

U

An in vitro set-up to study
low-frequency ultrasound
effects on dental cells

B

Upen Patel

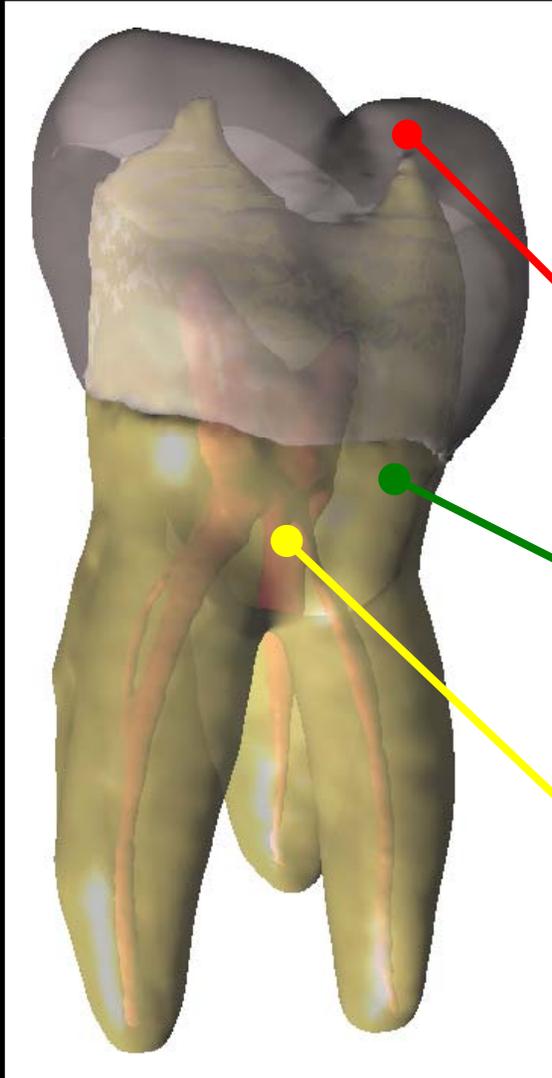
University of Birmingham, UK

Rationale

- **Therapeutic effect**
- **Regenerative effect**
- **Non-invasive**
- **In-expensive**



