

BUILDING SMART MICROSCOPES

CHAS NELSON

WHY?



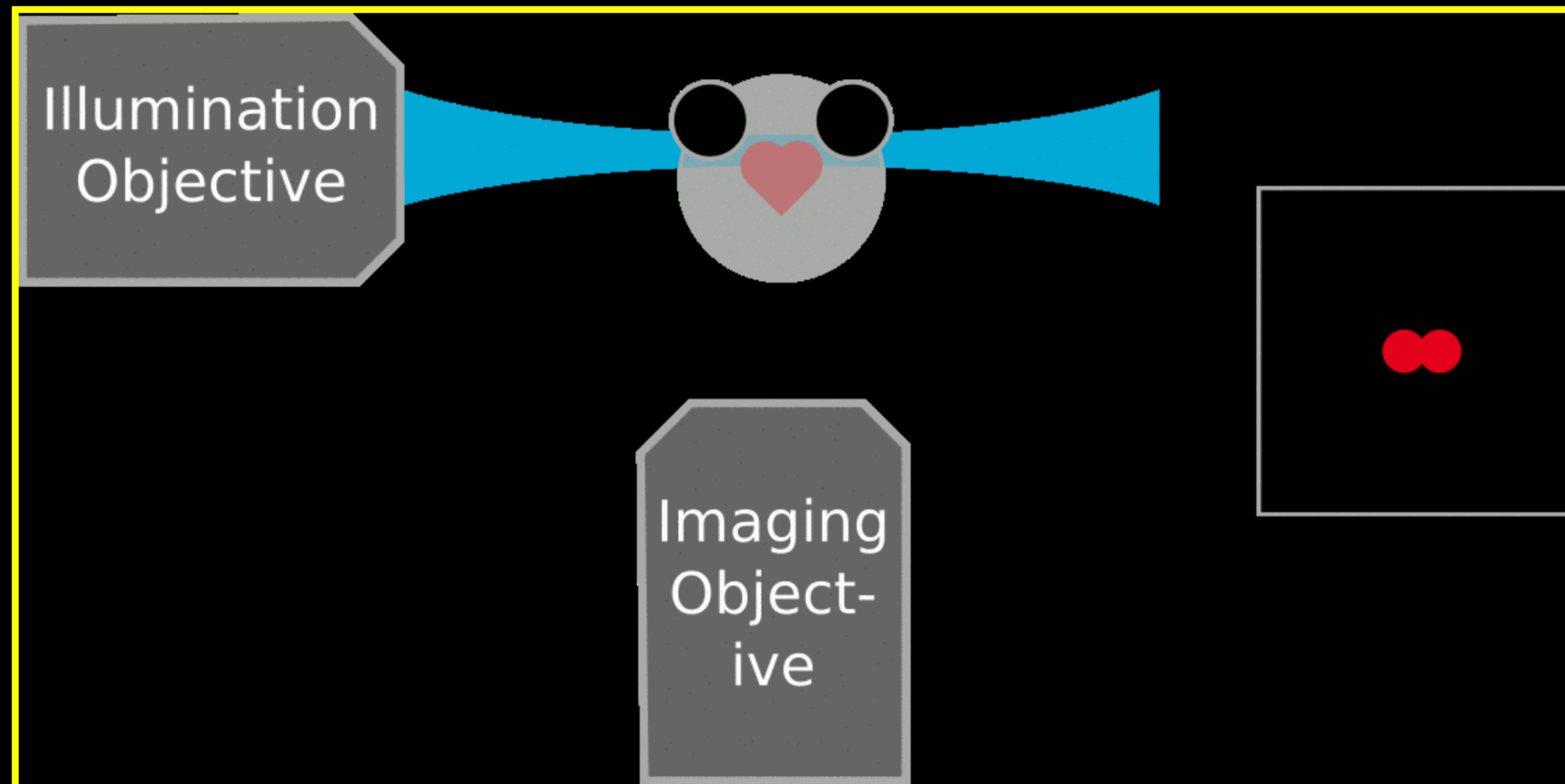
**Mending
broken
hearts
appeal**

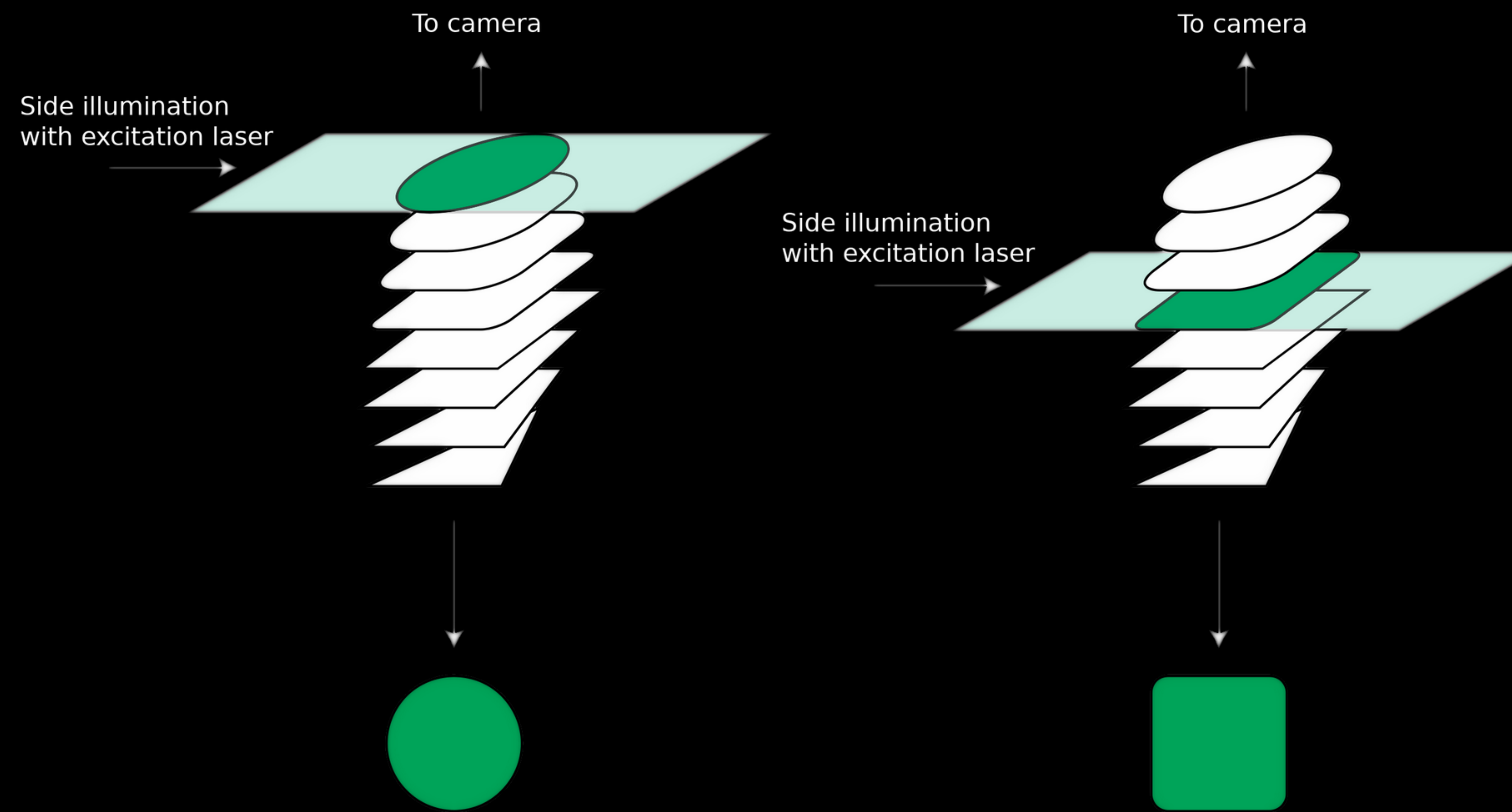
HOW?

