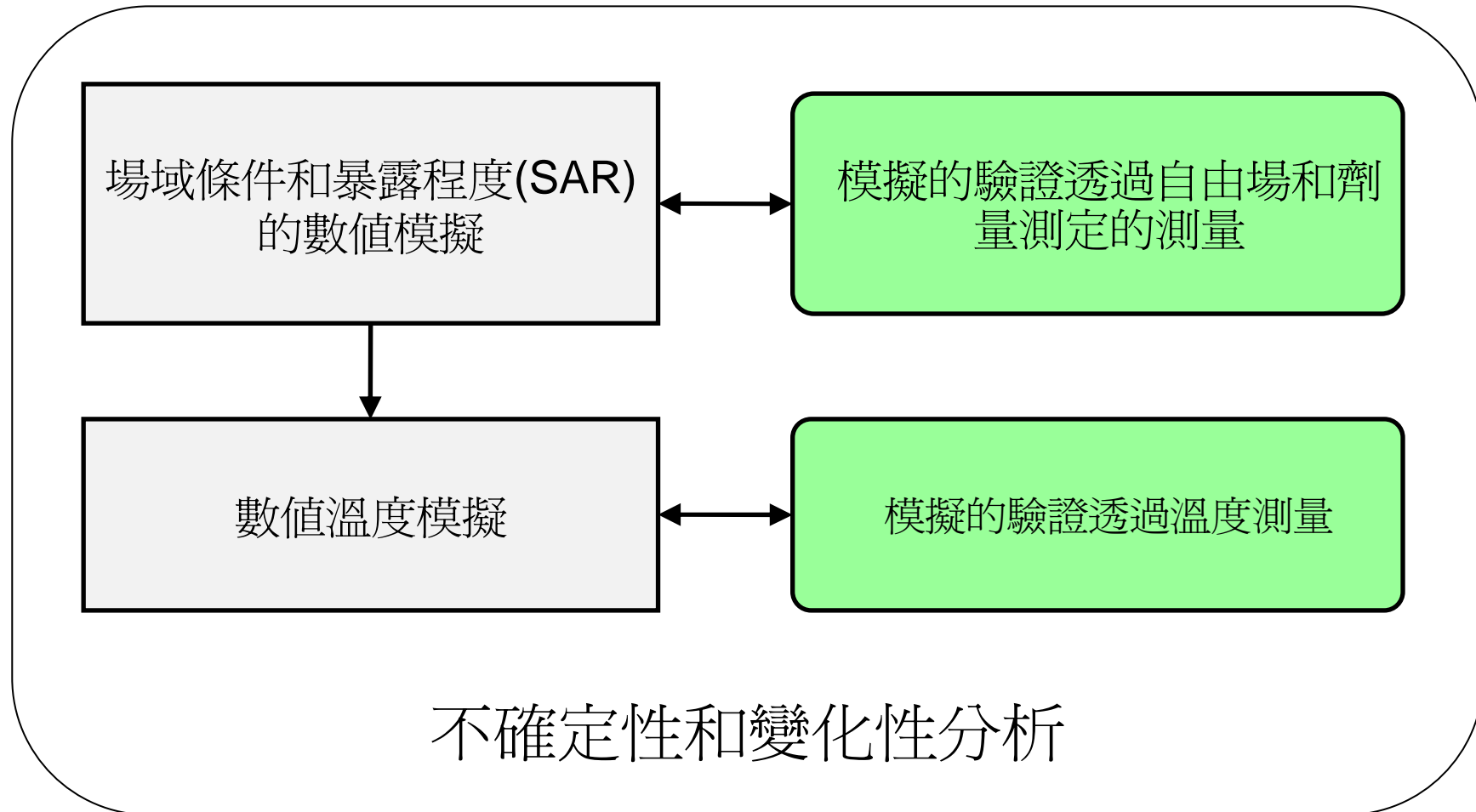
sXc
900

sXcRF 機構 – 波導電磁場

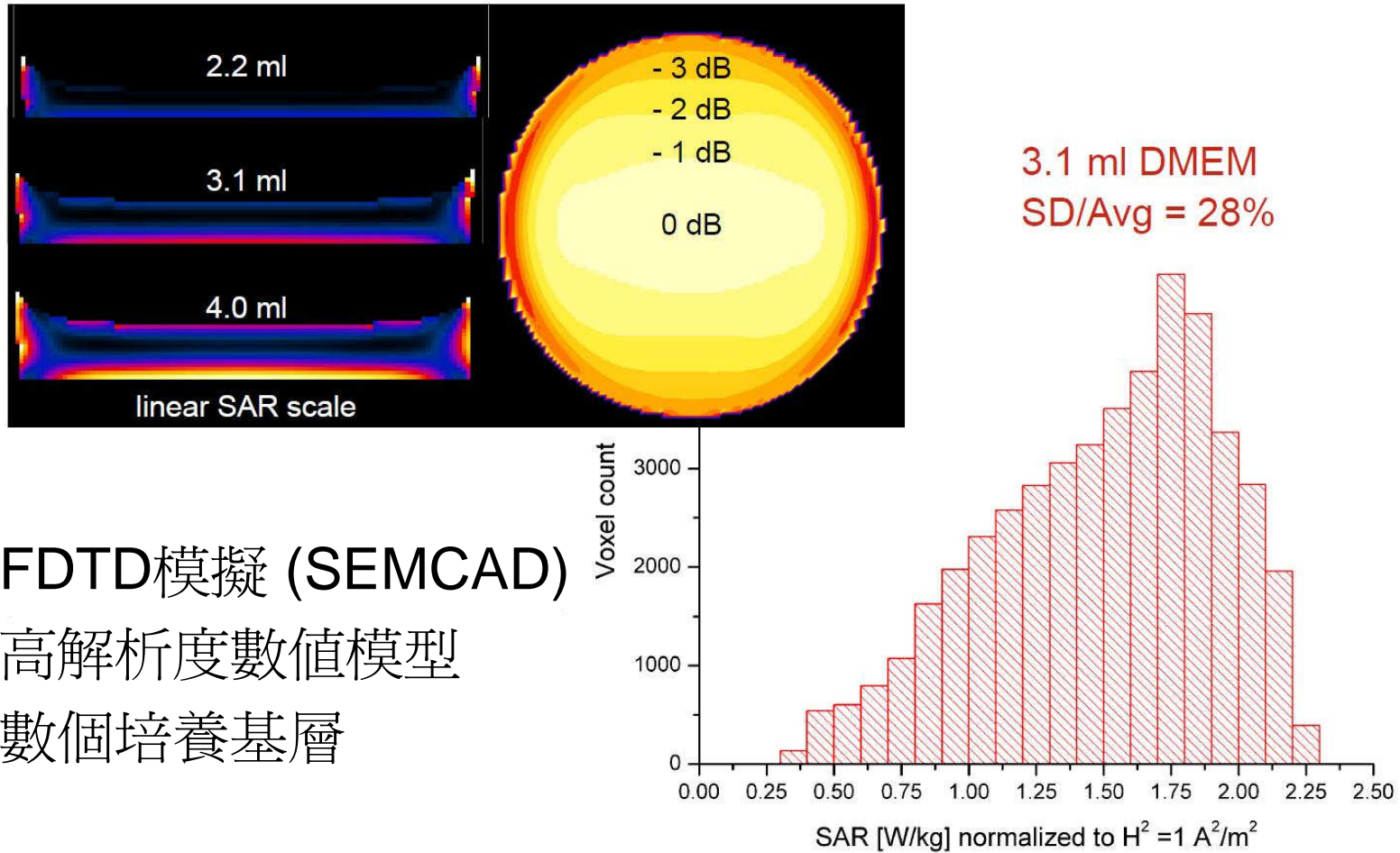
- 電磁波、電場、磁場
- 波的傳播、反射、駐波