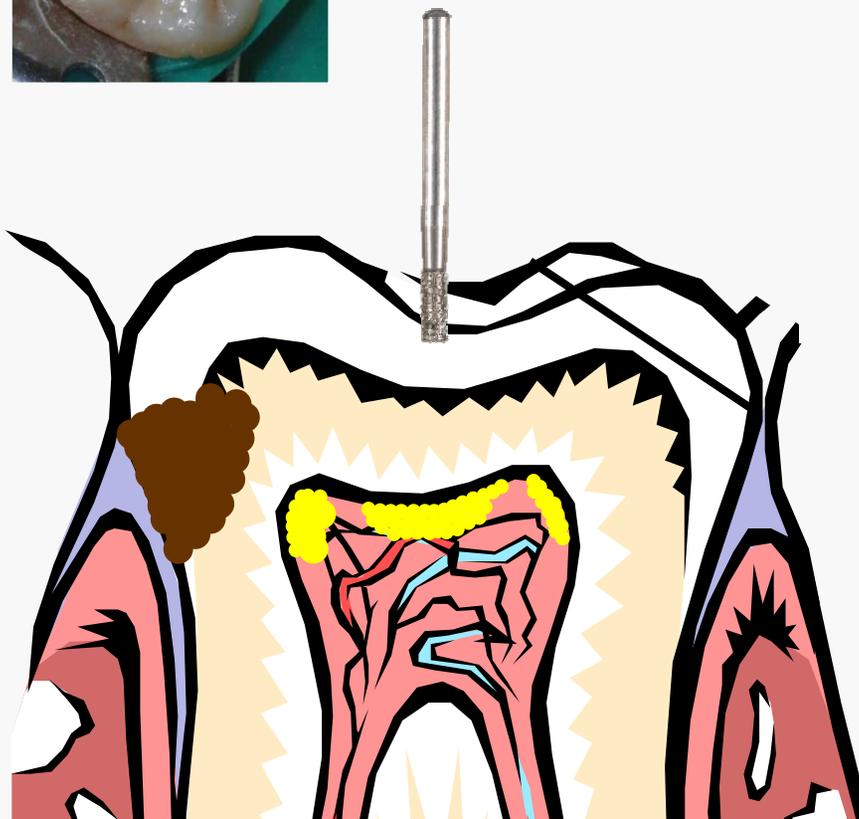
UNIVERSITY OF
BIRMINGHAM



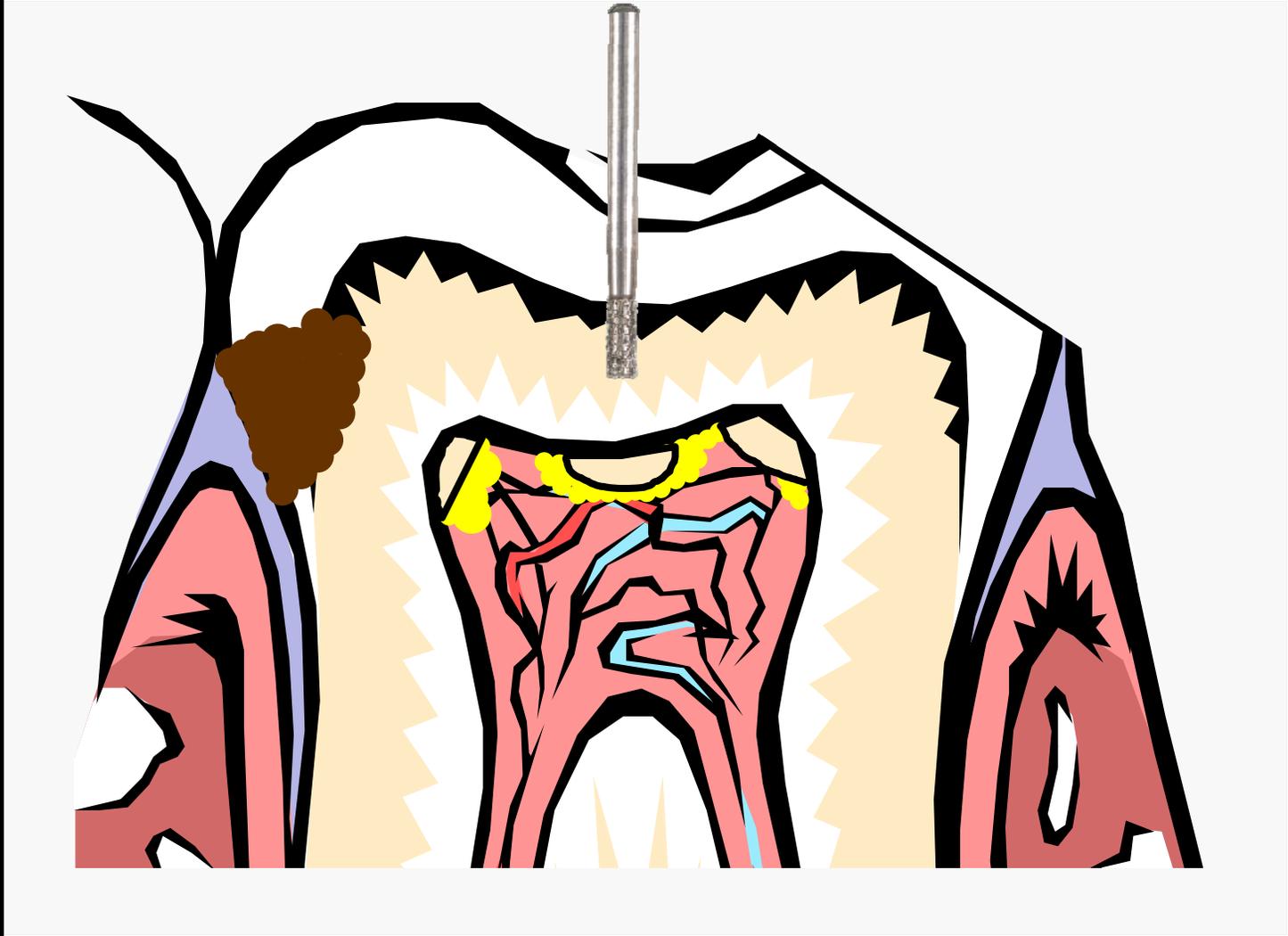
Enamel

Dentine

Pulp

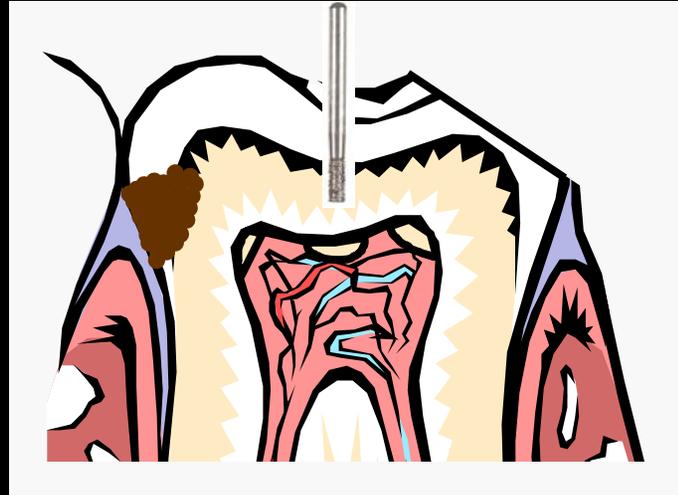


UNIVERSITY OF
BIRMINGHAM

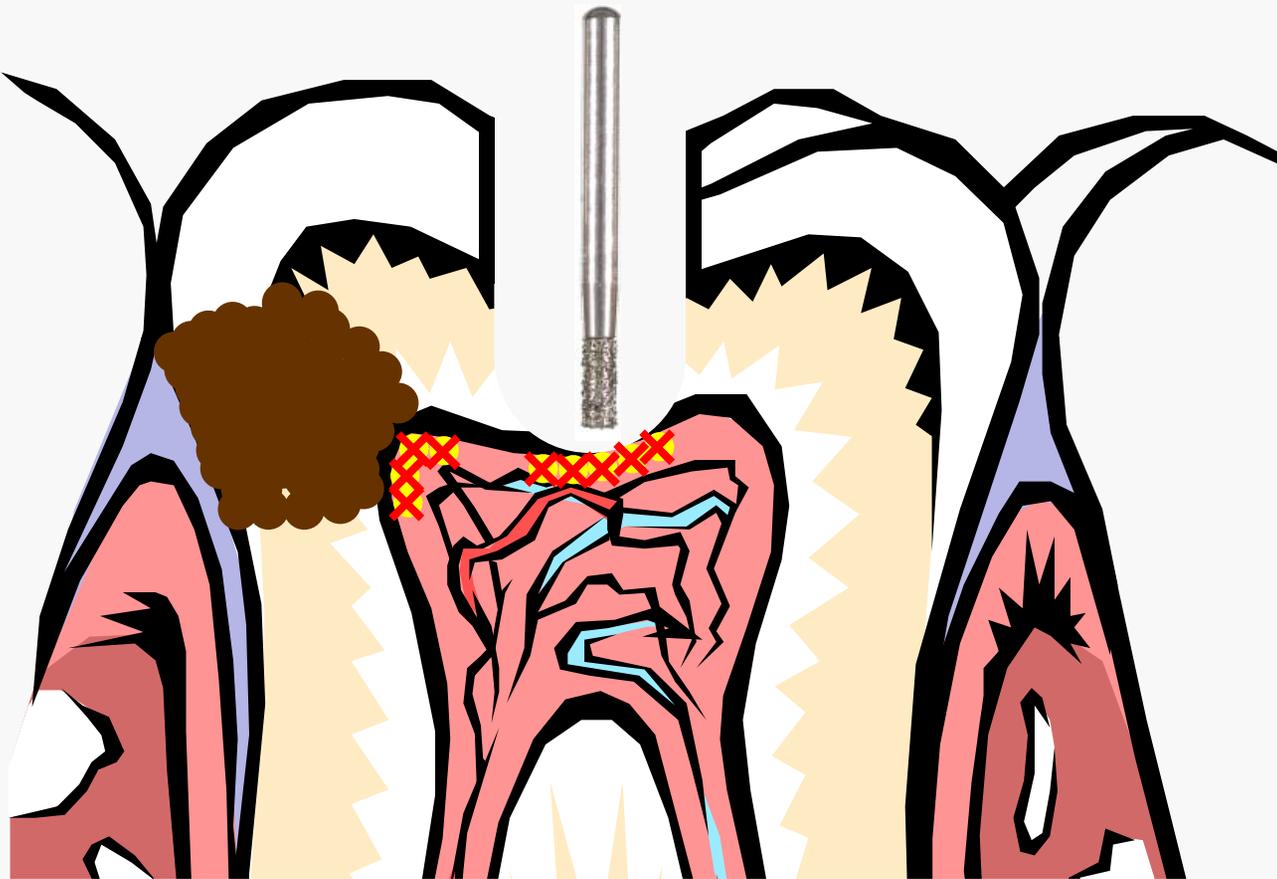


UNIVERSITY OF
BIRMINGHAM

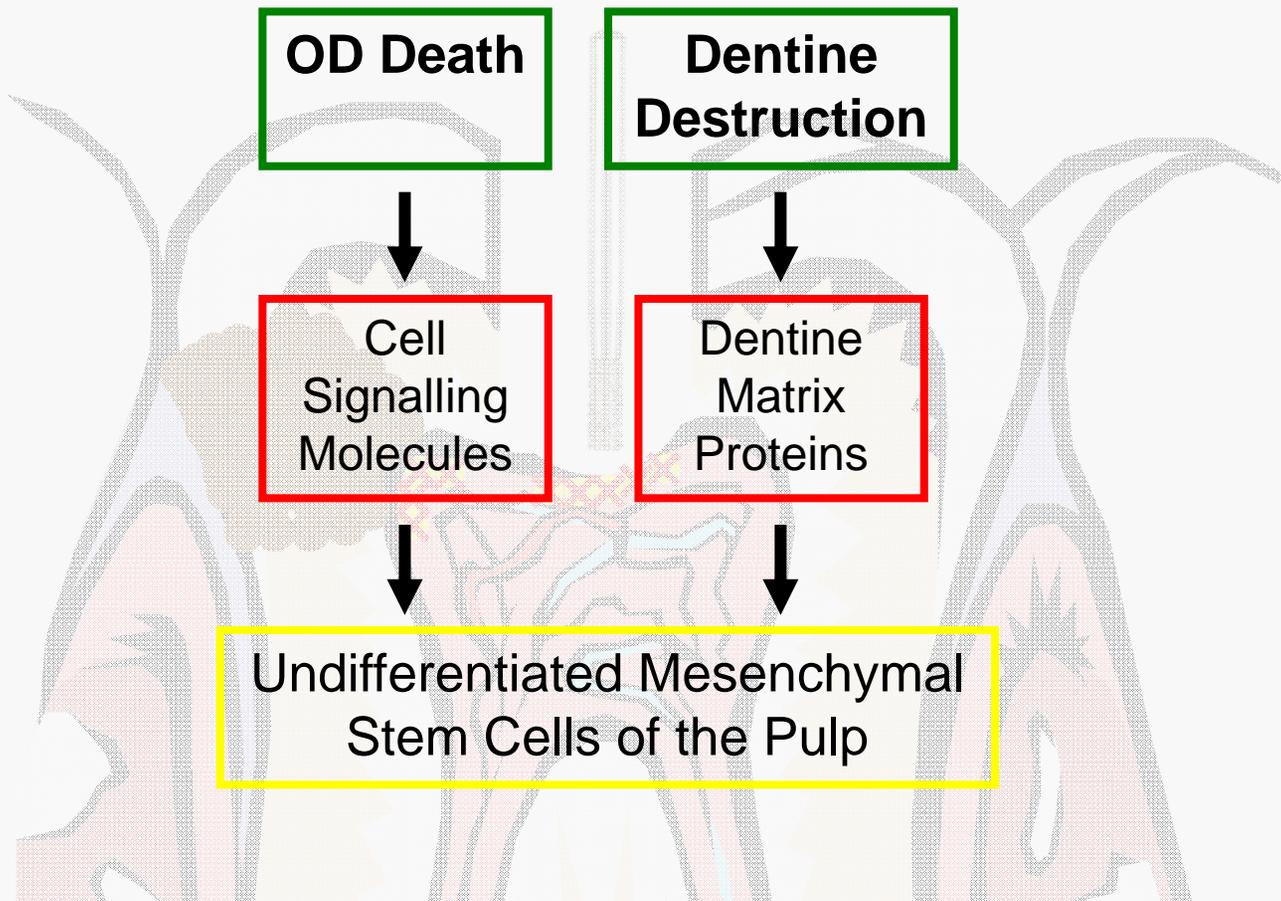