LIGHT SHEET FLUORESCENCE MICROSCOPY

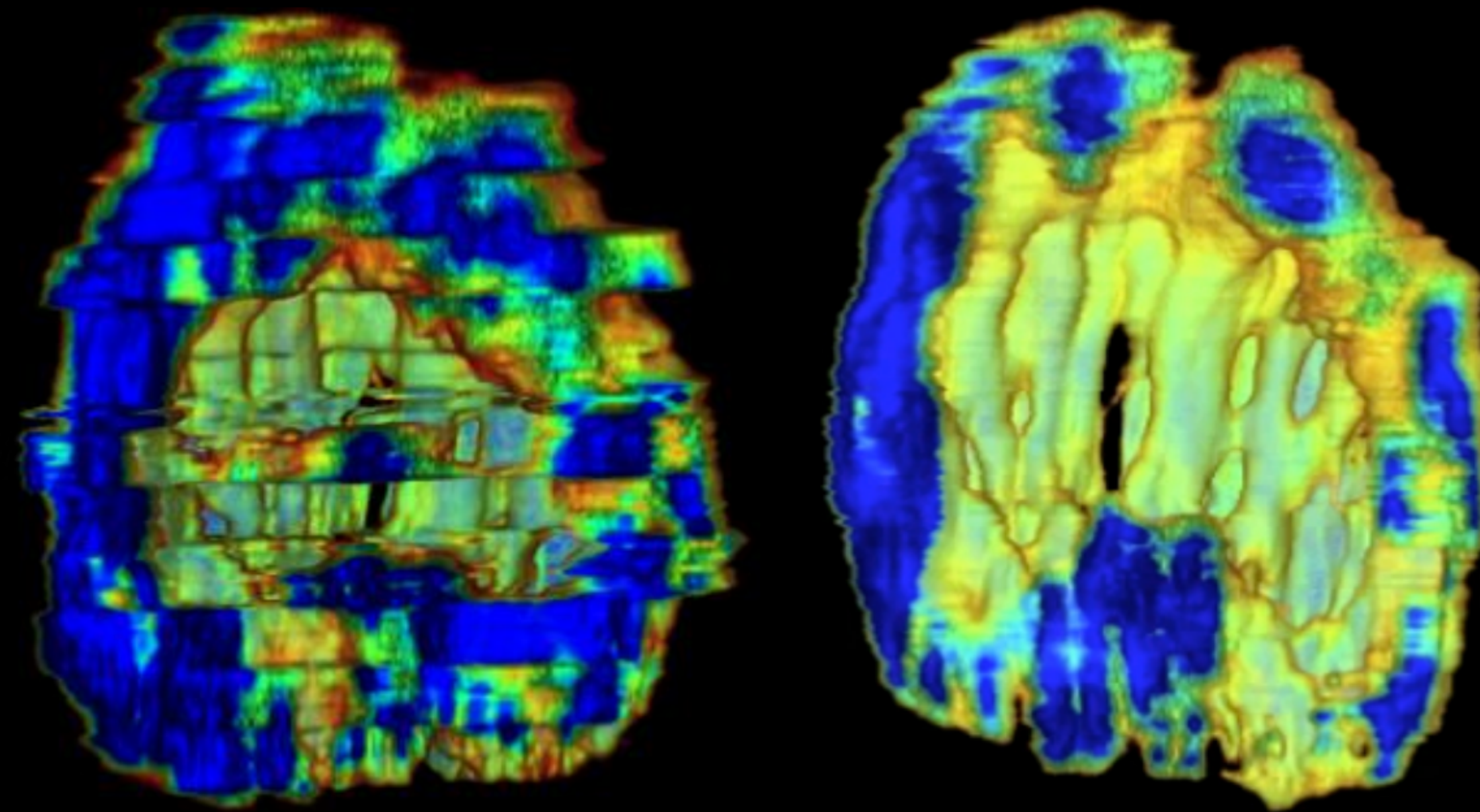








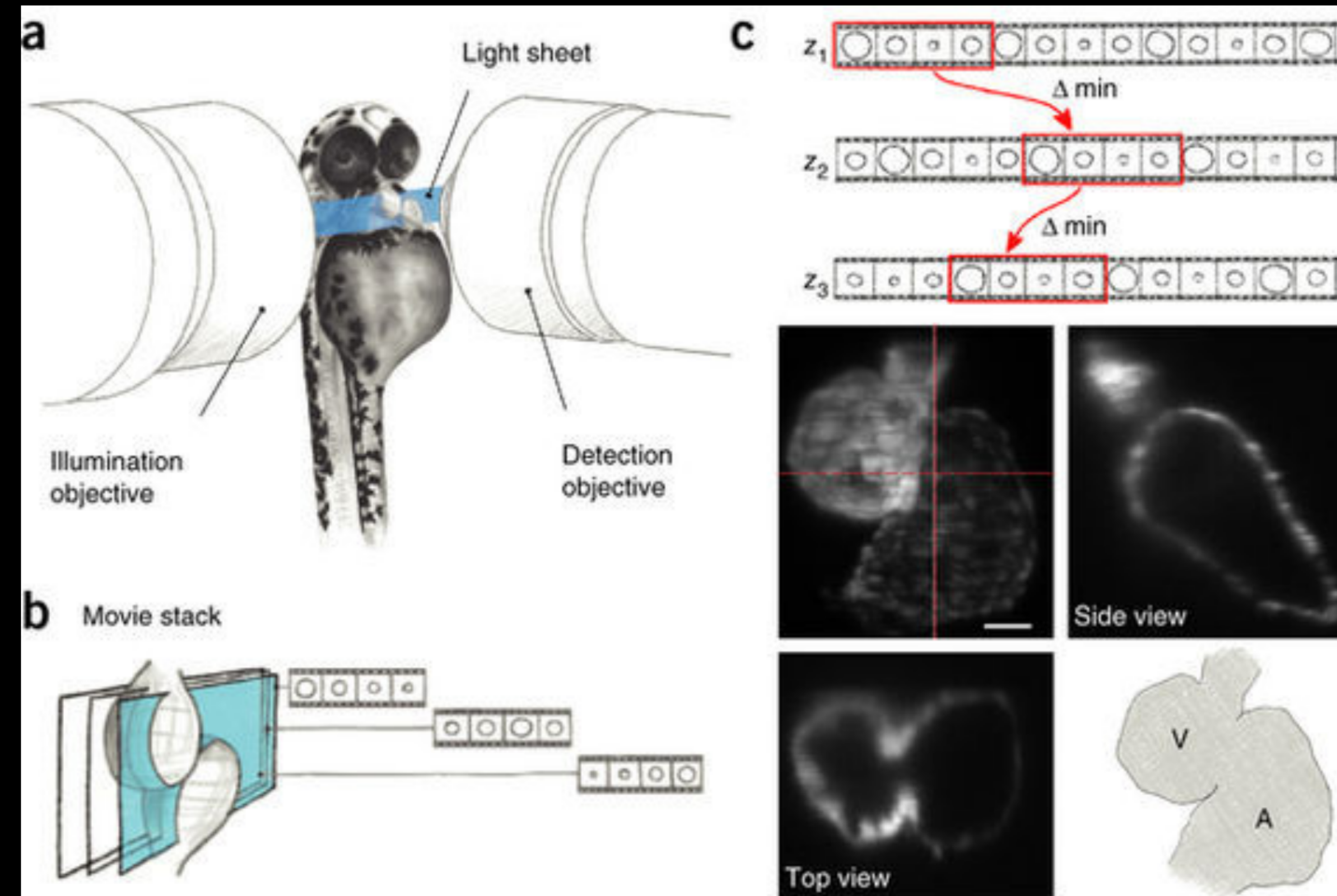
Taylor *et al.* Proc. of SPIE (2012)