劑量測定的概念 – 概要

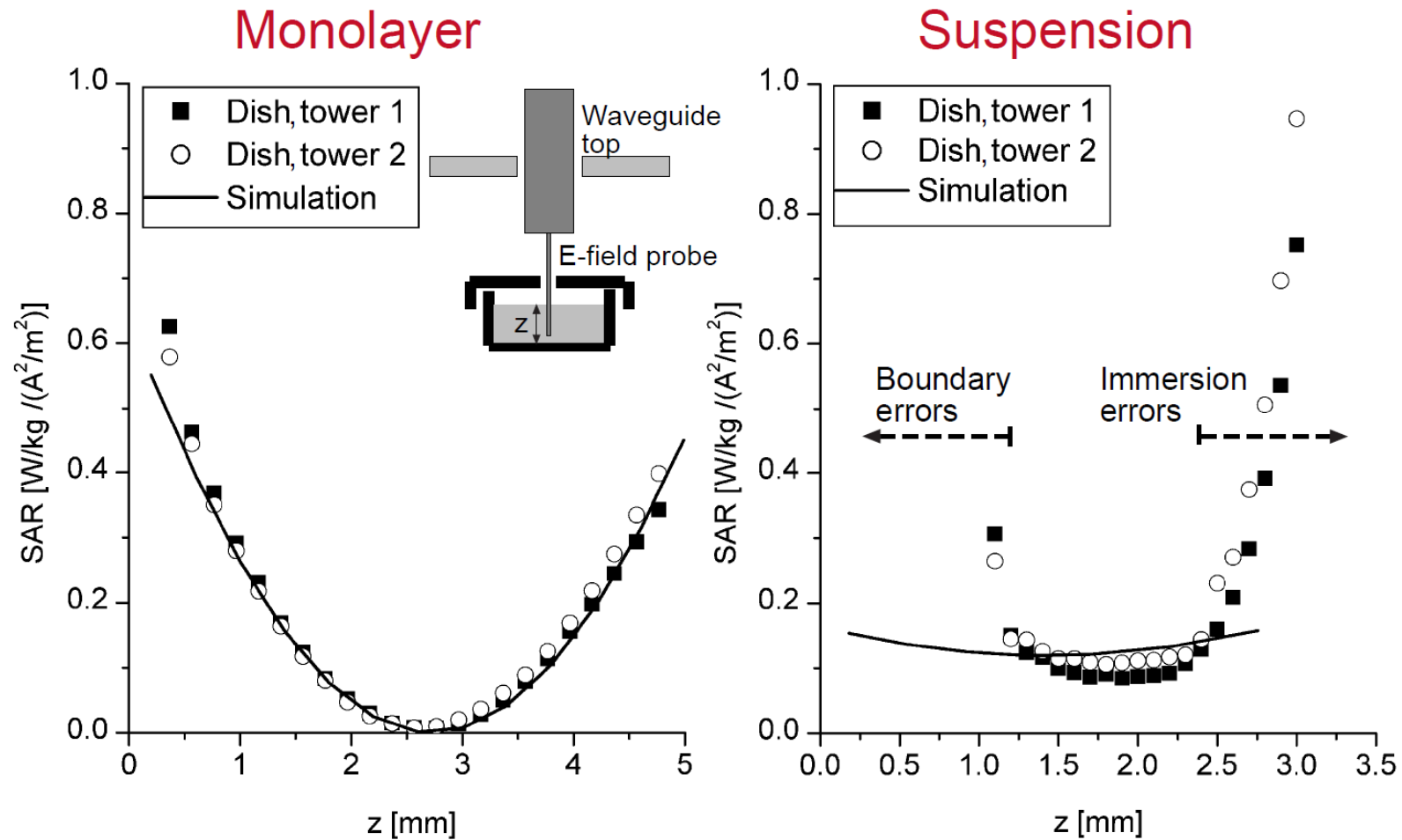


劑量測定的概念 – SAR 評估

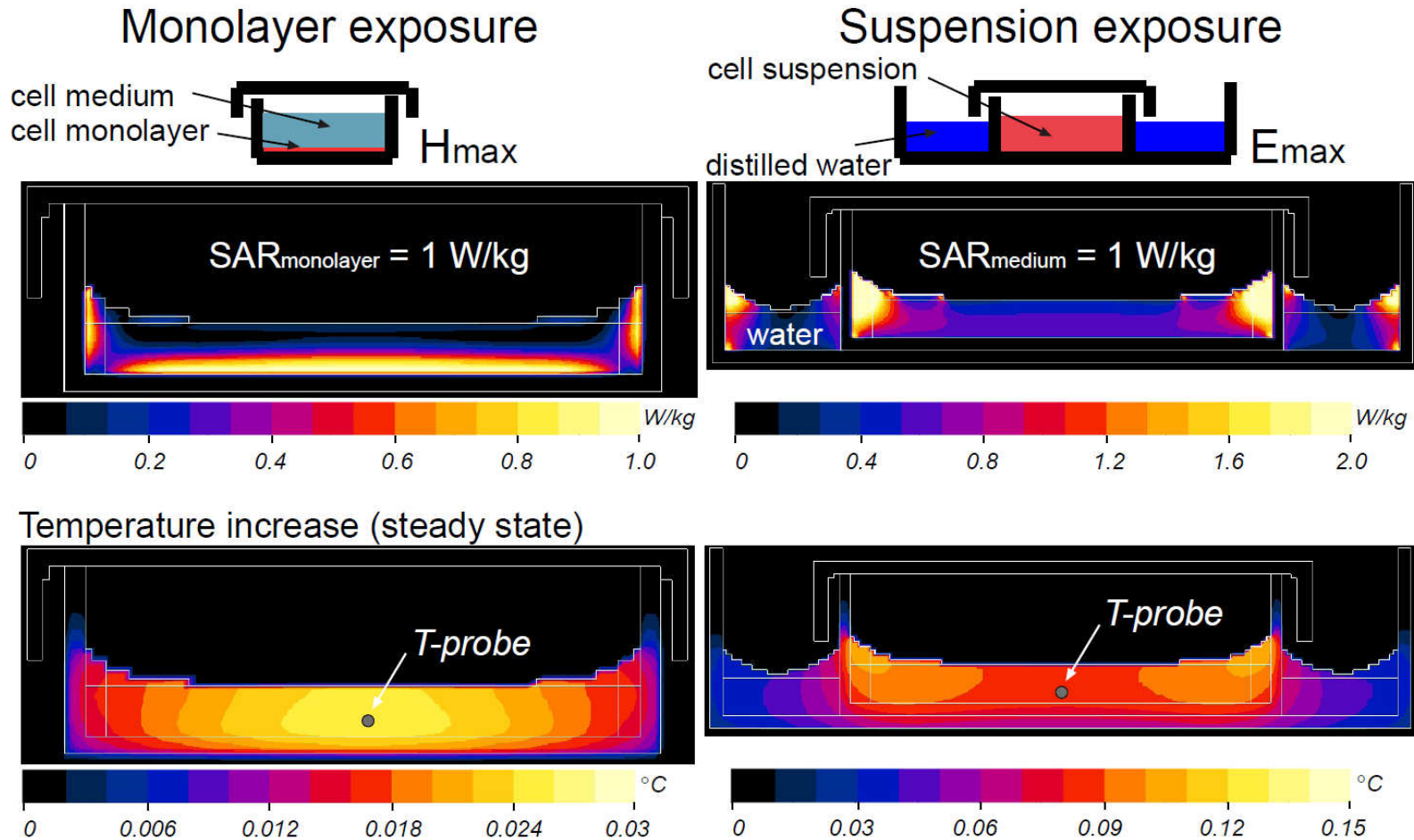


- ❏ FDTD模擬 (SEMCAD)