Reactionary Dentinogenesis



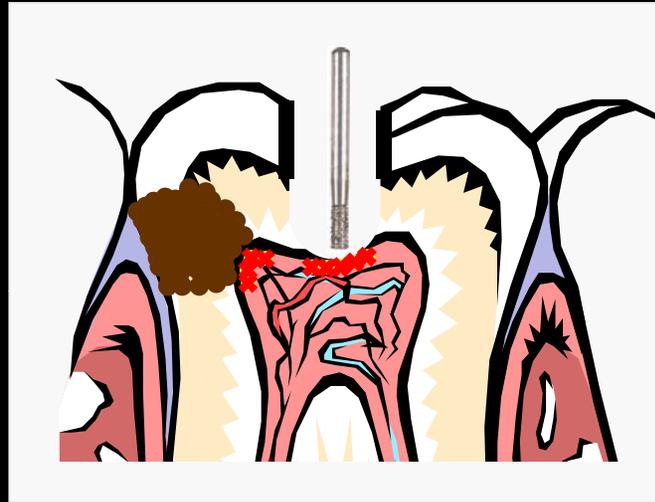
- US to enhance this process
- Quicker dentine formation
- Better protection of the pulp



UNIVERSITY OF
BIRMINGHAM



Reparative Dentinogenesis



- US to enhance (initiate?) cell differentiation
- Enhance cell migration
- Form 'dentine bridges'
- Maintain tooth vitality

US Application

- **Reactionary Dentinogenesis**
 - Enhance production of dentine

- **Reparative Dentinogenesis**
 - Enhance cell differentiation / migration
 - Enhance ‘dentine bridge’ formation

US Device

- **DUOSON**
- **Dual Frequency Ultrasound Therapy Unit**
- **SRA Developments Ltd & Orthosonics Ltd**