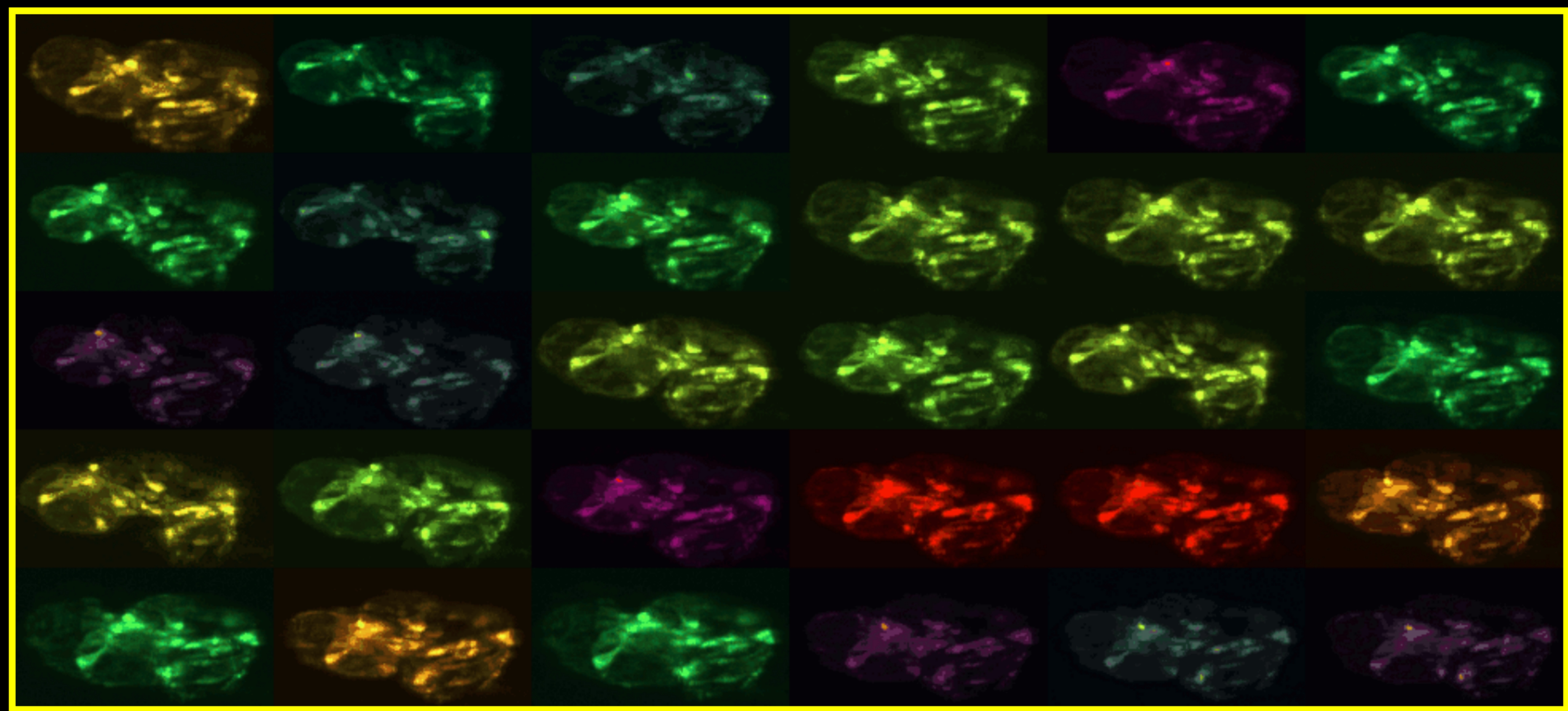
Taylor *et al.* J. of Biomedical Optics (2011)

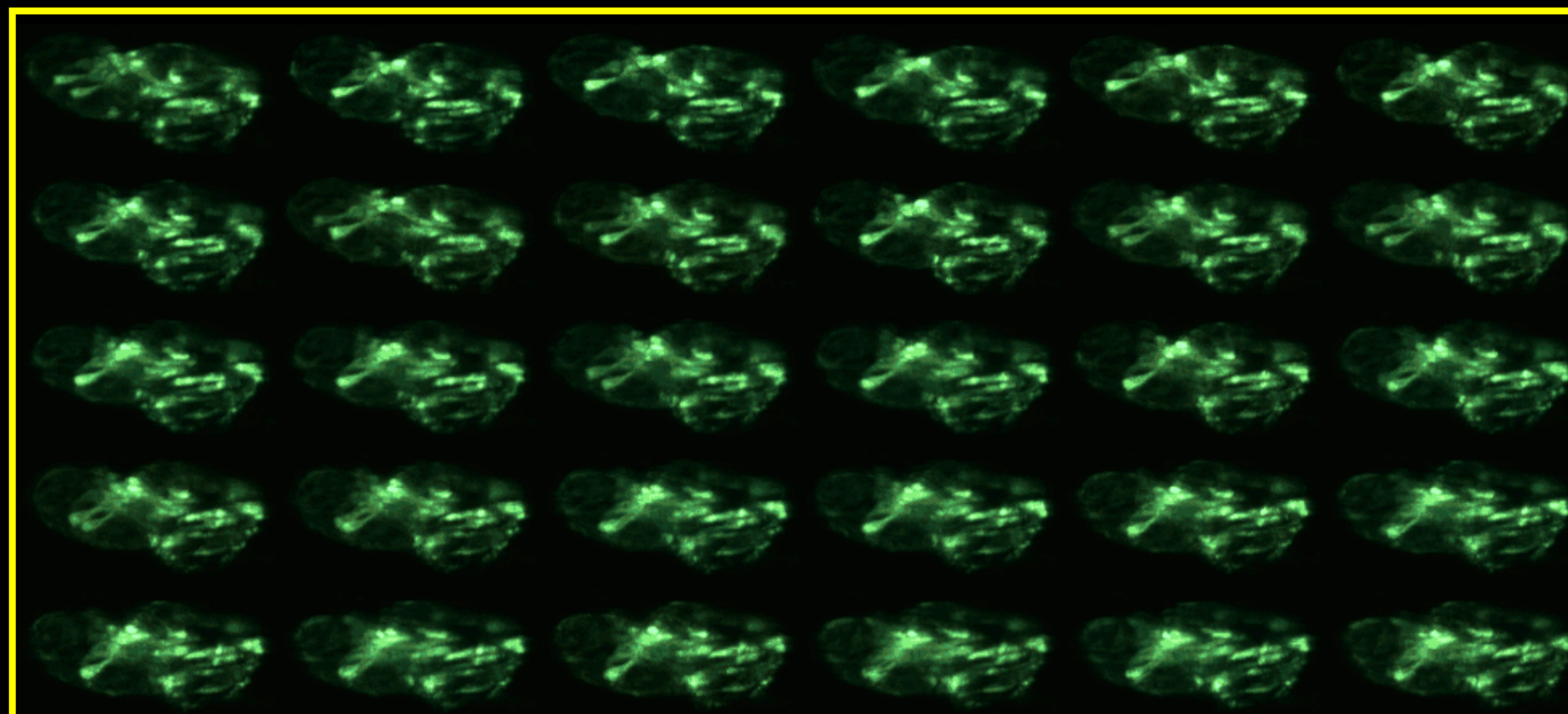
RETROSPECTIVE OPTICAL GATING

Liebling *et al.* IEEE ISBI (2006)



