
DETECTION OF EARLY RADIATION DAMAGE TO THE EYE-LENS OF RAINBOW TROUT

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INTRODUCTION & BACKGROUND

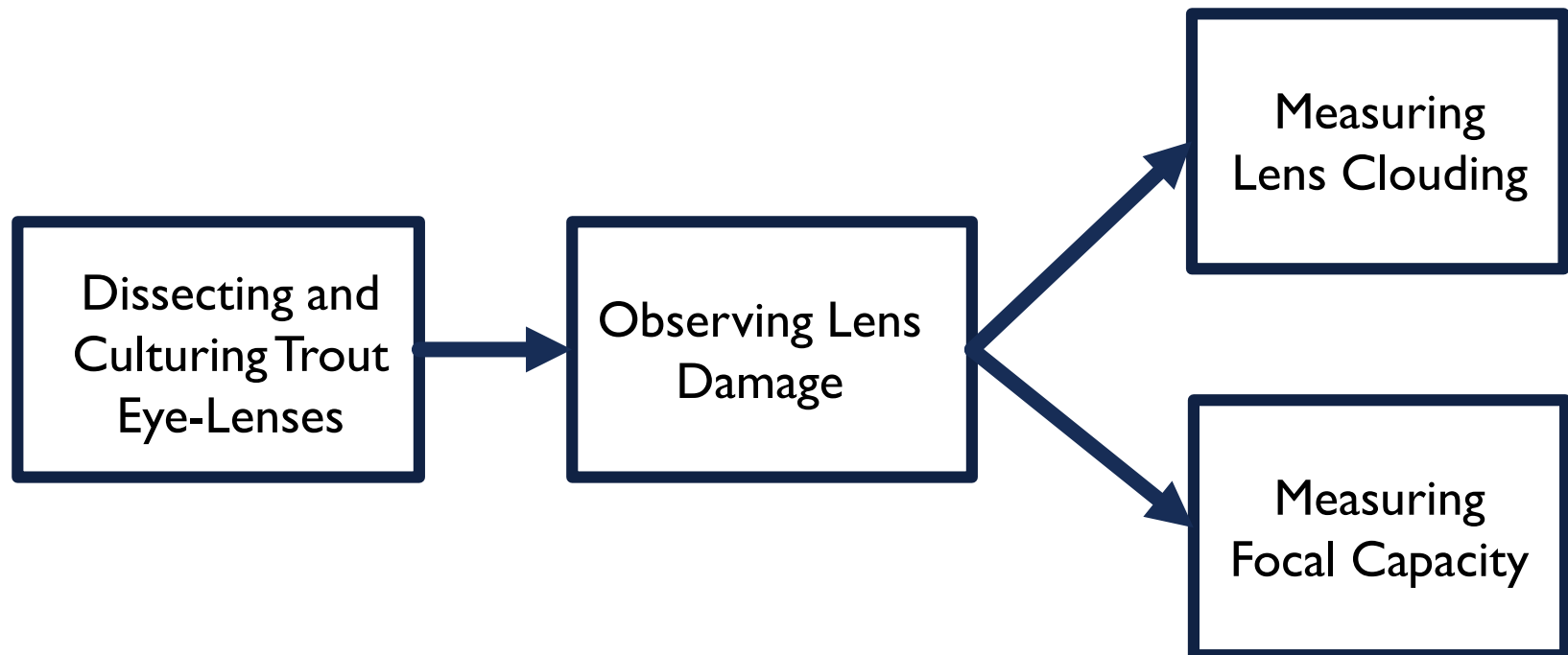
Recent interests of regulatory bodies

- *The CNSC intends to lower the eye-lens dose limit*
- *The ICRP emphasizes the importance of protecting the environment and non-human biota ²*

The intersection of these topics is the study of radiation effects on animal eye-lenses – with possible crossover to better understanding radiation effects in human eye lenses.

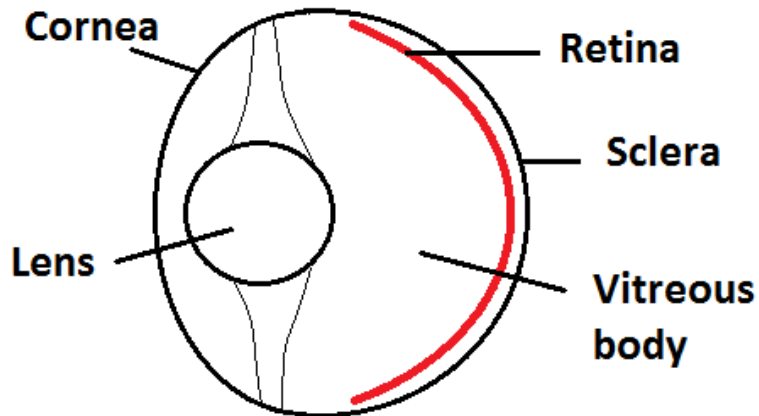
[2] ICRP, 2007. The 2007 Recommendations of the International Commission on Radiological Protection. ICRP Publication 103. Ann. ICRP 37 (2-4).