- **1 MHz (pulsed 63 Hz at 3.2 ms)**
- **45 KHz (continuous)**

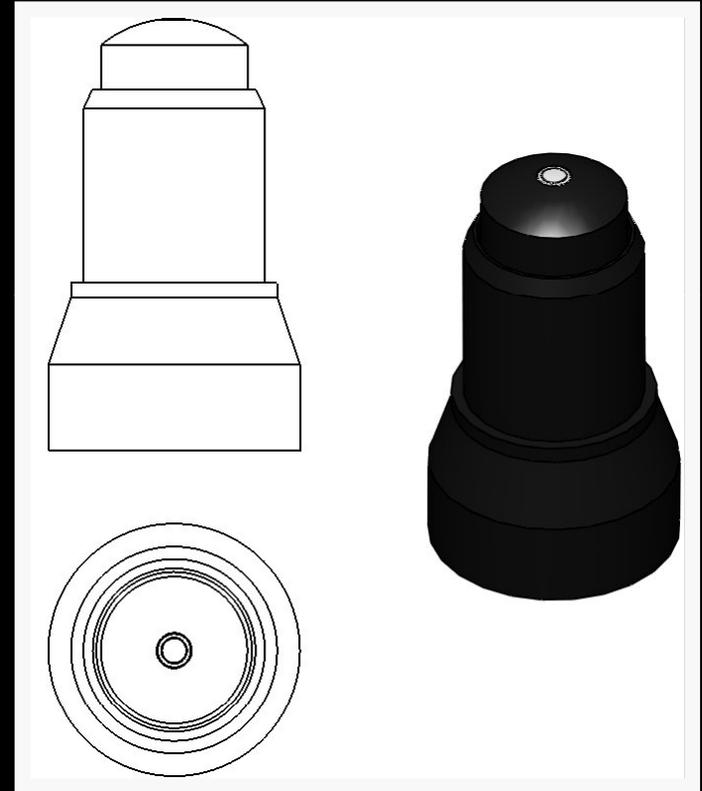
US Device

- Has the ability to deliver both 1 MHz (HF) and 45 KHz (LF) simultaneously

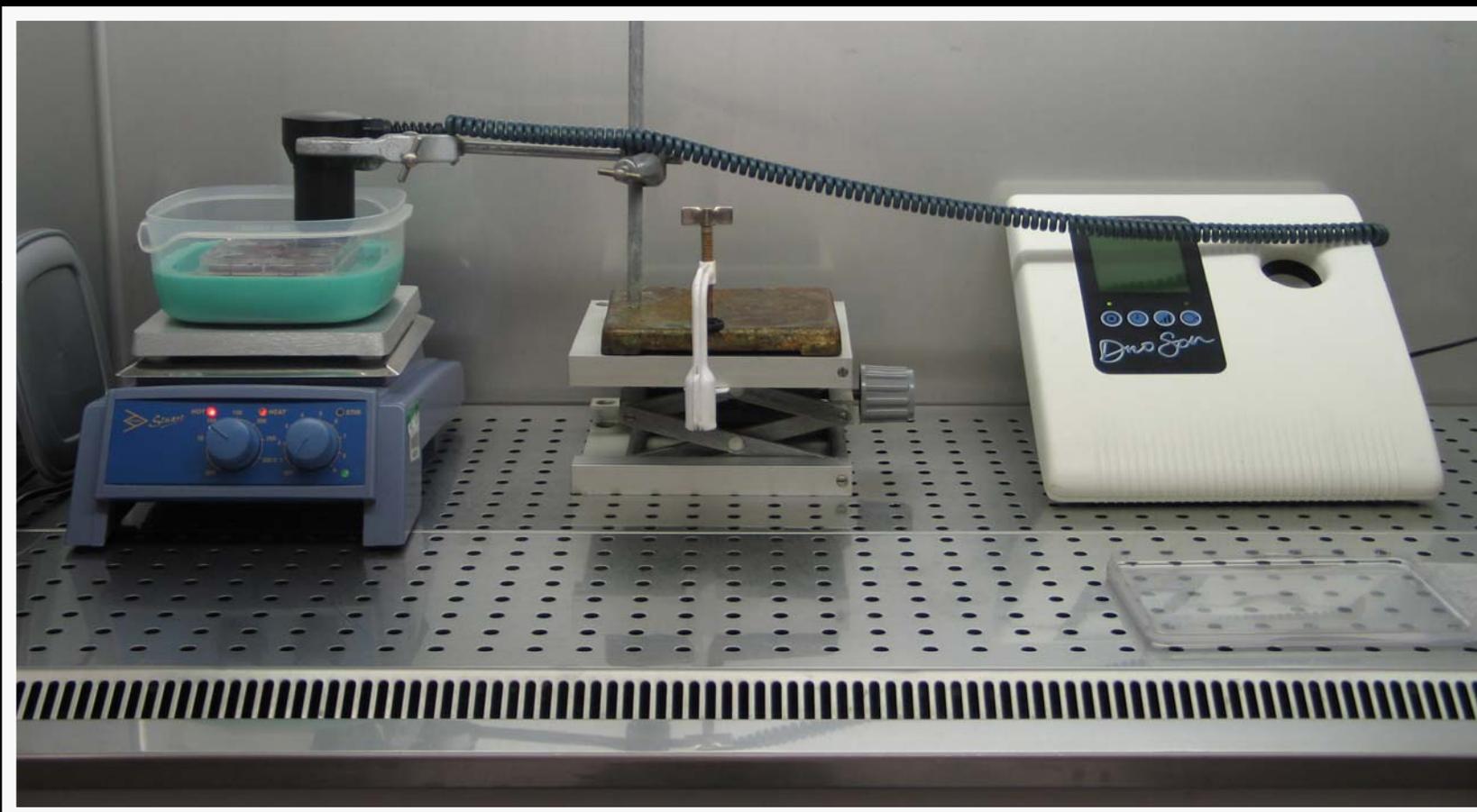
Mode		Force Balance Reading		Total Acoustic Power		LF Acoustic Intensity		HF Acoustic Intensity	
1	HF1	1.3	mg	19	mW			248	mW/cm ²
2	HF2	4	mg	58	mW			763	mW/cm ²
3	LF1	11	mg	159	mW	10	mW/cm ²		
4	LF2	28	mg	406	mW	25	mW/cm ²		
5	LF2+HF1	30	mg	435	mW	25	mW/cm ²	248	mW/cm ²
6	LF3	85	mg	1217	mW	75	mW/cm ²		
7	LF3+HF1	87	mg	1261	mW	75	mW/cm ²	248	mW/cm ²
8	LF3+HF2	89	mg	1290	mW	75	mW/cm ²	763	mW/cm ²