- ❏ 高解析度數值模型
- ❏ 數個培養基層

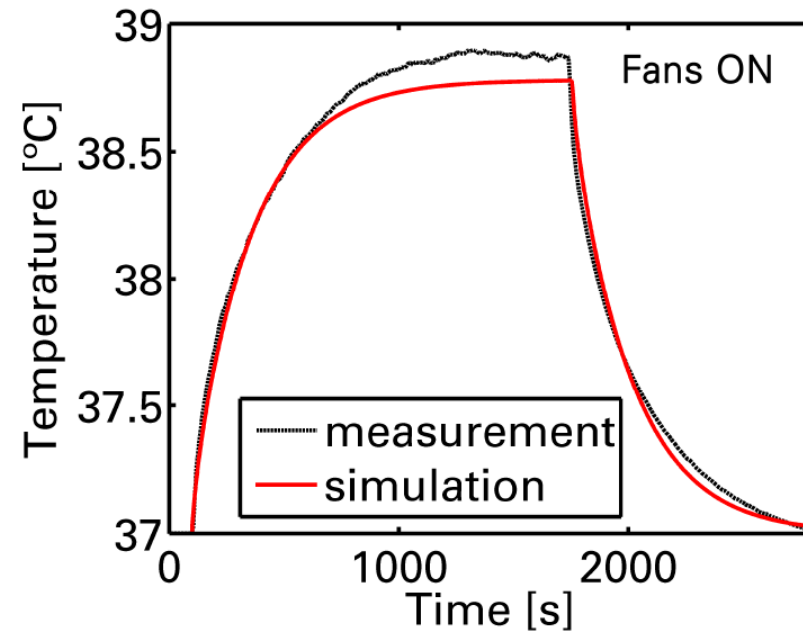
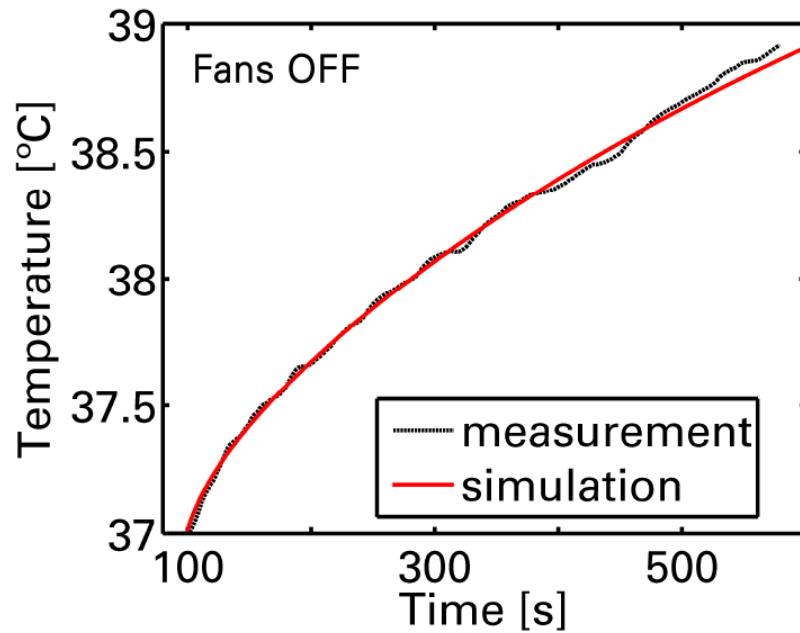
劑量測定的概念 – 驗證測量