METHODOLOGY OVERVIEW

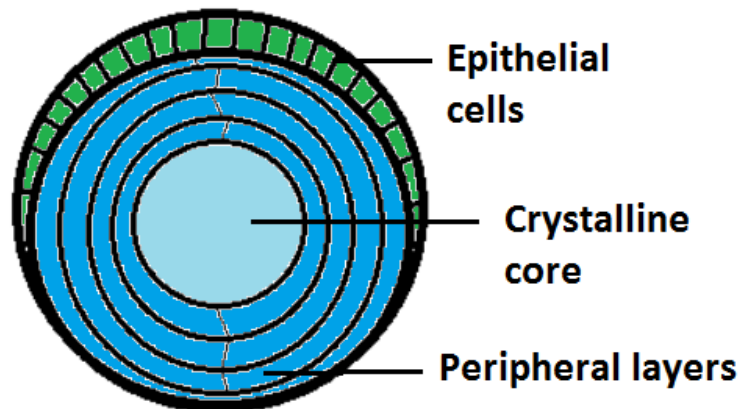


METHODOLOGY

STRUCTURE OF A FISH EYE & LENS



Structure of a fish eye



Structure of a fish eye lens:

- Regularly dividing epithelial cells
- Migration towards centre
- Crystallization at core

METHODOLOGY

DISSECTION & CULTURING

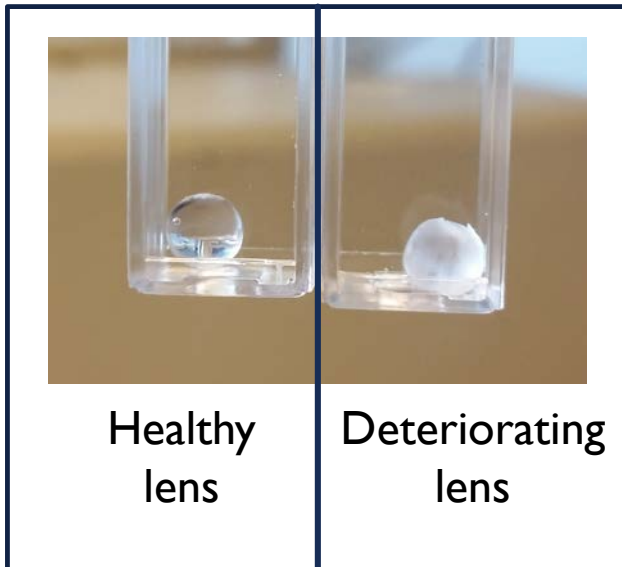
1. Eyeballs removed from head
2. Sclera cut around equator
3. Contents of sclera removed
4. Lens separated from vitreous body



METHODOLOGY

MEASURING LENS CLOUDING

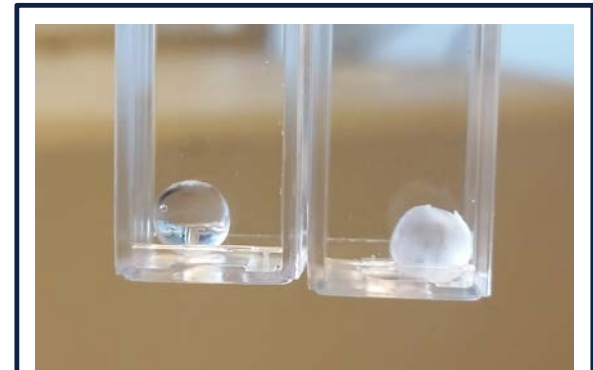
- The first obvious sign of lens damage was slight clouding or “haziness”
- This was measured quantitatively using a spectrophotometer
- Spectrophotometry measures light transmittance



RESULTS

MEASURING LENS CLOUDING

- Differences in transmittance are too slight to use for precise damage analysis
- However, this suggests that the clouding is thin and confined to the epithelium
- This was confirmed by dissecting the lens



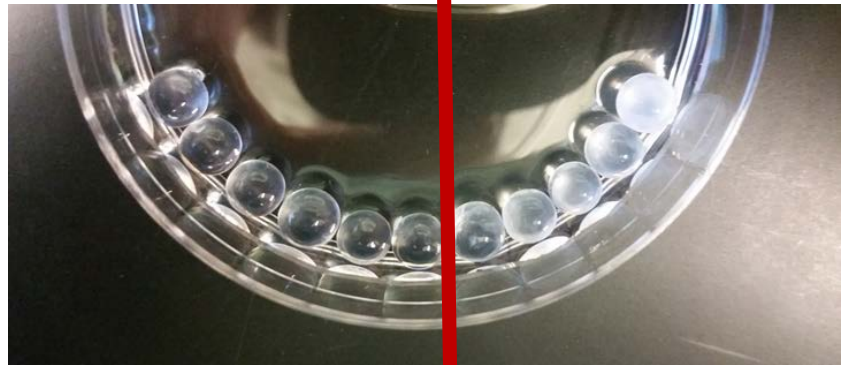
These lenses have a
transmittance
difference of ~2%

RESULTS

MEASURING LENS CLOUDING

Evidence of damage recovery was observed following an extended power outage:

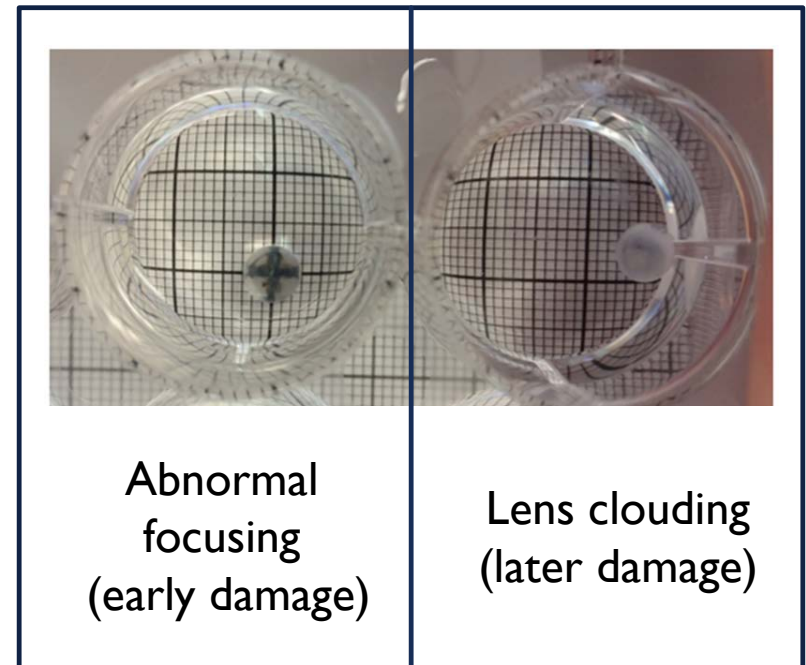
- Lenses became hazy after cooling was interrupted
- Some lenses became transparent again after cooling was restored



RESULTS

MEASURING LENS CLOUDING

- Lenses begin to show irregular focusing before the onset of clouding
- Are changes in focusing ability a better indicator of early lens damage?

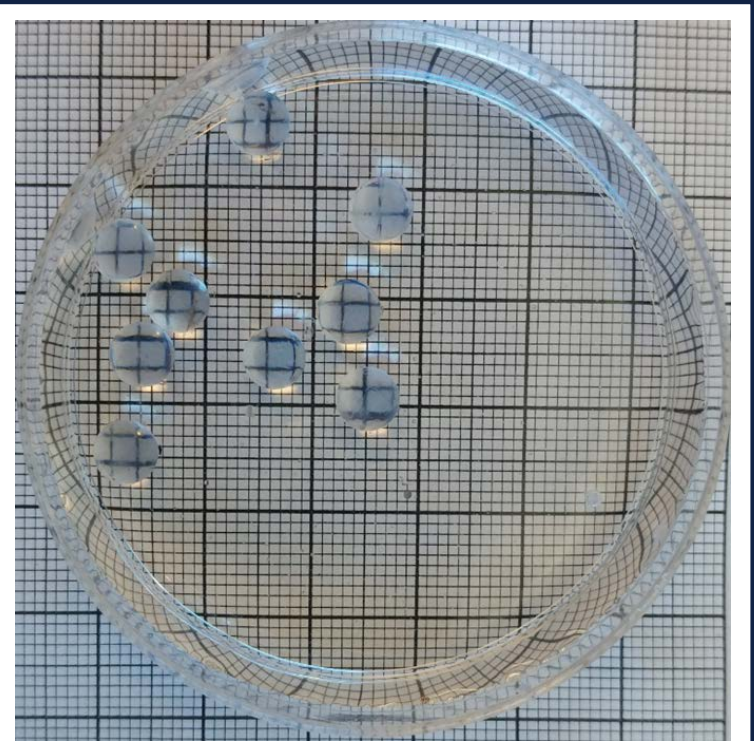


METHODOLOGY

MEASURING FOCAL CAPACITY

- Lenses begin culture with near-perfect focusing ability
- Focal damage (pre-existing or from dissection) is barely perceptible

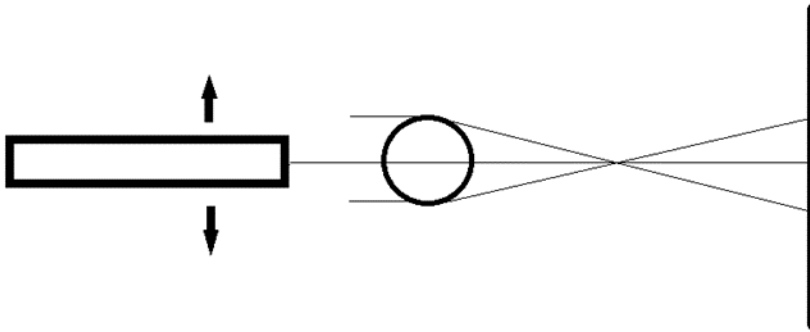
Goal: To design and build a system to measure slight changes in focal capacity