US Device

- **Effective Radiating Area**
 - 45 KHz: 16.3cm^2
 - 1 MHz: 0.38cm^2



Laboratory Set-Up



UNIVERSITY OF
BIRMINGHAM

Laboratory Set-Up



MDPC-23: Odontoblast-like cells

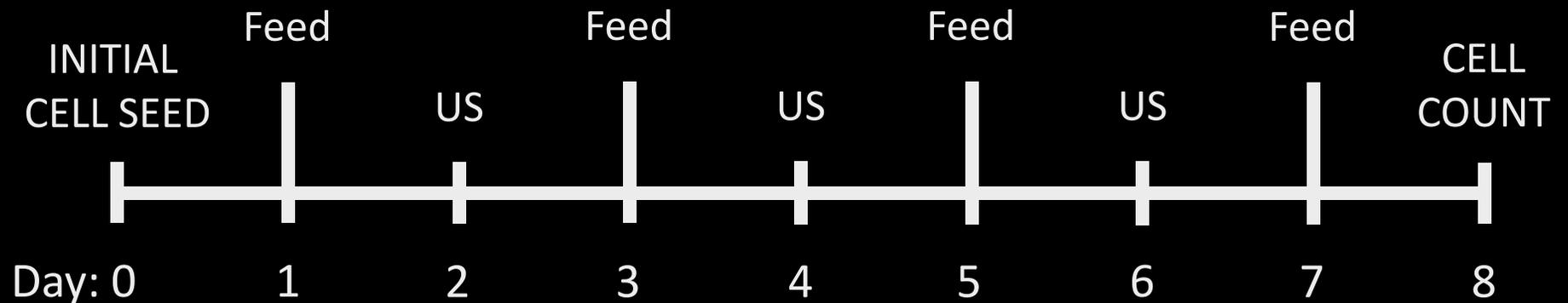
**UNIVERSITY OF
BIRMINGHAM**

Methodology

□ Cell Proliferation

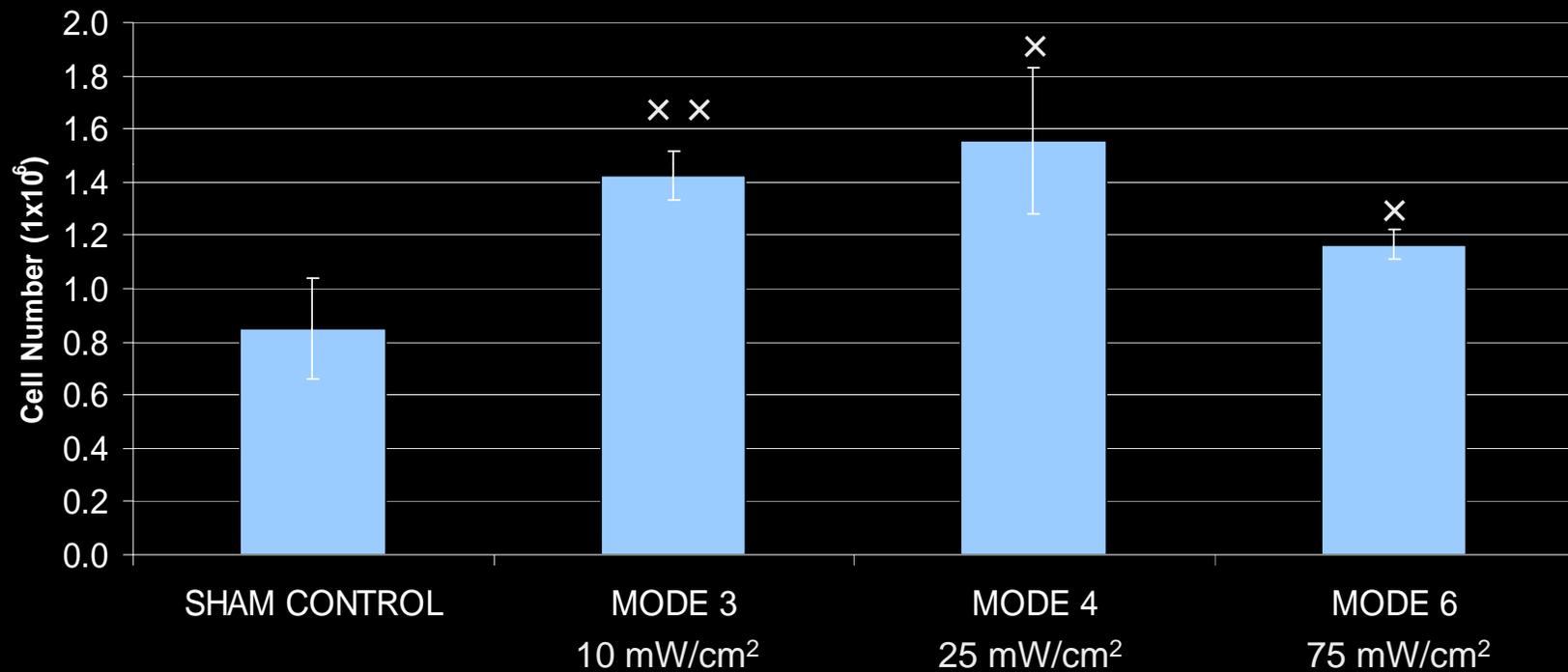