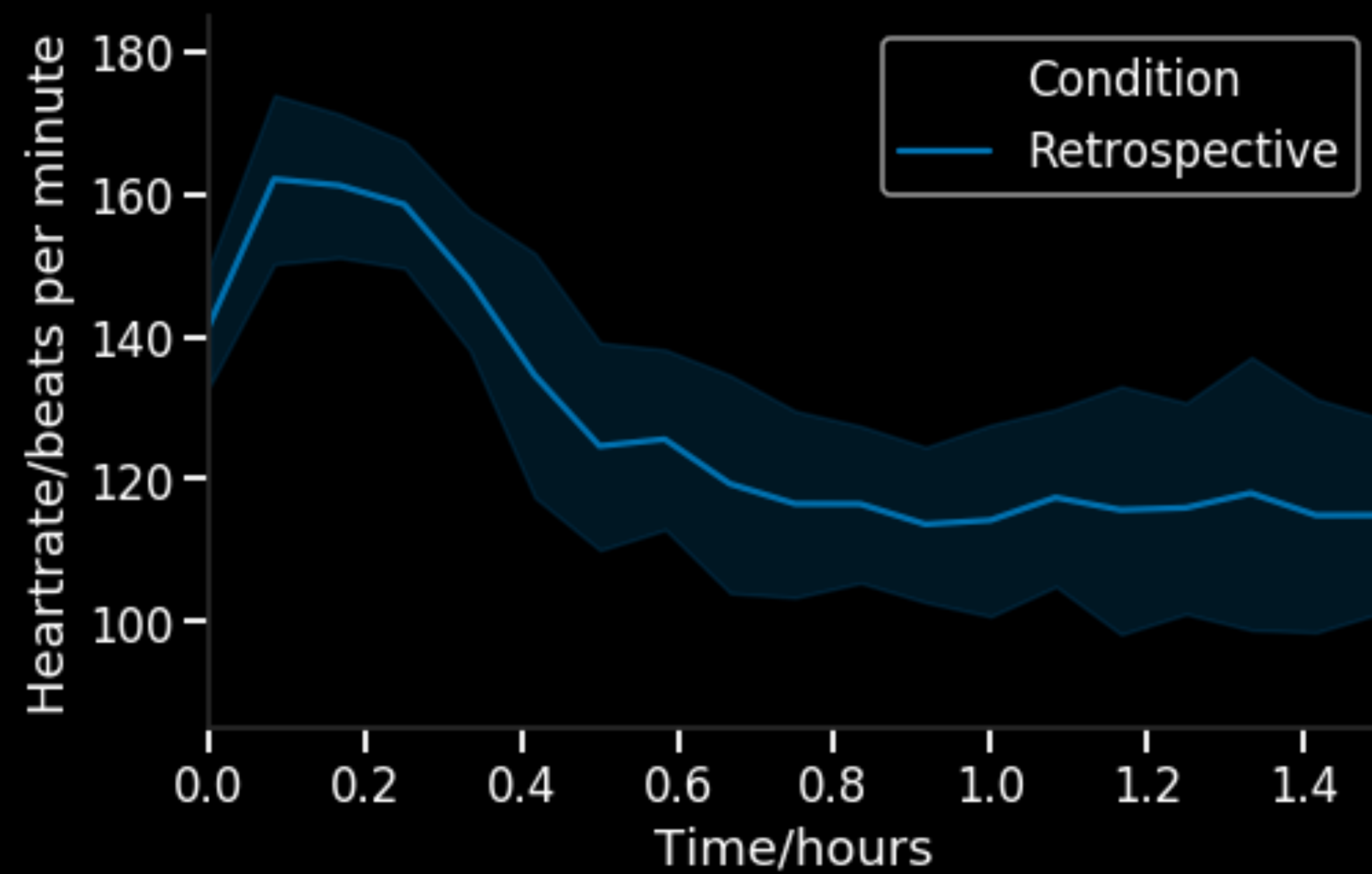
Mickoleit *et al.* Nature (2014)







Your zebrafish ran into a problem that
it couldn't handle.