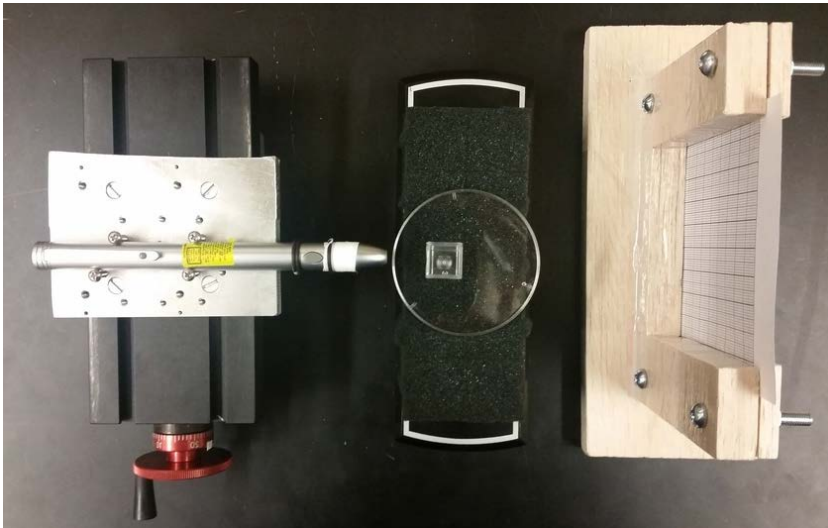
Lenses on millimeter-grid paper

METHODOLOGY

MEASURING FOCAL CAPACITY



1. Move laser in steps across the width of the lens
2. Note laser spot position on the screen at each step
3. Find the intersection of all beams