□ 45 KHz

– 3 intensity modes



Results

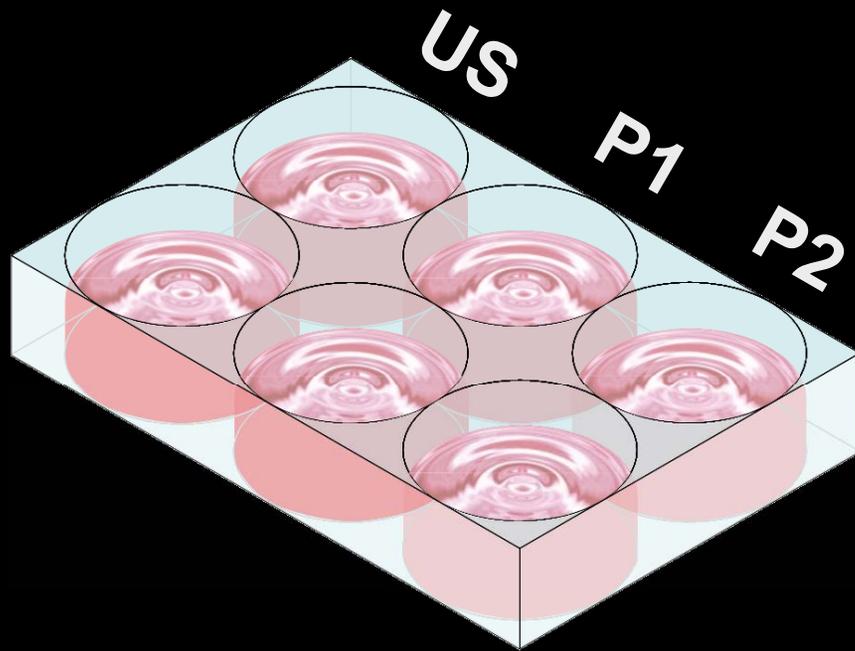
Cell Proliferation with US Application



Limitations

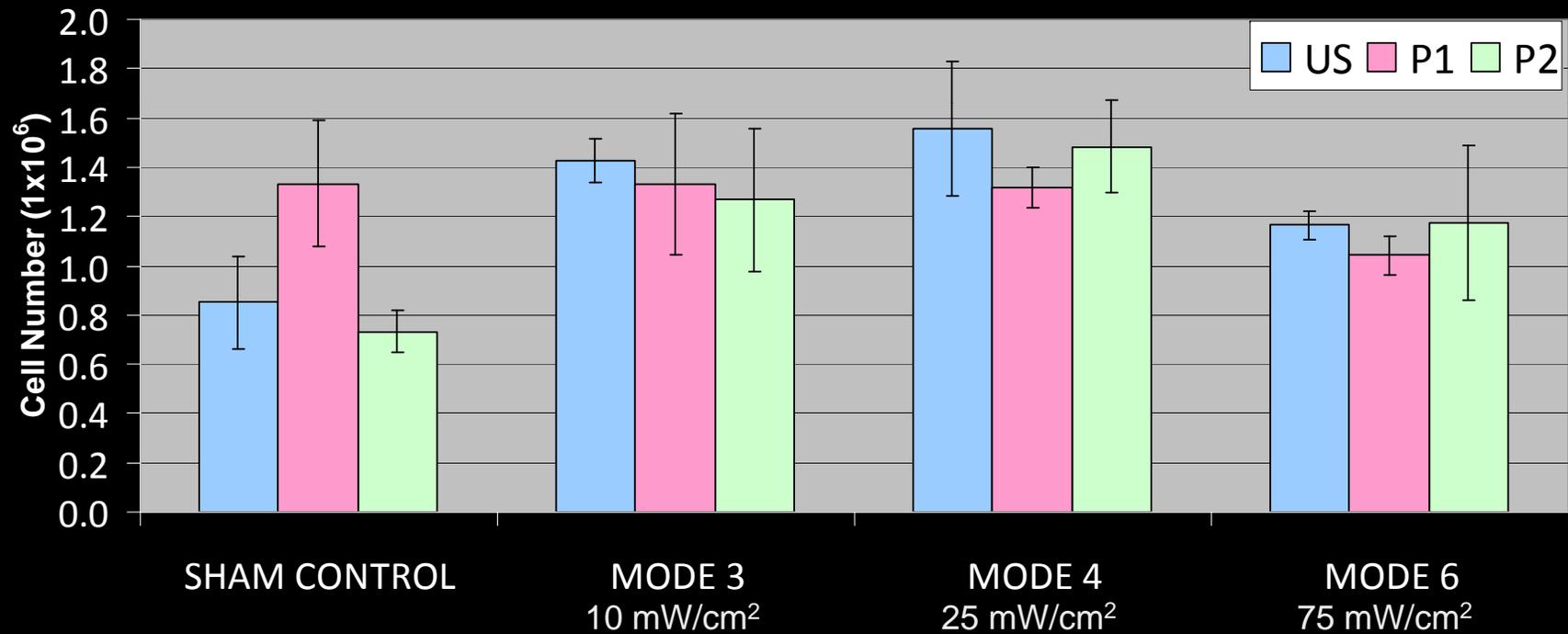
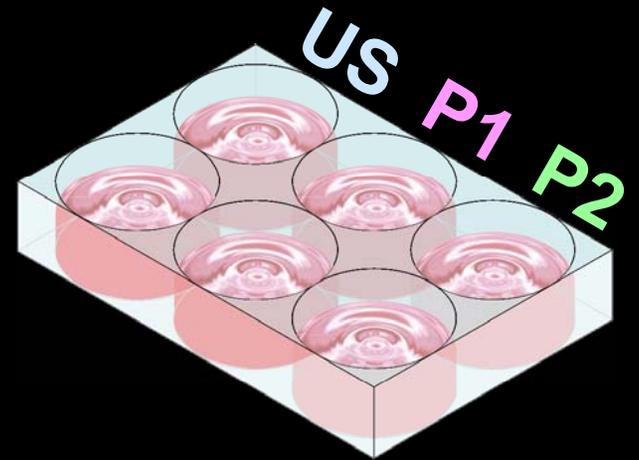
- **US transfer in multi-well culture plates**
- **Standing waves**
- **Temperature changes**