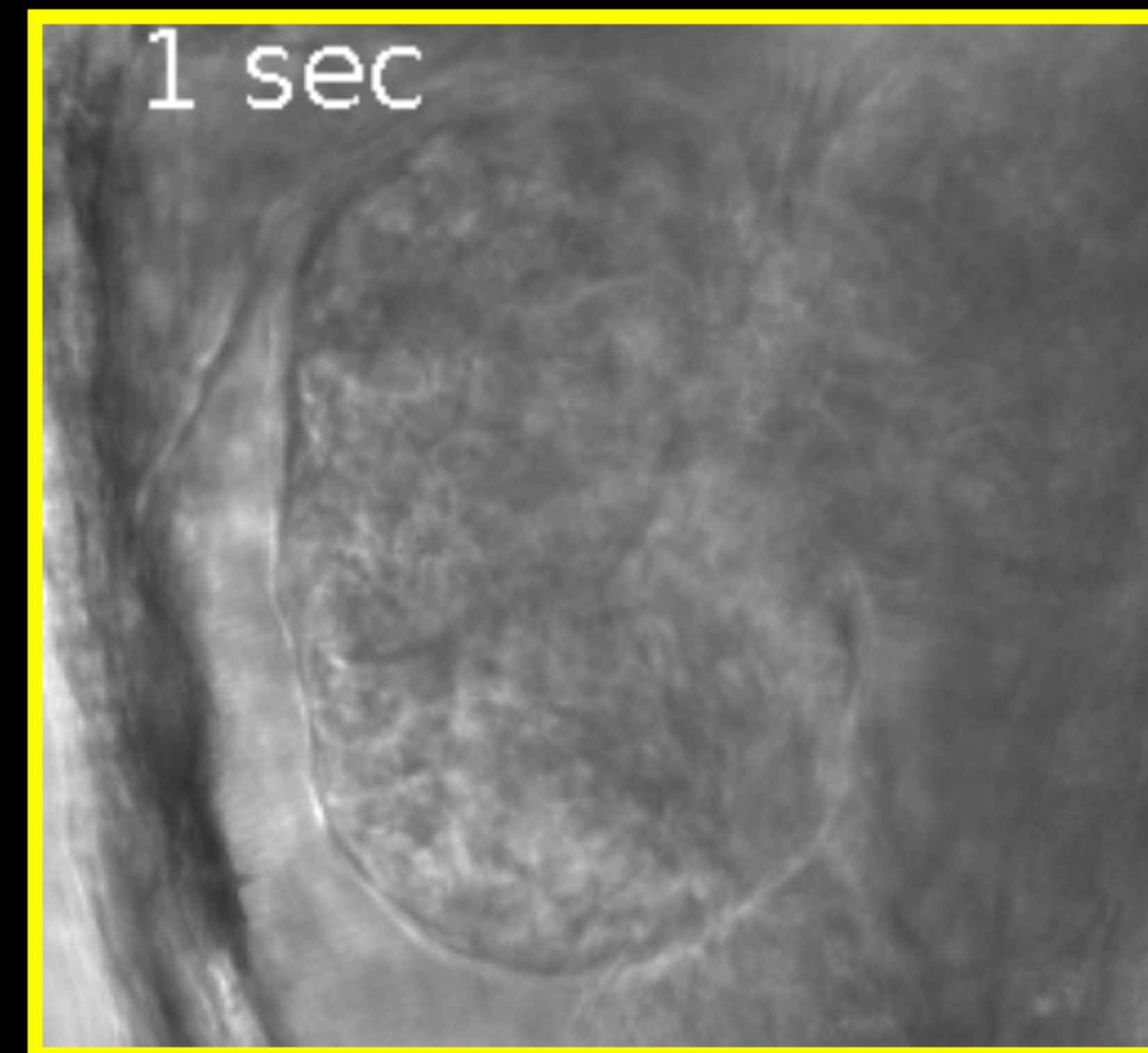


**A SMART MICROSCOPE
FOR IMAGING THE BEATING HEART
WITHOUT BREAKING IT**

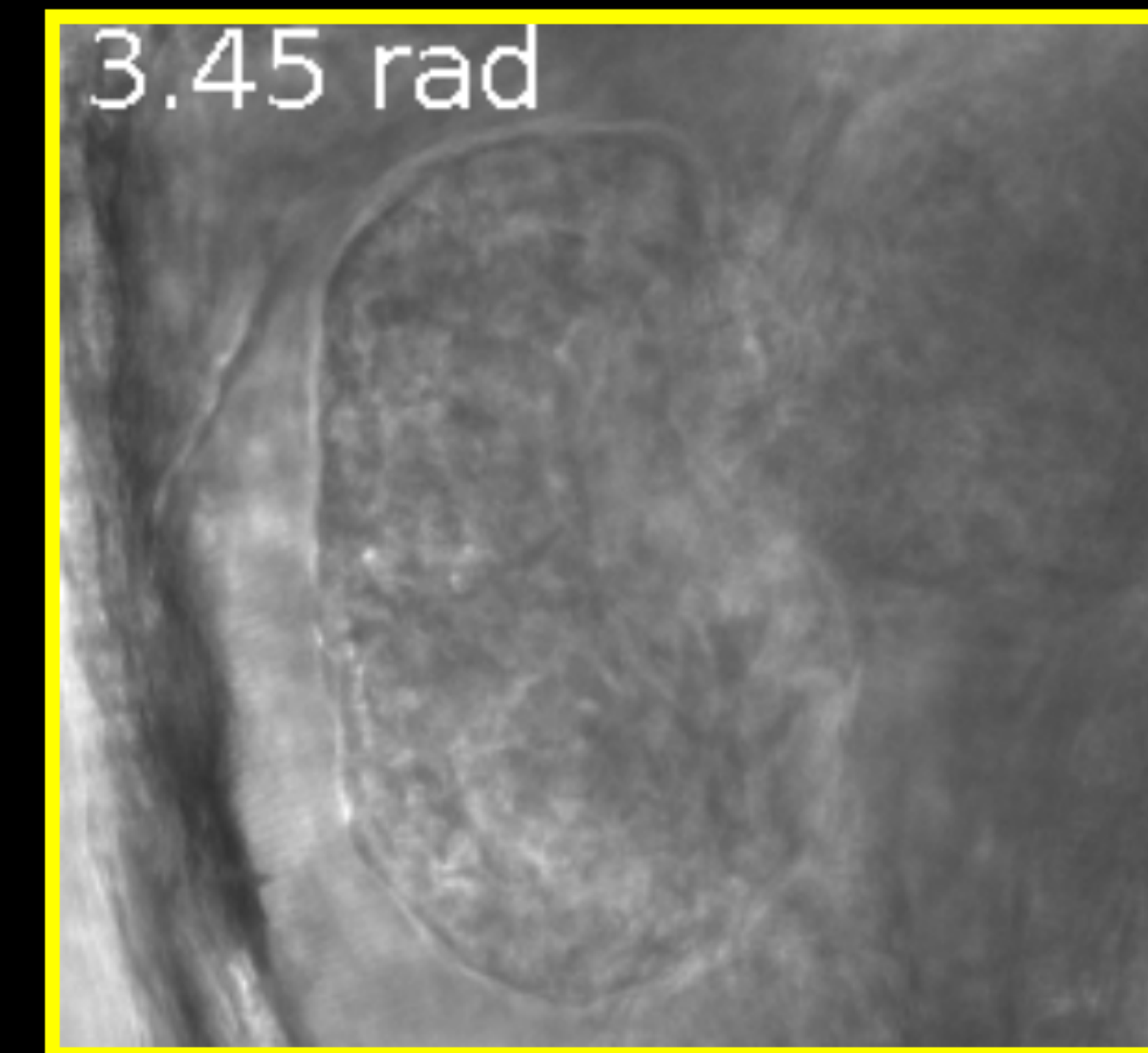
REAL-TIME PROSPECTIVE OPTICAL GATING

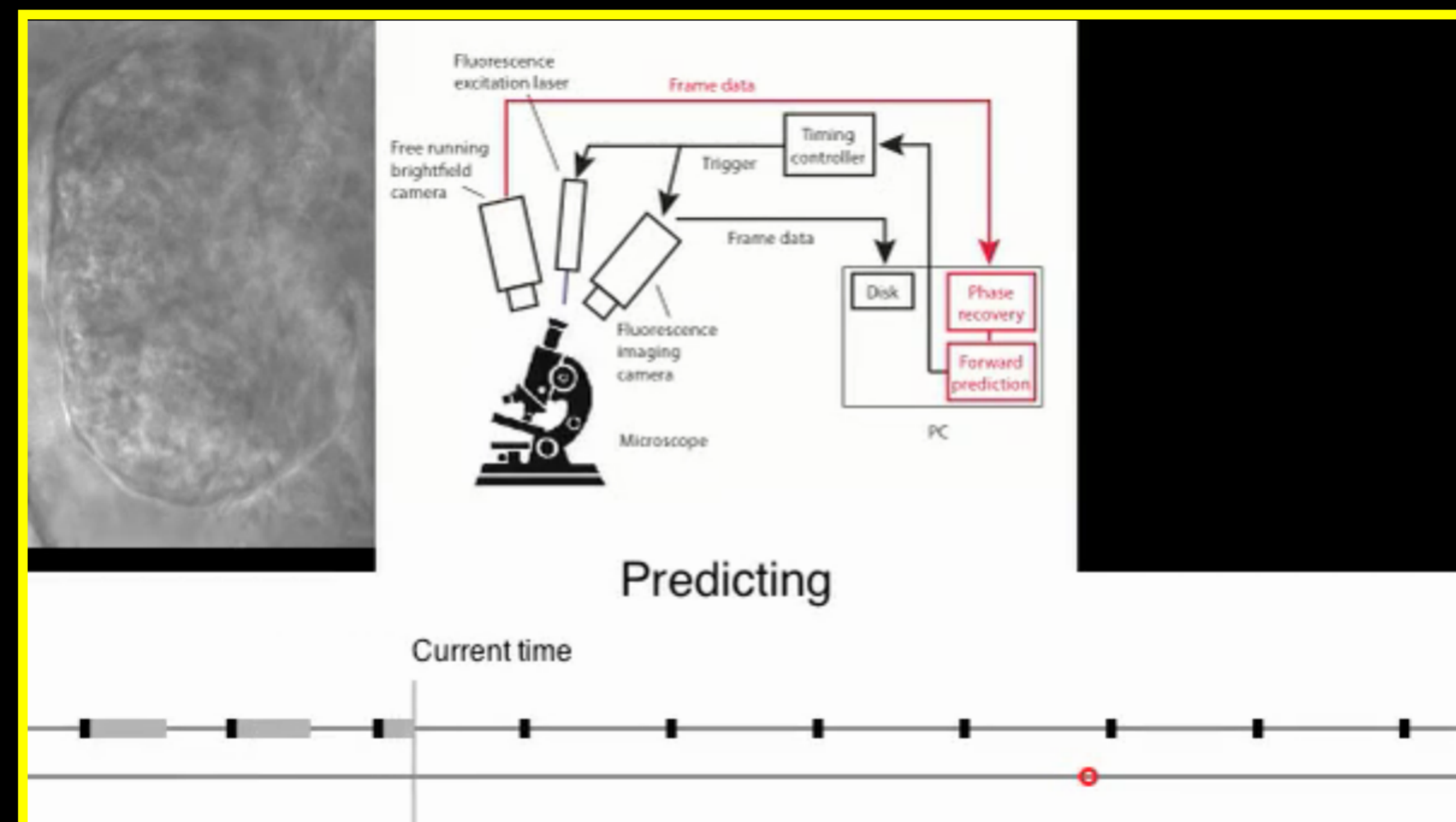
Taylor *et al.* J. of Biomedical Optics (2011)