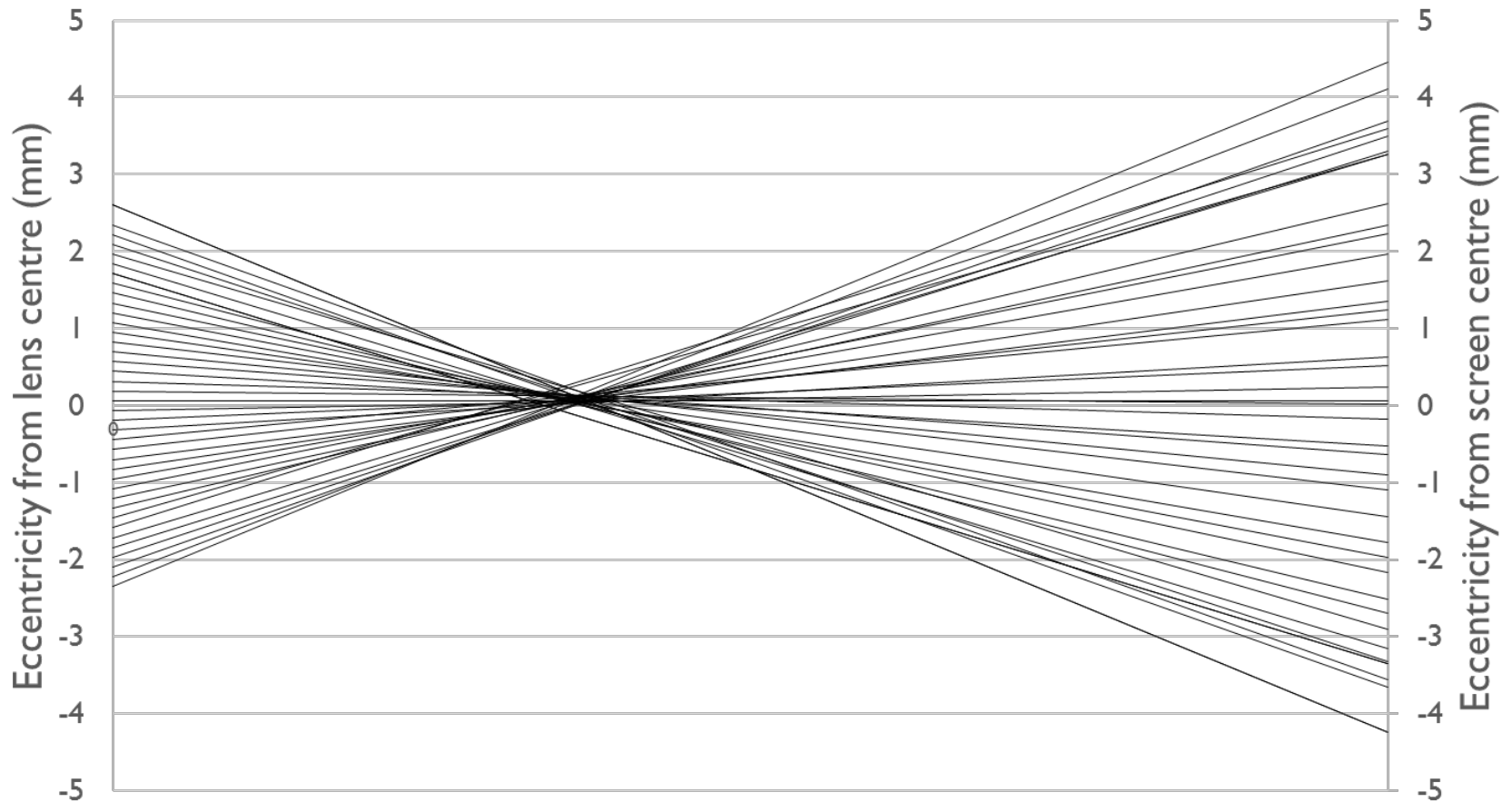


Dimensions

- Lens diameter 5mm
- Laser beam width 0.15mm

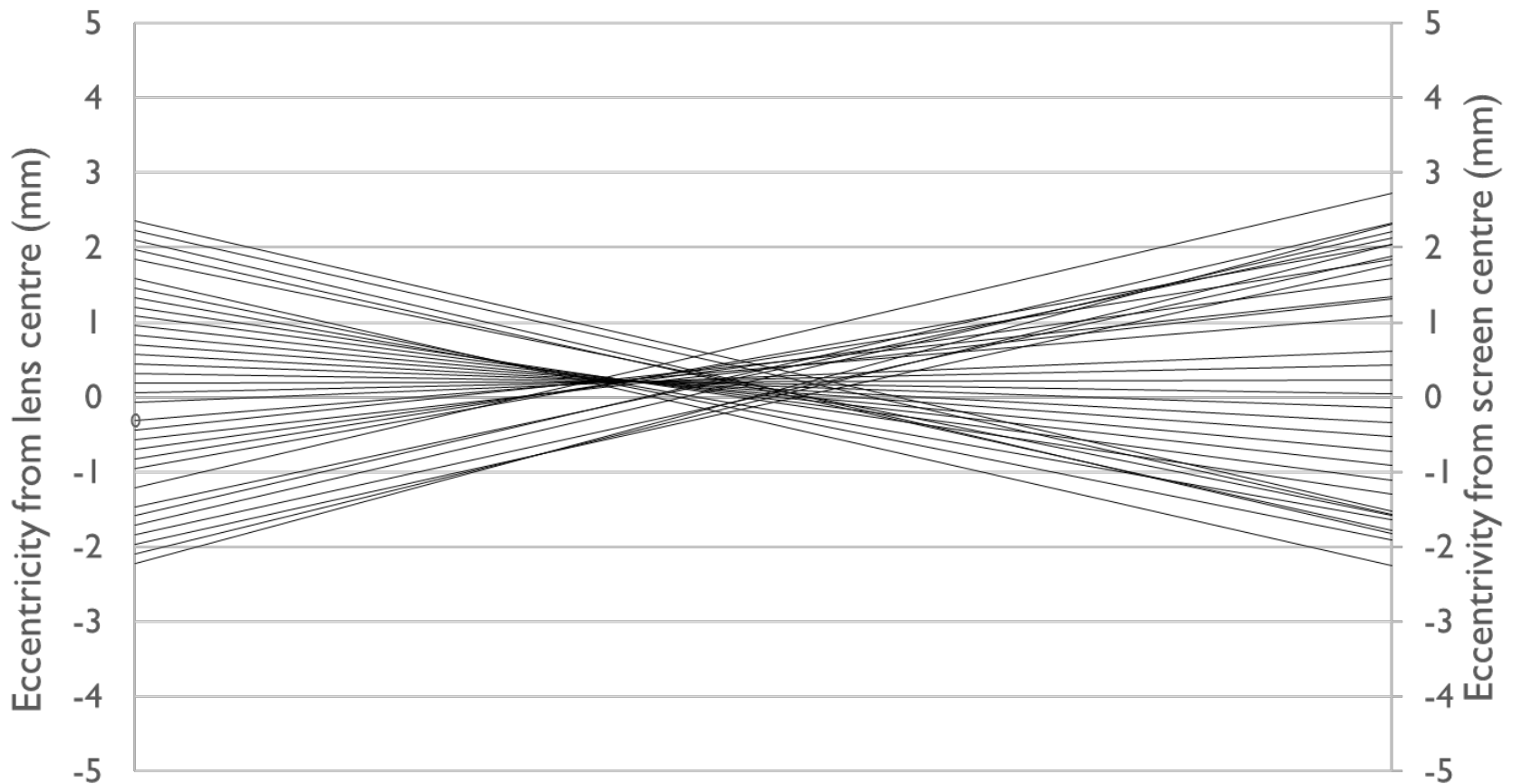
RESULTS

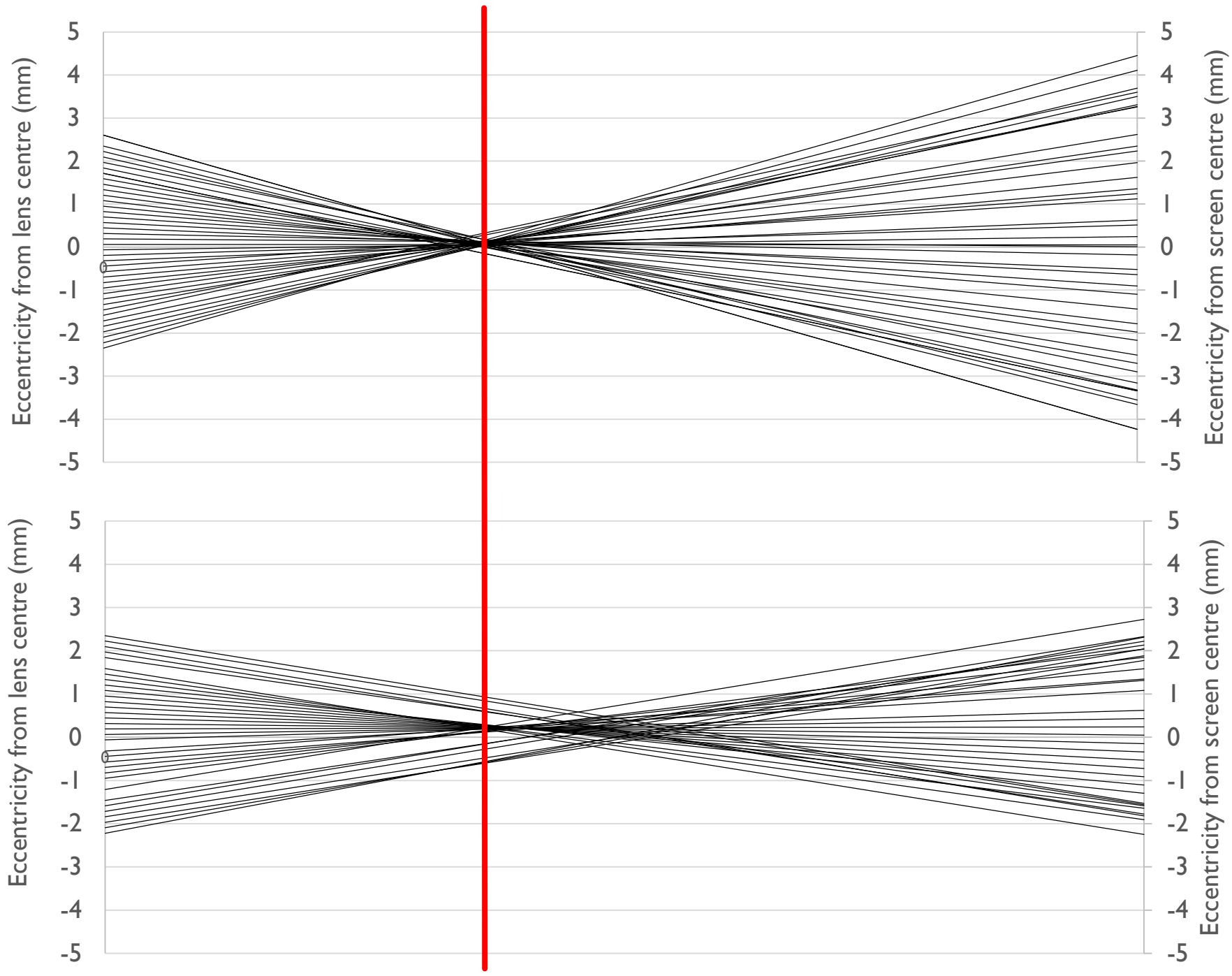
LASER FOCAL ANALYSIS – DAY 1



RESULTS

LASER FOCAL ANALYSIS – DAY 8