US Transference

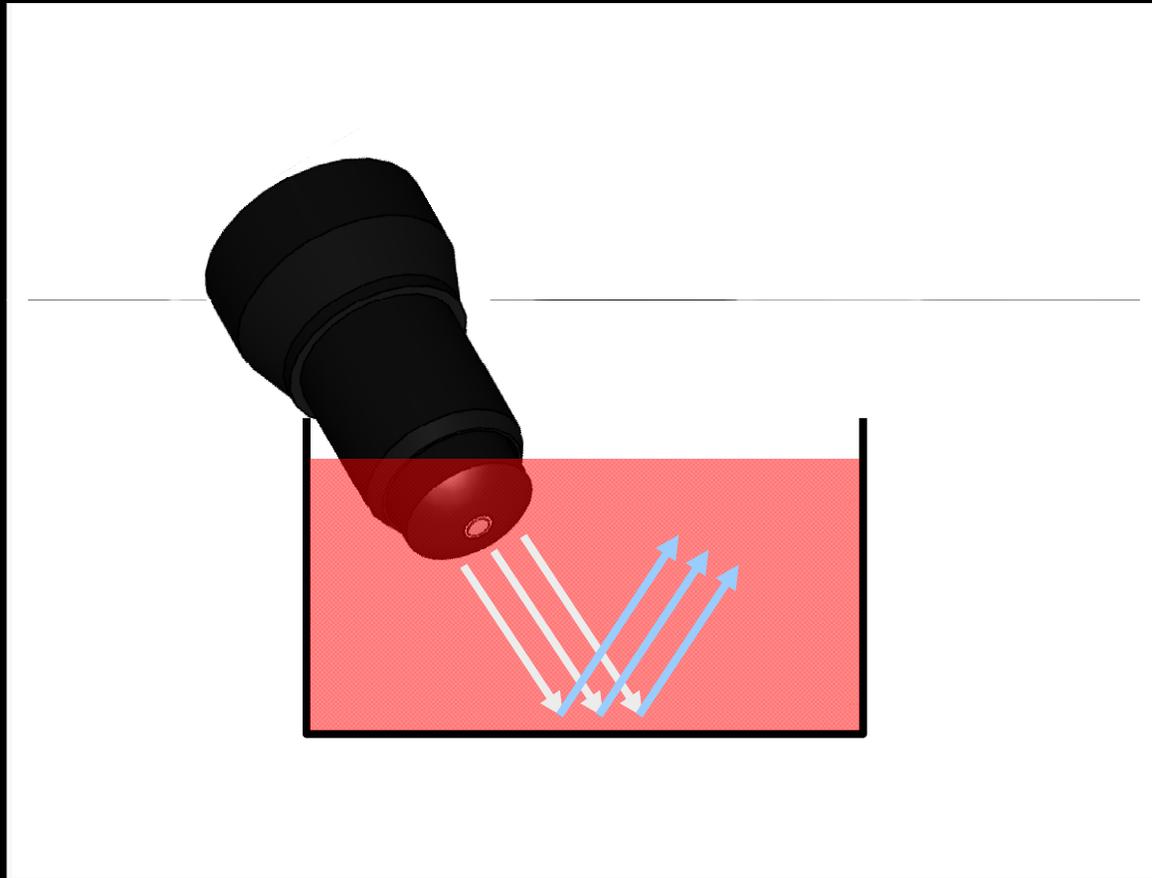


UNIVERSITY OF
BIRMINGHAM

US Transference

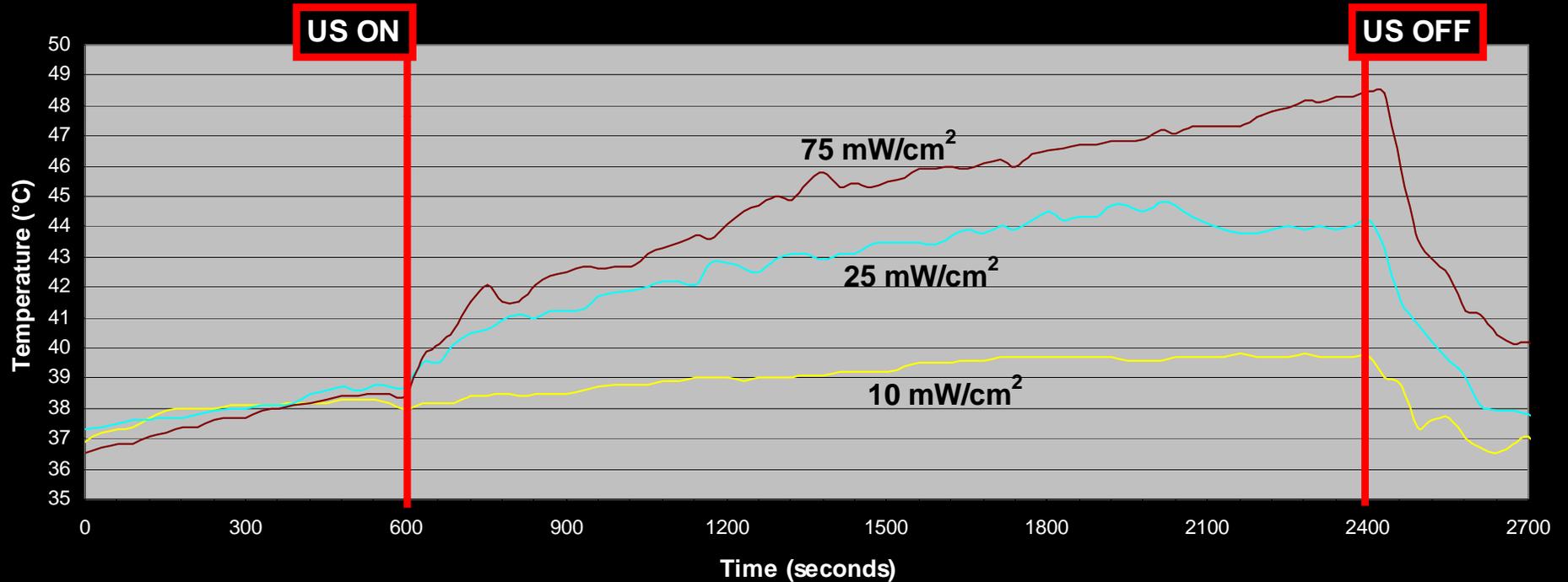


Standing Waves



Temperature Changes

US Effect on Temperature in Culture Medium (30 second intervals)



Conclusions

- **Set-up described shows a positive affect**
- **Can be used for future in vitro experiments**
- **Further development is required**

Thank you for listening

UNIVERSITY OF
BIRMINGHAM