Brightfield Stream

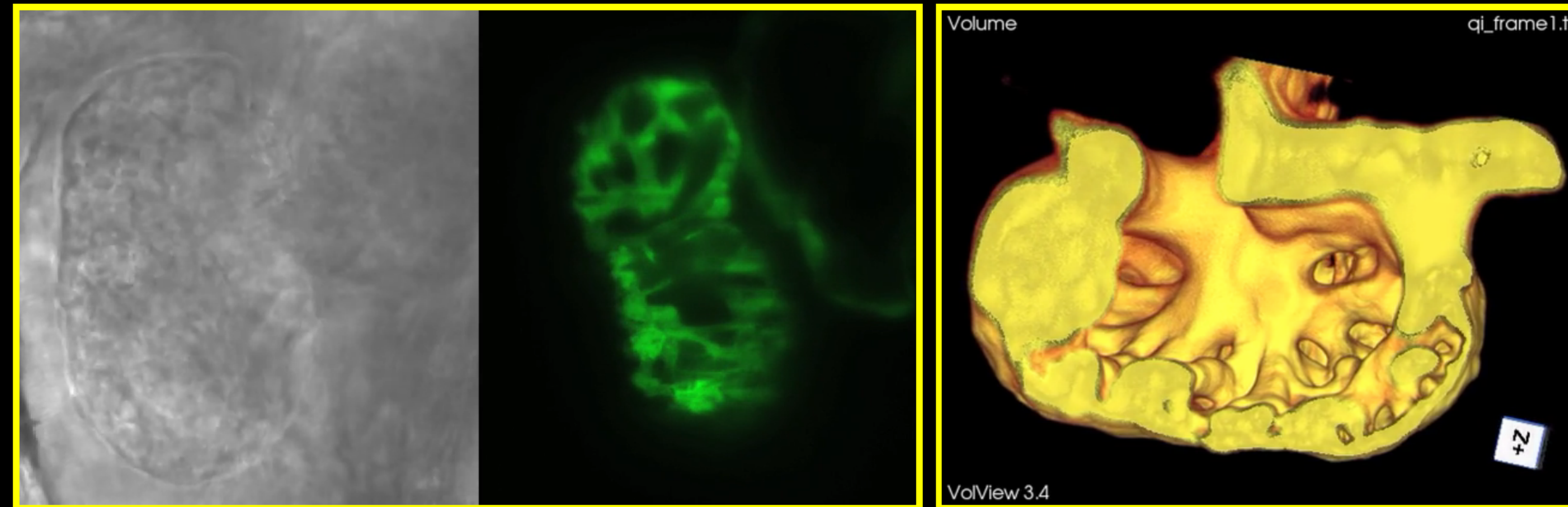


Reference Heartbeat





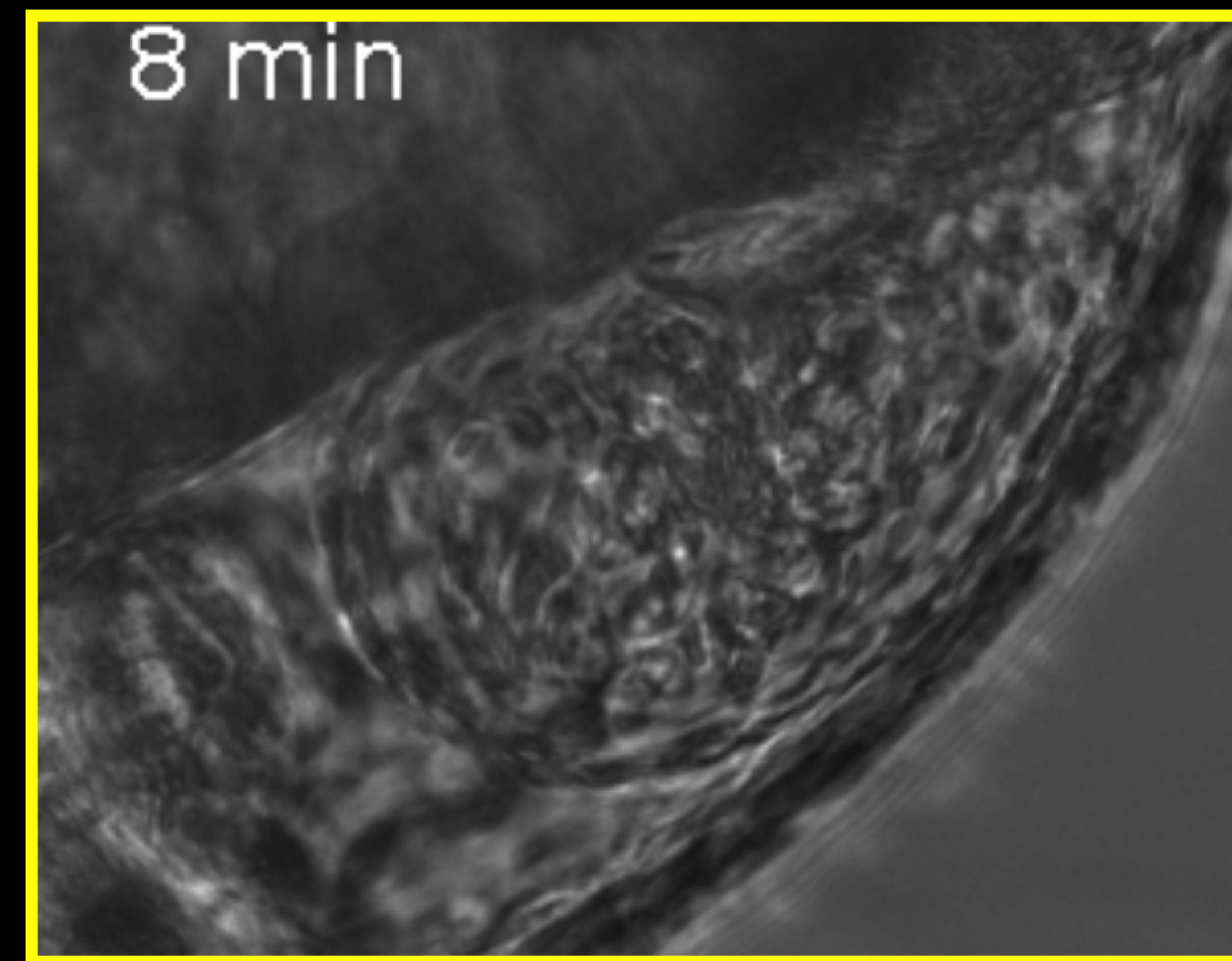
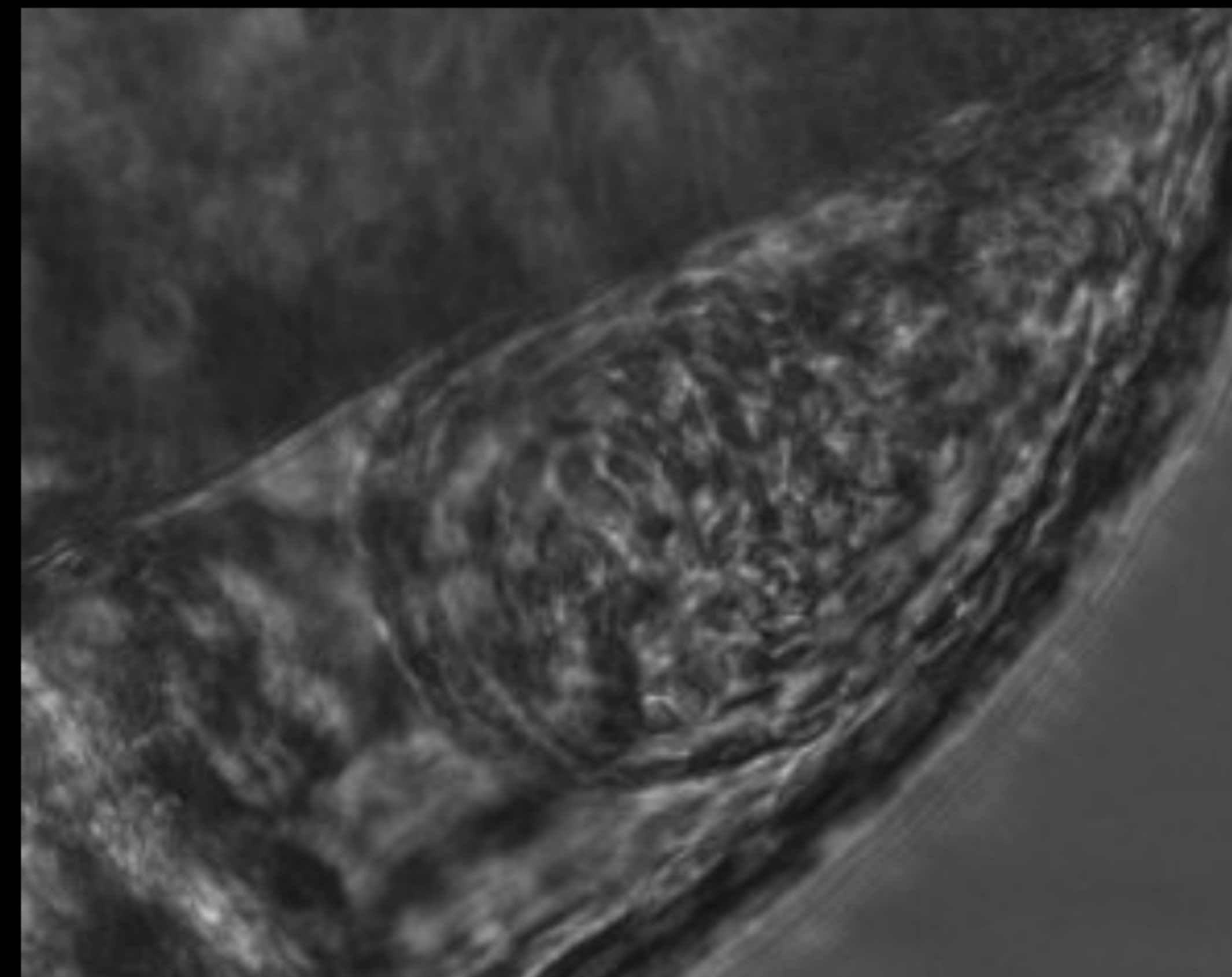