劑量測定的概念 – 溫度評估



劑量測定的概念 – 驗證測量



劑量測定的概念 – 不確定性和變化性

❶ 不確定性預算參數

例如數值離散化、電介質參數、探針不確定性和定位

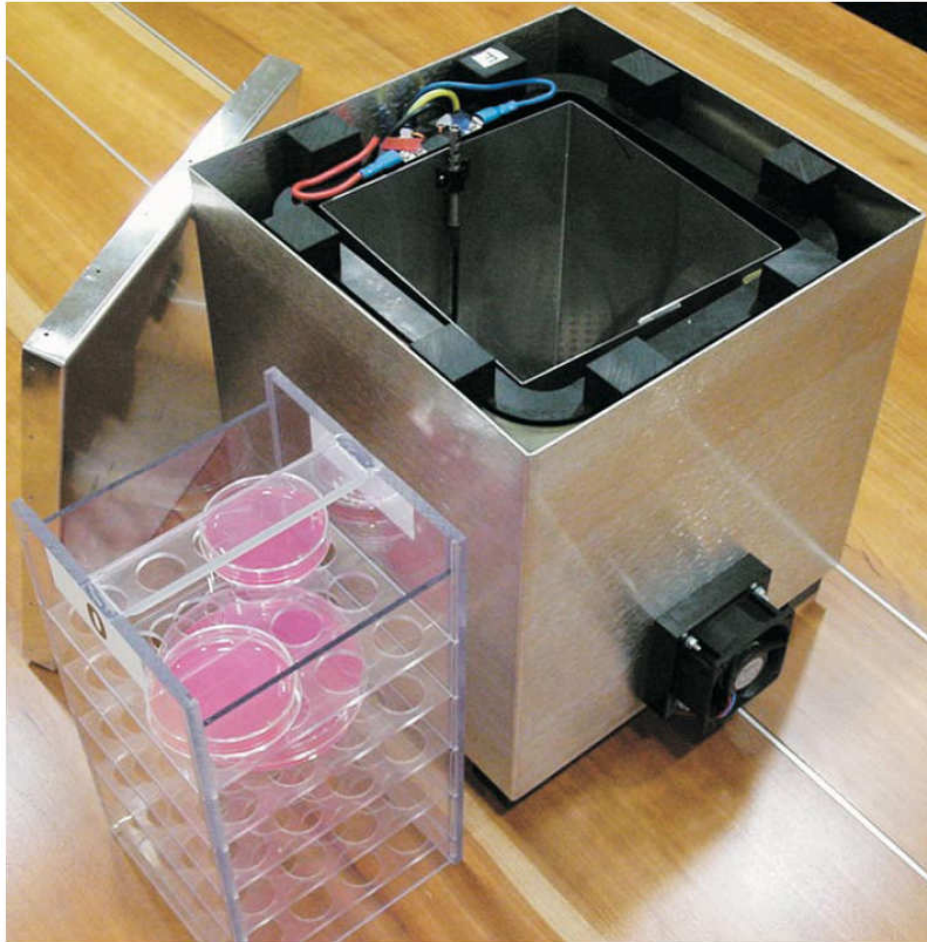
《在對比模擬和測量結果中預期的不確定性》

❷ 變化性預算參數

例如培養基體積的變化、盤架誤放

《重複實驗下暴露程度的變化》

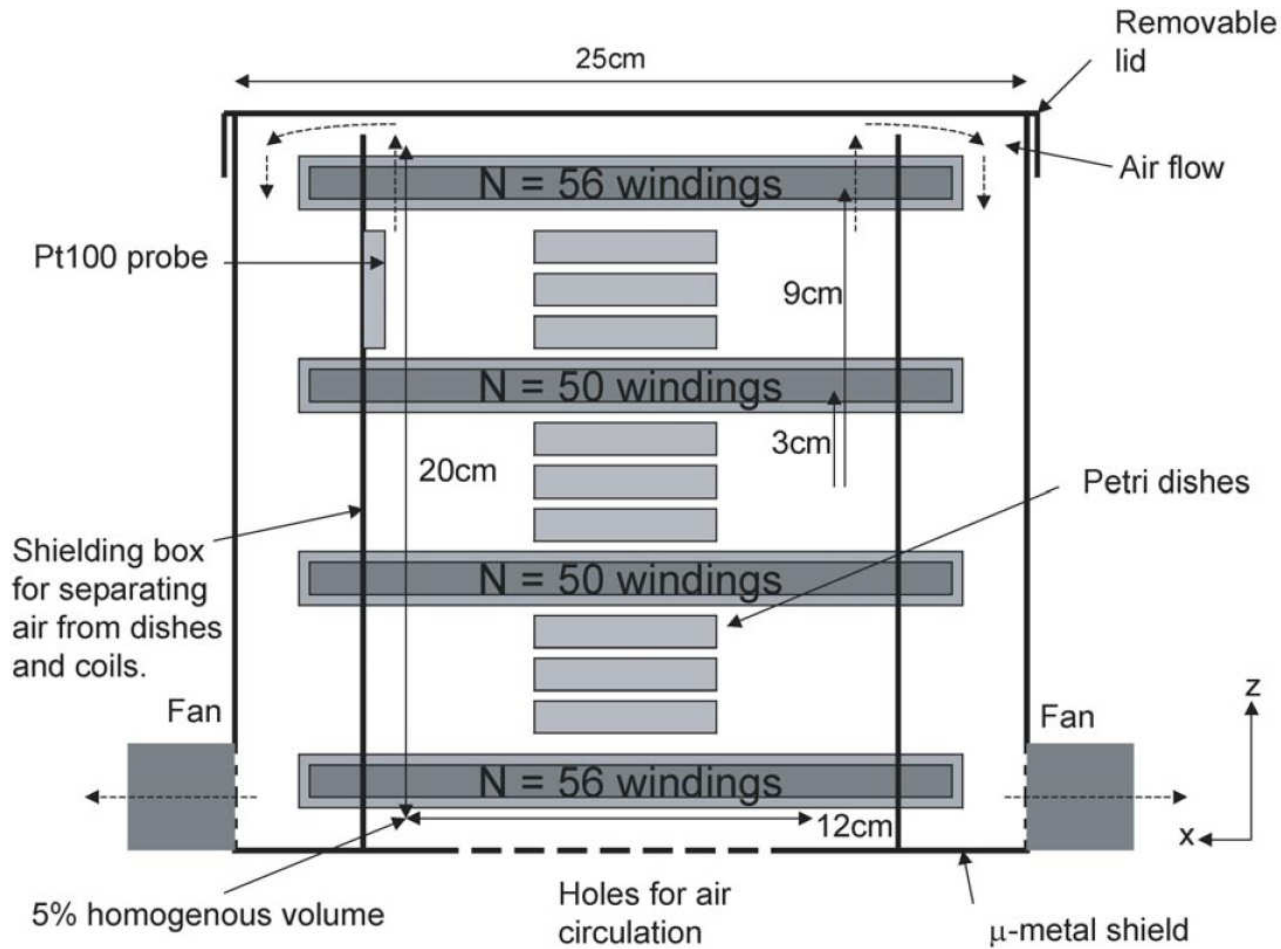
sXcELF 機構 – 機械設計 (1)