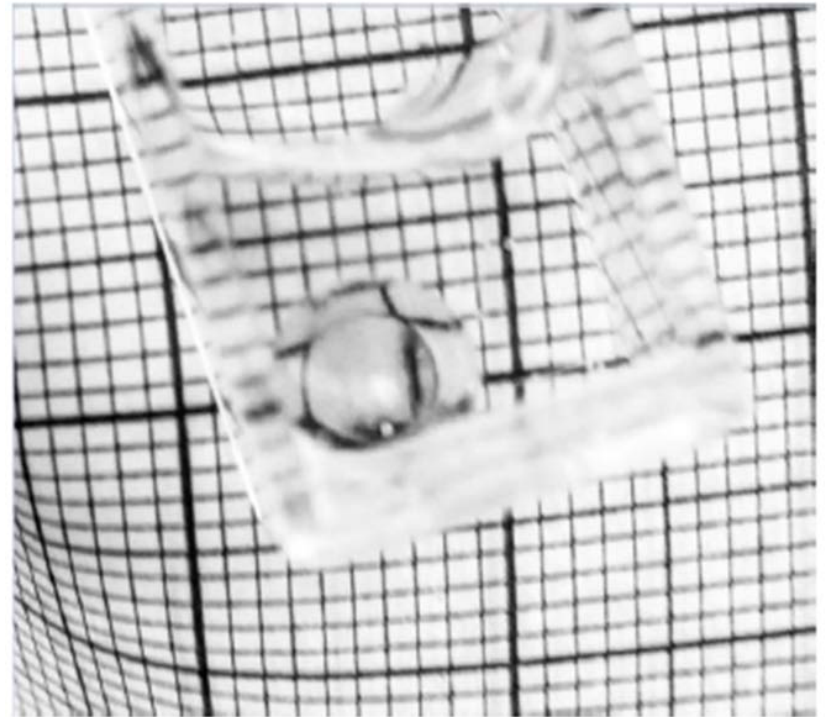




DISCUSSION

LASER FOCAL ANALYSIS

- This lens shows what these variations in focal length look like in terms of lens condition
- There is a clear separation between the lens core and periphery
- This matches the separation seen in the laser focal analysis