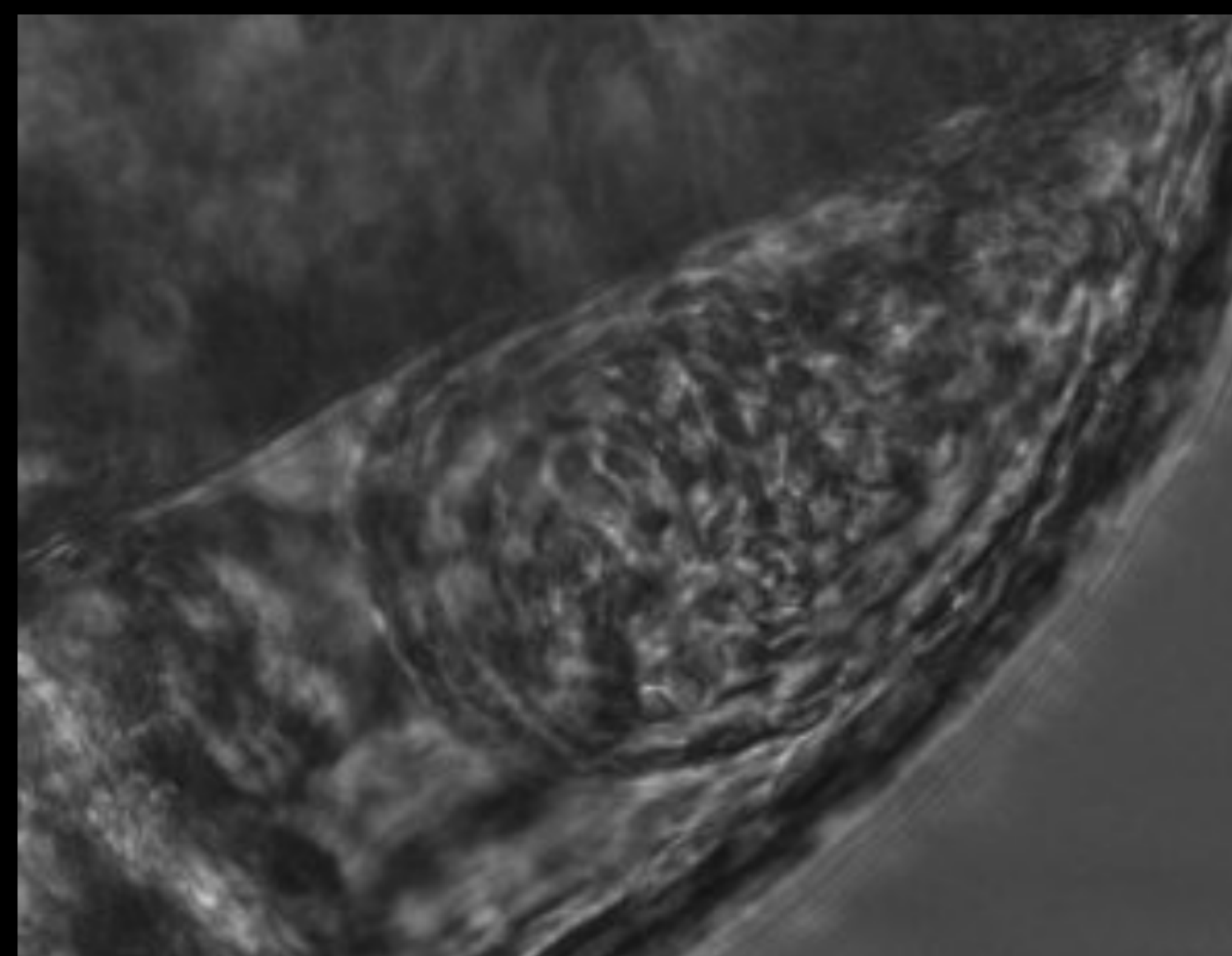
Taylor *et al.* J. of Biomedical Optics (2011)

BUT...