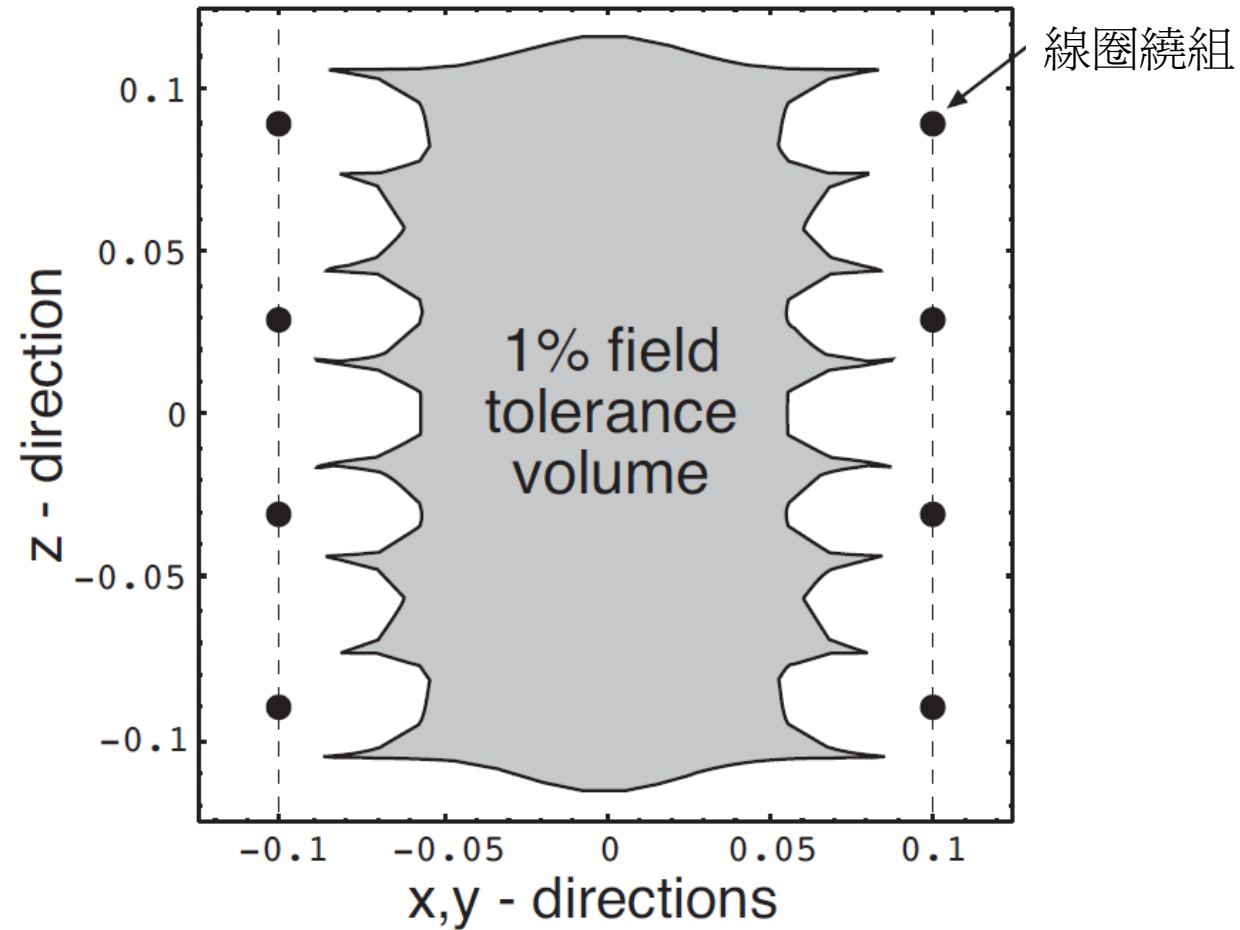
sXcELF 機構 – 機械設計 (2)



sXcELF 機構 – 機械設計 (3)



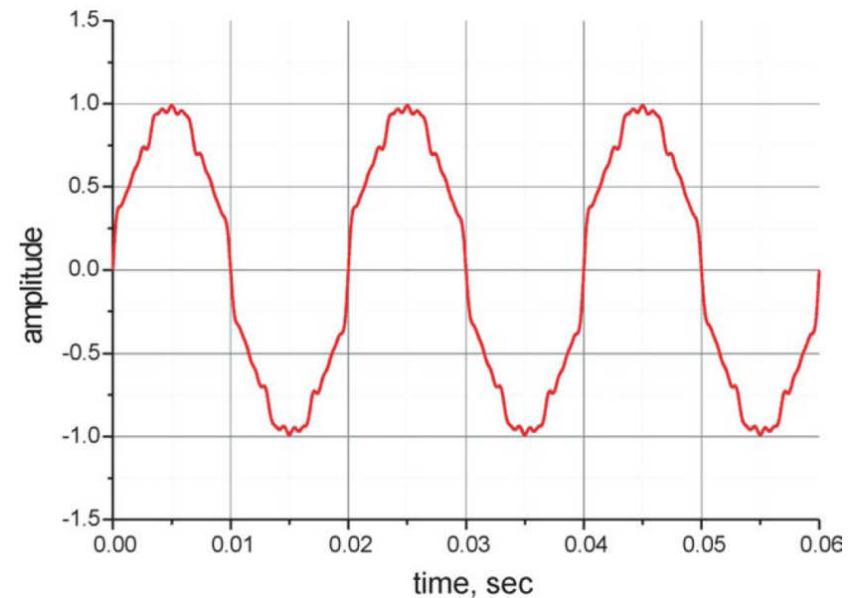
sXcELF 機構 – 磁場(B-Field)分佈



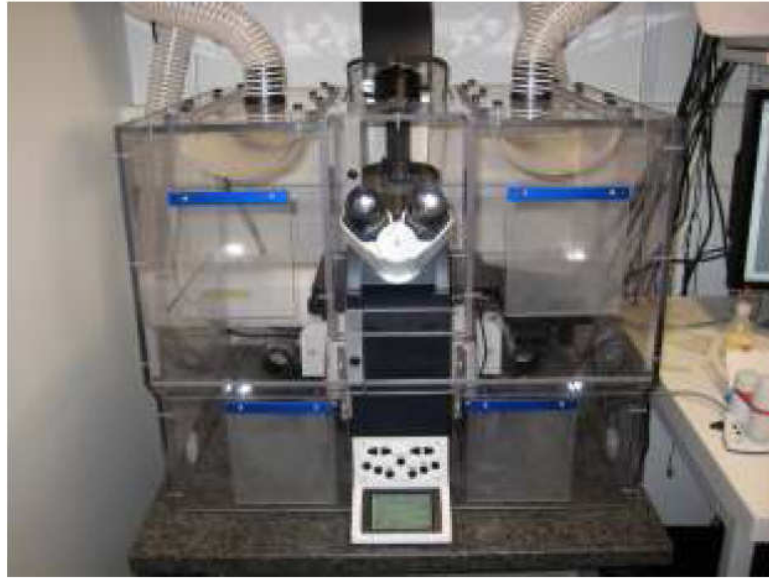
sXcELF 機構 – 50/60Hz 電力線信號

電力線信號的定義和實施

- IEC 1000電磁兼容性，”對於連接至培養基和高功率電源供應器電流之設備的諧波電流發射限制”
- 最大的頻率分量幅度上達第25個諧波 ($f = 1.25 \text{ kHz}$)



sXcLive – 活細胞成像



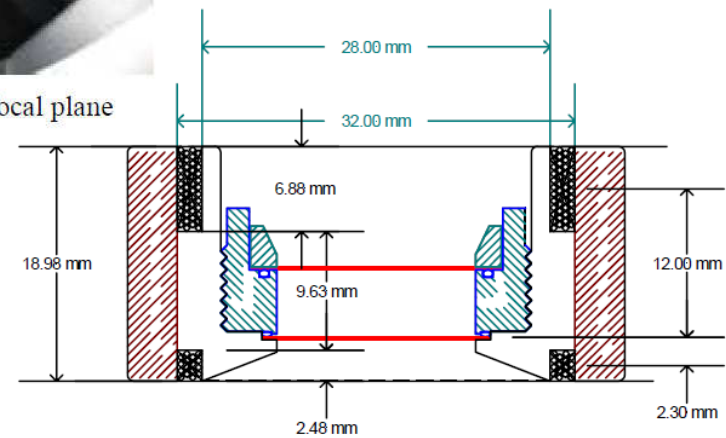
Leica DMI 6000B with the environmental hood



Space above the focal plane



Space below the focal plane



sXv 芝加哥的動物研究 (NIEHS)



- ❏ 該系統包括**21**個電波迴響室，**14**個用於大鼠，**7**個用於小鼠。
- ❏ 系統使用**GSM**或**IS95**信號於三個**SAR**程度之一或對造組，在整個生命週期中。使用一系列的**SAR**程度將提供引起任何可能的劑量反應的能力。

sXv 系統設計 (NIEHS)

- High resolution anatomical models with more than 100 body parts discriminated.