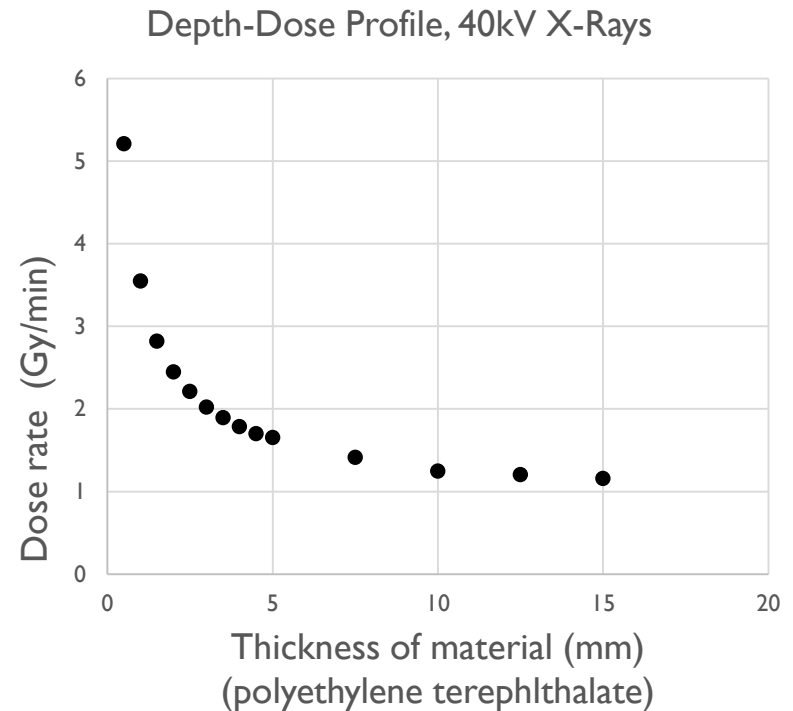
CONCLUSIONS

- Fish eye lenses can be excised and cultured to monitor optical quality
- Damage to lenses presents as changes in refractive index in the periphery, followed by the onset of haziness in the epithelium
- A basic laser scanning system has been developed to measure very slight changes in refractive index across the lens
- This scanning system is suitable for future work in monitoring lens damage as a result of exposure to ionizing radiation

FUTURE WORK

MEASURING DAMAGE CAUSED BY IRRADIATION

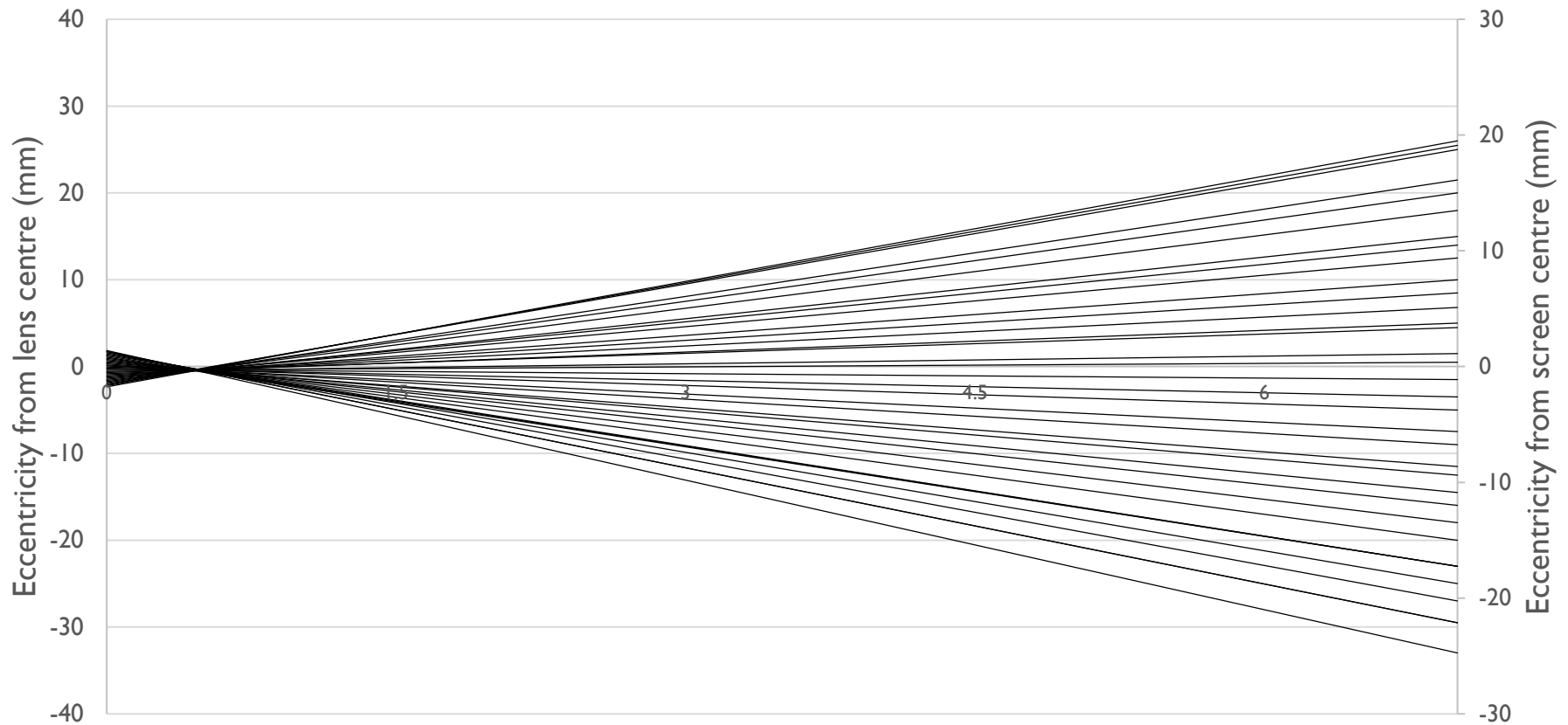
- A depth-dose profile for 40kV x-rays was been measured for the lens thickness
- Preliminary run:
 - 2 lenses irradiated to ~1 Gy at the core
 - 2 lenses control