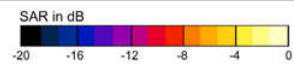
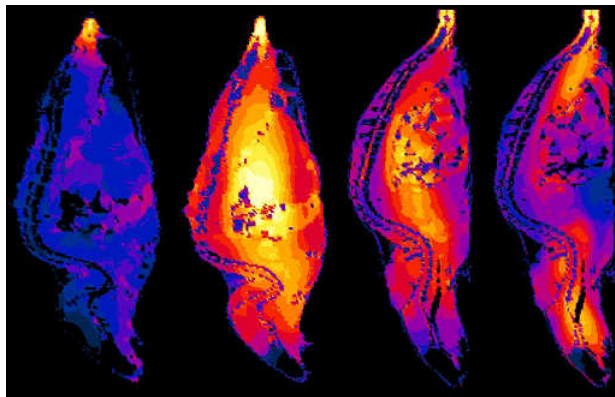
Sprague-Dawley female pregnant rat model

- weight: 253 g
- length: 327 mm
- slice distance: 0.595 mm



B6C3F1 female pregnant mouse model

- weight: 30 g
- length: 147 mm
- slice distance: 0.36 mm

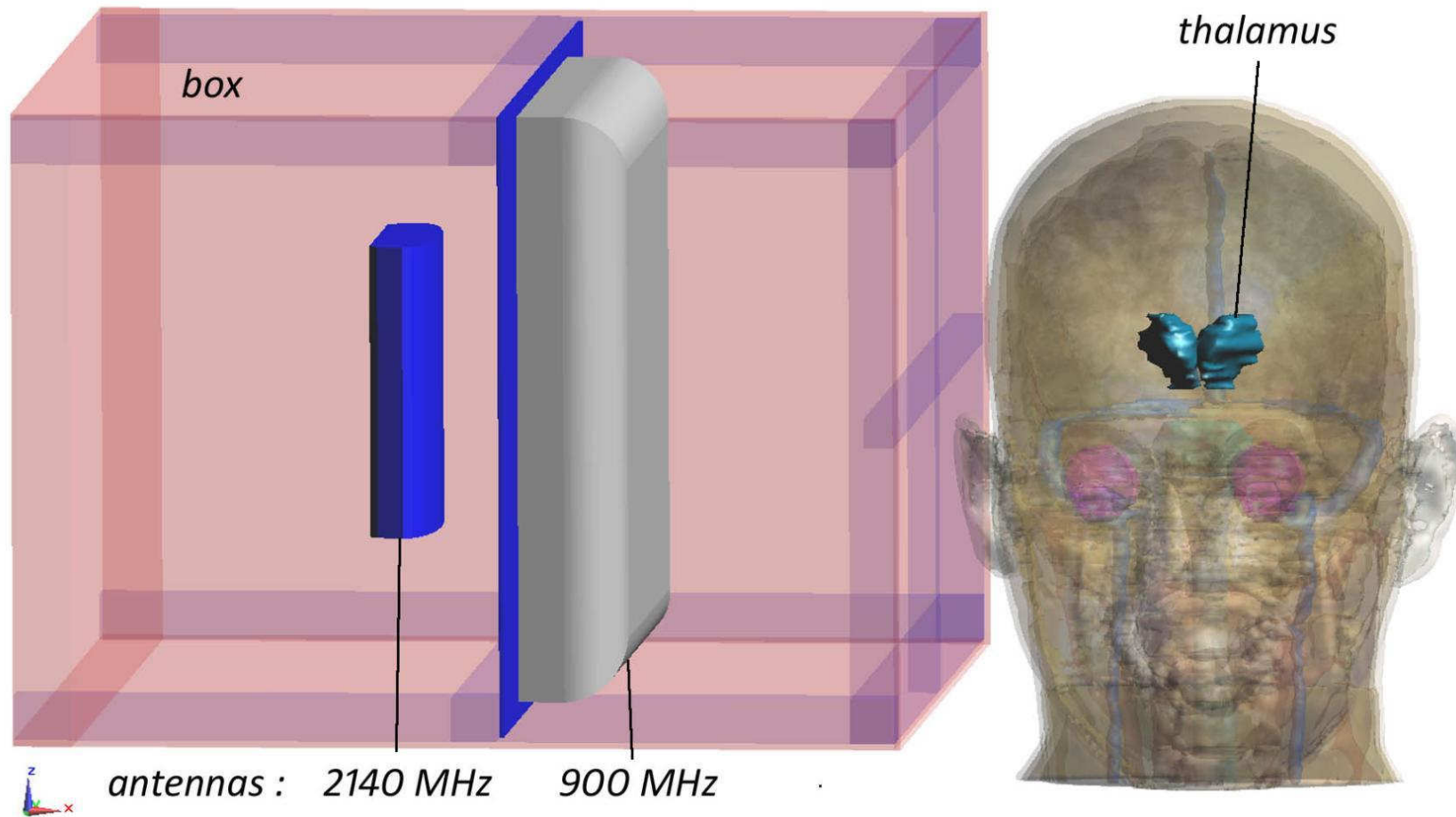


sXh900 / sXh2140 人體暴露系統

人類刺激研究的額外條件

- ❏ 完整的劑量測定評估包括大腦功能分區(Talairach 區)的組織特性SAR評估
- ❏ 人工製品的評估，例如腦電圖(EEG)電極的影響
- ❏ 樣本間的變異性評估
- ❏ 額外的預警要素

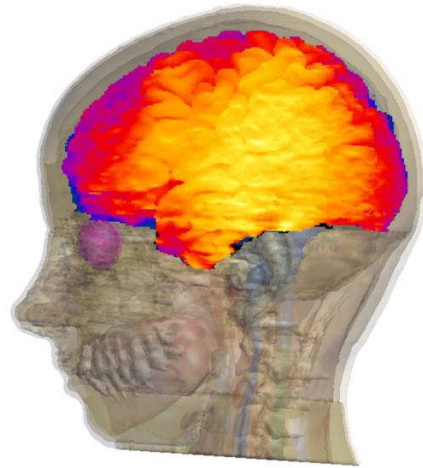
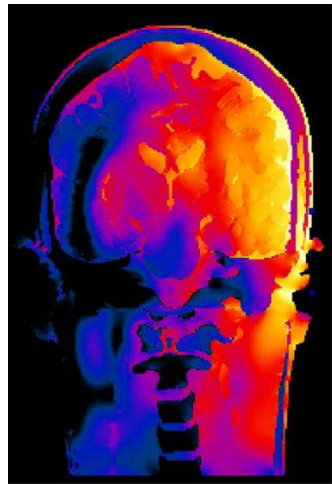
sXh900 / sXh2140 安裝設計 (1)