FUTURE WORK

MEASURING DAMAGE CAUSED BY IRRADIATION

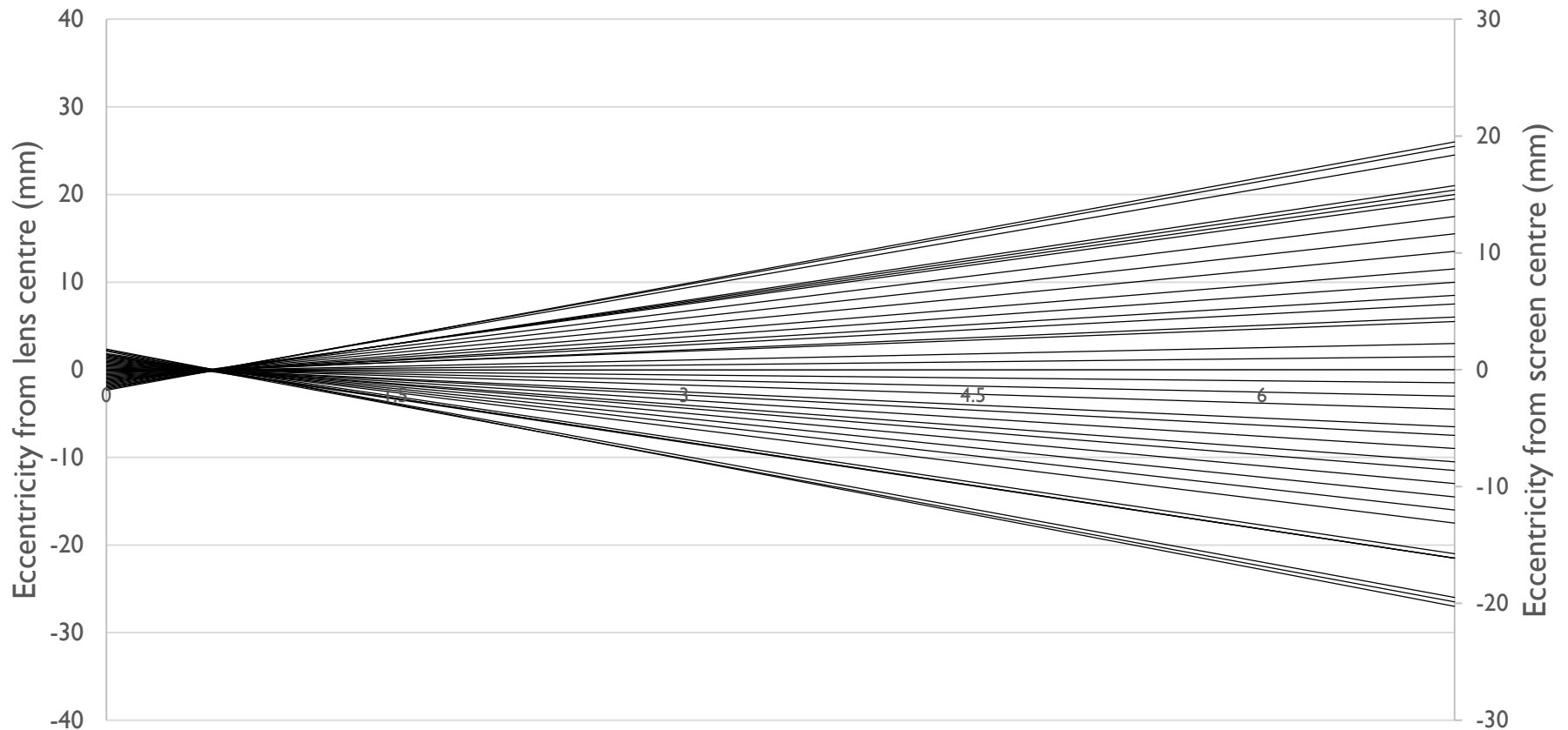
Focal Analysis Lens I (pre-irradiation)



FUTURE WORK

MEASURING DAMAGE CAUSED BY IRRADIATION

Focal Analysis Lens I (24 h post-irradiation)





THANK YOU

QUESTIONS?