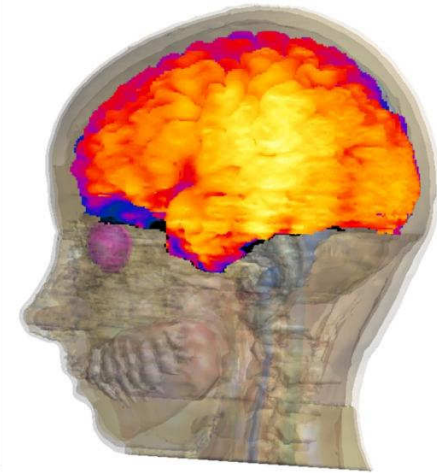
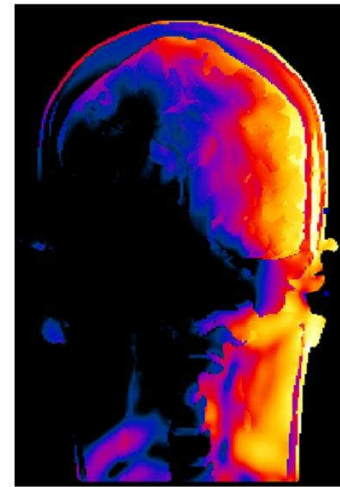
安裝設計 (2)



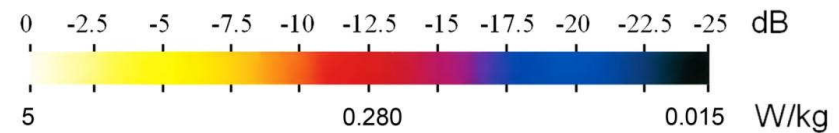
sXh900 / sXh2140 SAR 分佈



900 MHz



2140 MHz



腦部 Talairach 功能分區

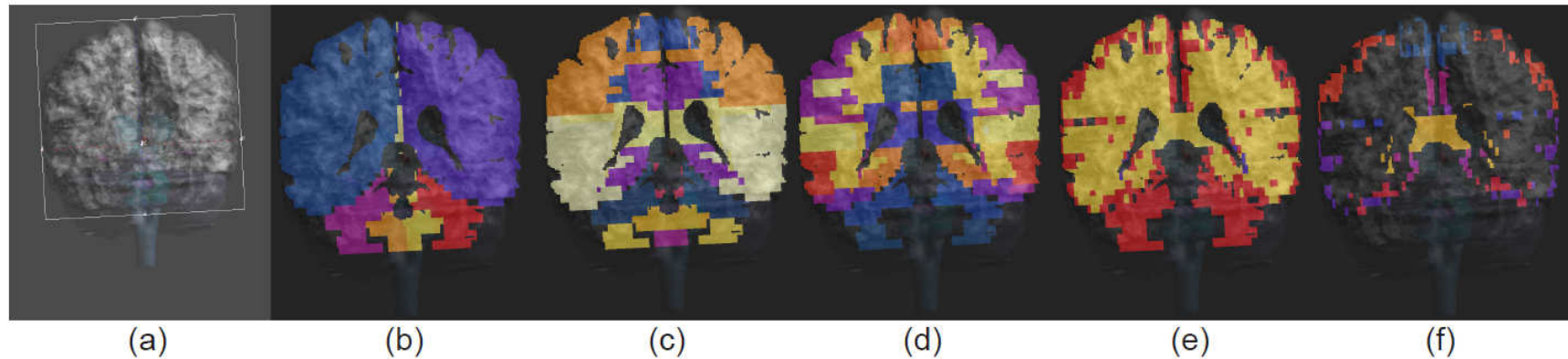


Figure 1A: (a) Coronal illustration of the bounding box of the Virtual Family adult female brain. Hierarchy of the Talairach labels mapped on the Virtual Family adult female brain, using high resolution atlas data in coronal orientation: (b) hemisphere level, (c) lobe level, (d) gyrus level, (e) tissues level, (f) cell level.

sXh – 劑量測定的結果

BOTH HEMISPHERES	1g psSAR (W/kg)			averaged SAR (W/kg)			Variation* [%]						Uncertainty*+[%]					
							1g psSAR			av. SAR			1g psSAR			av. SAR		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Grey matter	1.46	1.27	1.44	0.165	0.231	0.236	16	12	06	38	20	11	06	05	04	07	03	02
White matter	0.72	0.87	0.95	0.091	0.169	0.175	15	17	11	39	27	13	06	03	02	12	05	04
Grey & white matter	1.32	1.24	1.35	0.137	0.207	0.215	14	12	08	38	21	11	06	07	05	09	03	02
Thalamus	0.09	0.44	0.51	0.035	0.252	0.292	45	35	22	60	35	22	10	15	12	11	16	15
Brain avg.	1.32	1.43	1.35	0.128	0.206	0.212	14	21	13	37	22	13	06	04	05	07	04	03
Brain avg. With CSF	1.66	1.70	1.70	0.156	0.246	0.245	21	16	11	37	22	14	13	04	03	08	03	03
Total head	4.78	1.86	2.00	0.221	0.172	0.179	10	16	12	26	16	15	04	08	05	04	01	01
Subregion 1				0.338	0.450	0.383				36	15	16				15	03	09
Subregion 2				0.721	0.827	0.768				37	22	11				03	04	05
Subregion 3				0.565	0.773	0.848				14	18	14				03	02	04
Subregion 4				0.321	0.299	0.350				35	17	17				09	05	07
Subregion 5				0.670	0.790	0.783				27	16	08				07	03	04
Subregion 6				0.653	0.708	0.626				37	18	15				06	05	07
Subregion 7				0.467	0.499	0.455				37	17	19				09	03	08
Subregion 8				0.616	0.752	0.712				35	16	10				11	02	04

* Variation and uncertainty for coverage factor k = 1

+ Brain averaged values include grey matter, white matter, cerebellum, hippocampus, hypophysis, hypothalamus, midbrain, thalamus, pineal body, pons, medulla oblongata, commissura posterior, commissura anterior

Table 2. Dosimetry results: Adult female exposed at 2140 MHz (A), adult female exposed at 900 MHz (B), girl exposed at 900 MHz (C).

IT'IS 暴露系統的實驗室用途

- ❏ 系統是完全由電腦控制的
- ❏ 所有設定參數被自動記錄，雙盲信息被加密並儲存於日誌文件中
- ❏ 日誌文件可以在IT'IS進行評估，考慮到實驗的完整重現

控制軟體

GSM Experiment [X]

Description:

Petri dishes

Medium

Amount (2 - 5) [ml]

Exposure duration
Duration on cycle [s]
Duration off cycle [s]
Total duration [s]

Start Delay Time
Hours Minutes Seconds

Signal

SAR average [mW/g] SD: [%]
SAR slot average [mW/g]
Temperature rise [°C]

實驗的評估 (1)

EXPERIMENT EVALUATION, IT'IS Foundation

sXcRF-Analyzer_V6.4

Exposure Software sXcRF_V1.8b1

sXc900 Bern - Cell Exposure

Experiment description:

PC12-Hann 2h repetition (02.12.08)

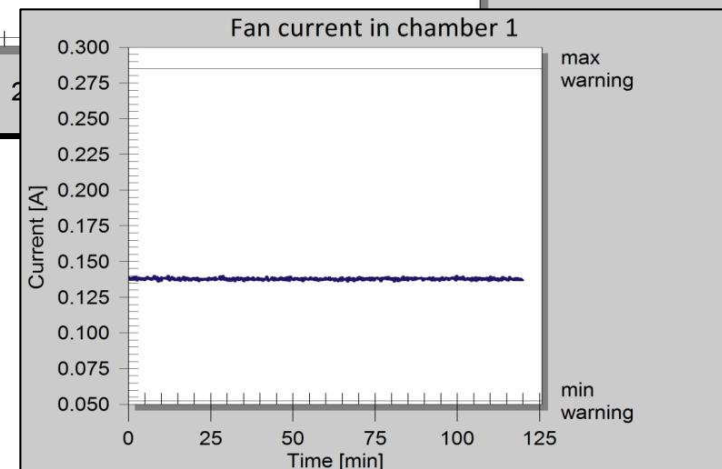
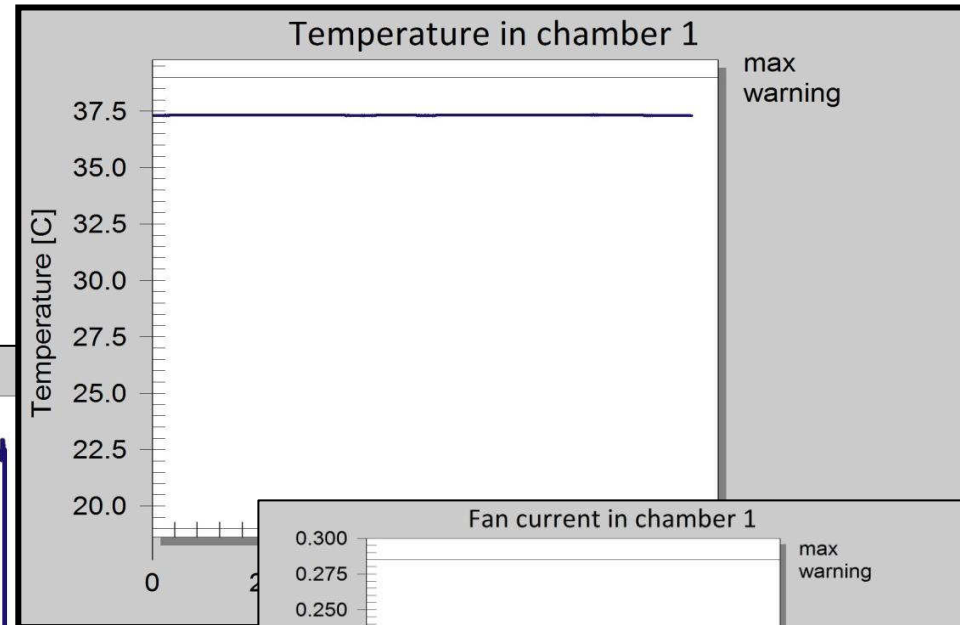
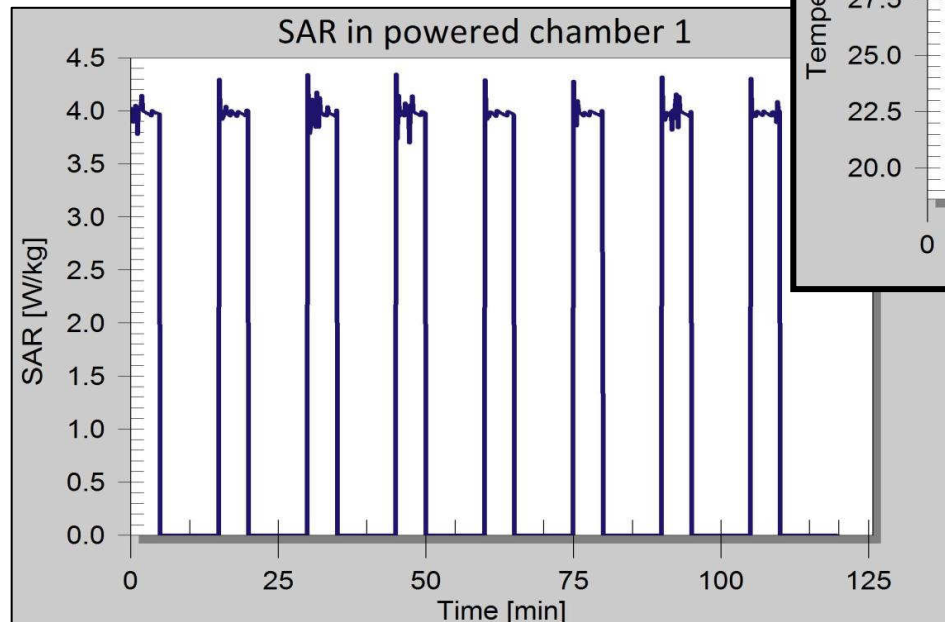
Description	Value	Dimension
Start Date and Time	2008-12-02 14:50:59	
Stop Date and Time	2008-12-02 16:51:53	successful
Cell Medium & Volume	Bern DMEM-PC12 norm+diff	4 [ml]
Expected Average SAR	4	[W/kg]
Exposure Signal Type	GSM Basic	
Modulation (217Hz)	ON	[]
Frame Structure	ON	[]
DTX	OFF	[]
Talk	OFF	[]
Duration ON	300	[s]
Duration OFF	600	[s]
Total Duration	2	[h]
Number of Cycles	8	[#]
Expected Temp rise	0.096	[K]

Description	Exposure Chamber 1	Exposure Chamber 2	Dimension
Power	ON	OFF	
SAR ± SD (during exposure)	3.98 ± 0.08	0.00 ± 0.00	[W/kg]
SAR (Min, Max) (during exposure)	3.70, 4.35	0.00, 0.00	[W/kg]
T ± SD	37.32 ± 0.01	37.34 ± 0.01	[°C]
T (Min, Max)	37.29, 37.33	37.31, 37.36	[°C]
deltaT ± SD	0.02 ± 0.00	0.02 ± 0.00	[°C]
deltaT (Min, Max)	0.02, 0.03	0.02, 0.03	[°C]
Fan current ± SD	0.1378 ± 0.0007	0.1369 ± 0.0007	[A]
Resonance Frequency	933.00	n/a	[MHz]

0 Warning Events

0 Abortions

實驗的評估 (2)



Thank You

Questions

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IT^{IS} FOUNDATION

ETH

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Swiss Federal Institute of Technology Zurich