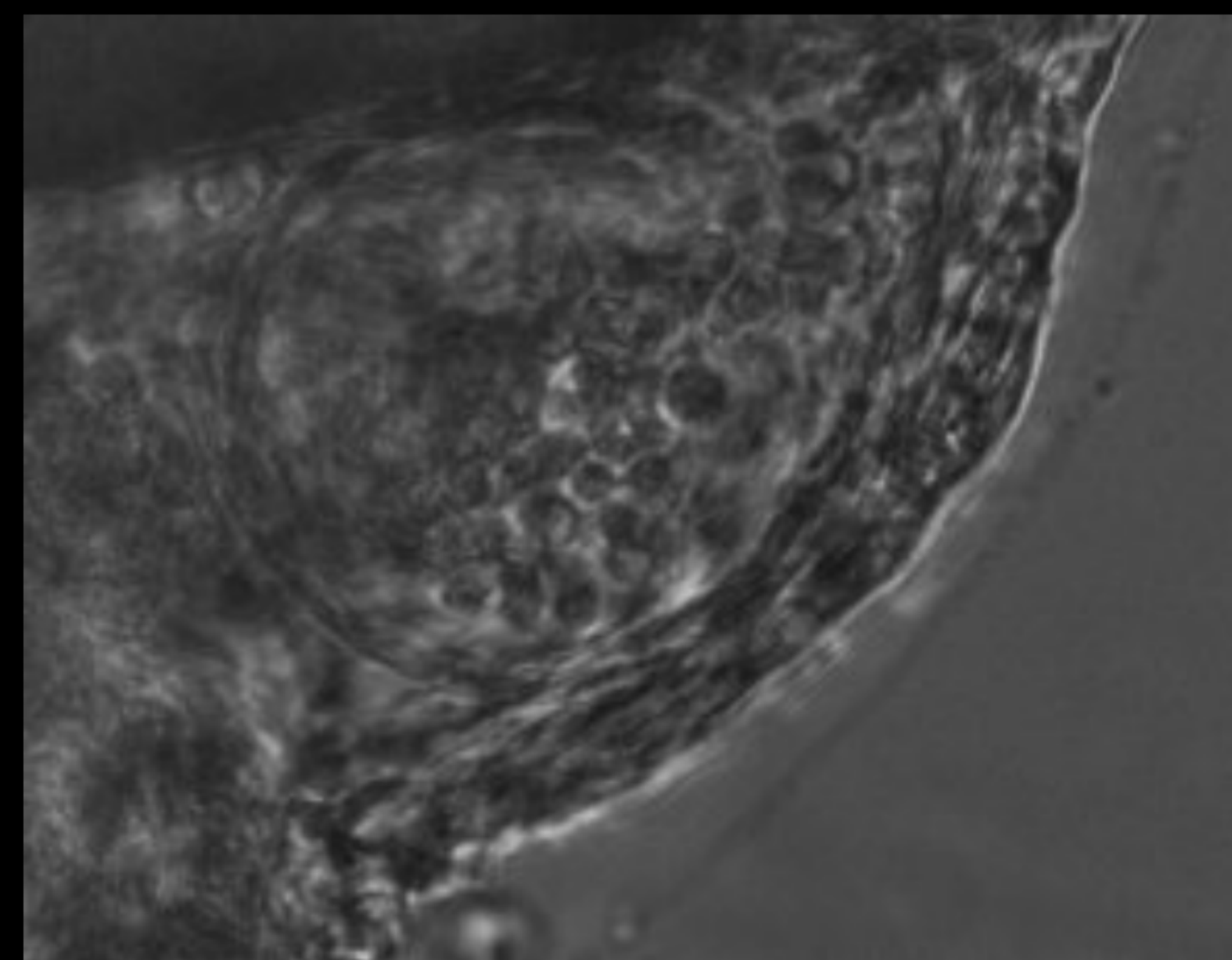
Initial Target Frame

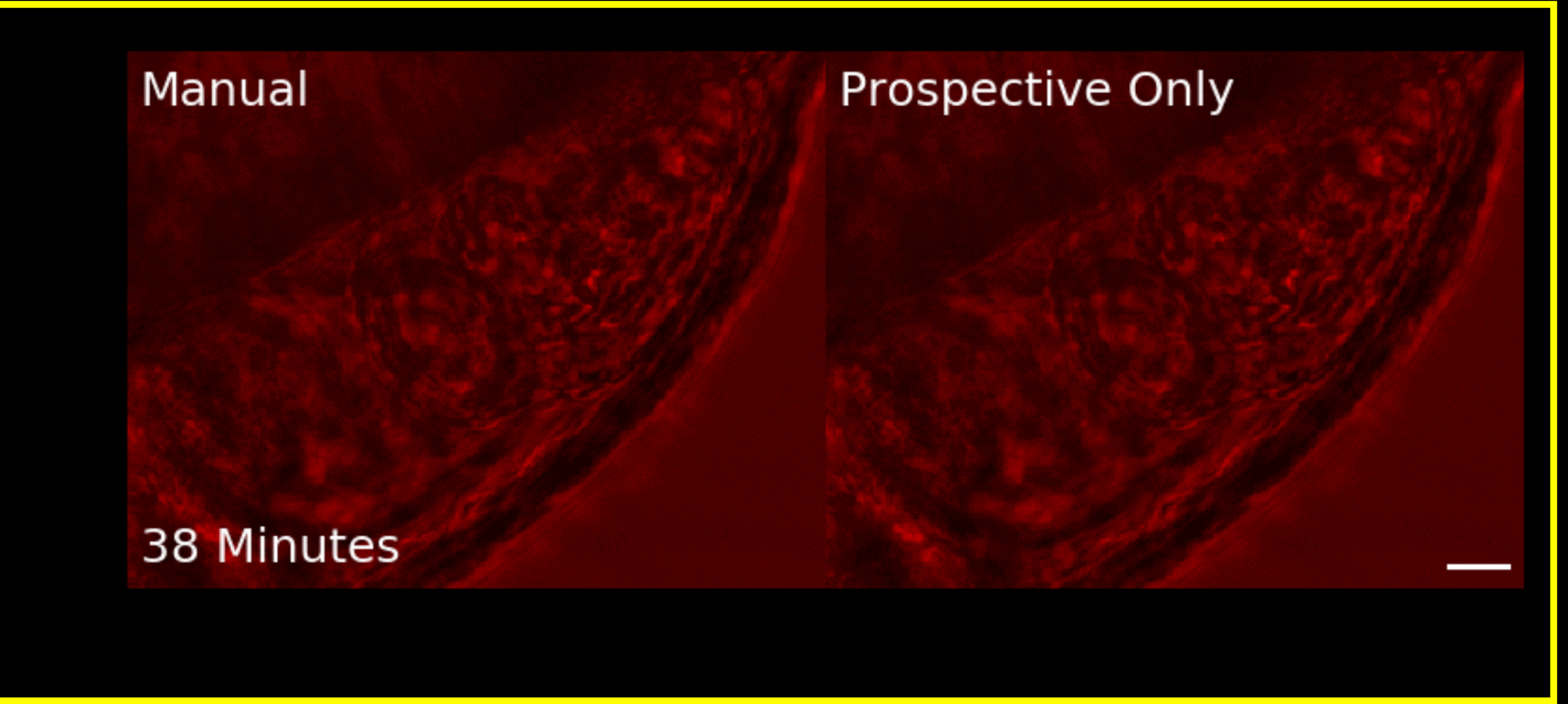


Initial Target Frame



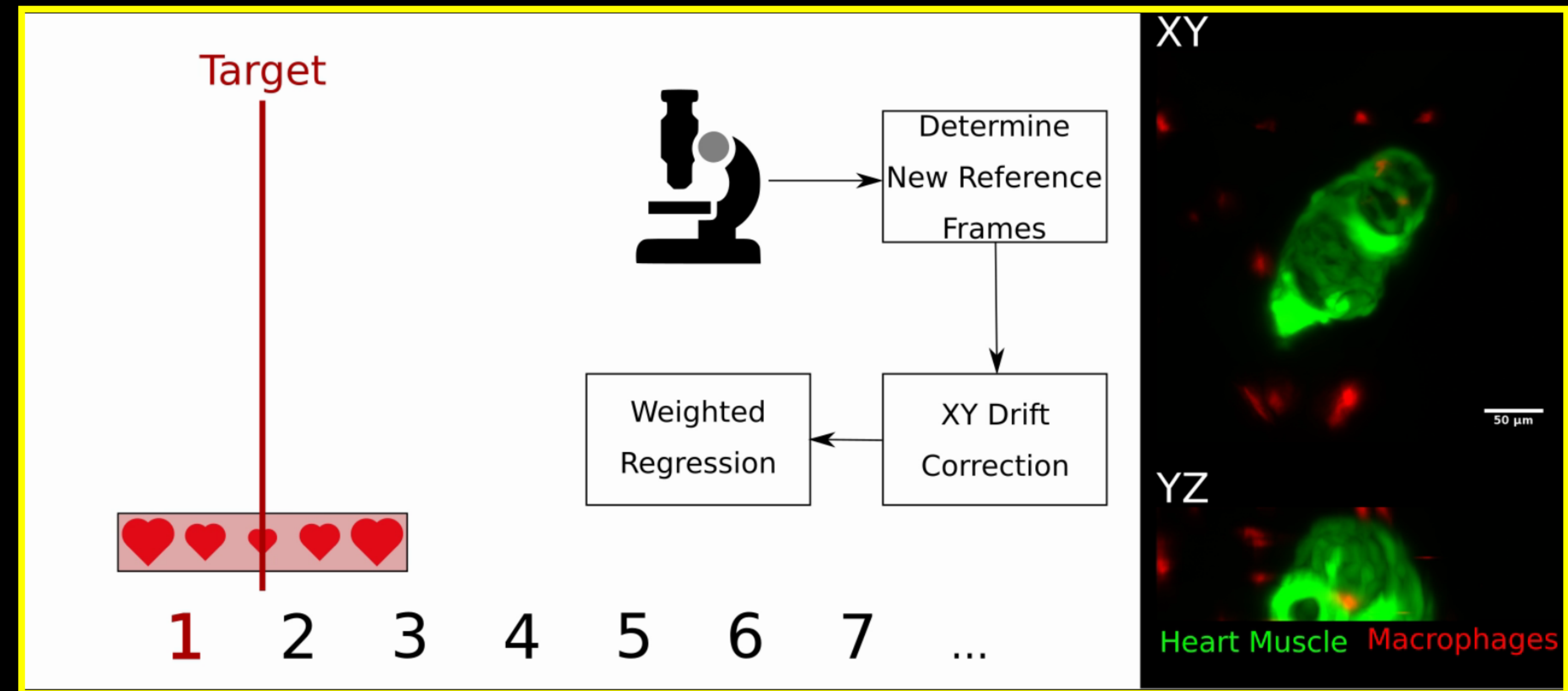
Final Target Frame

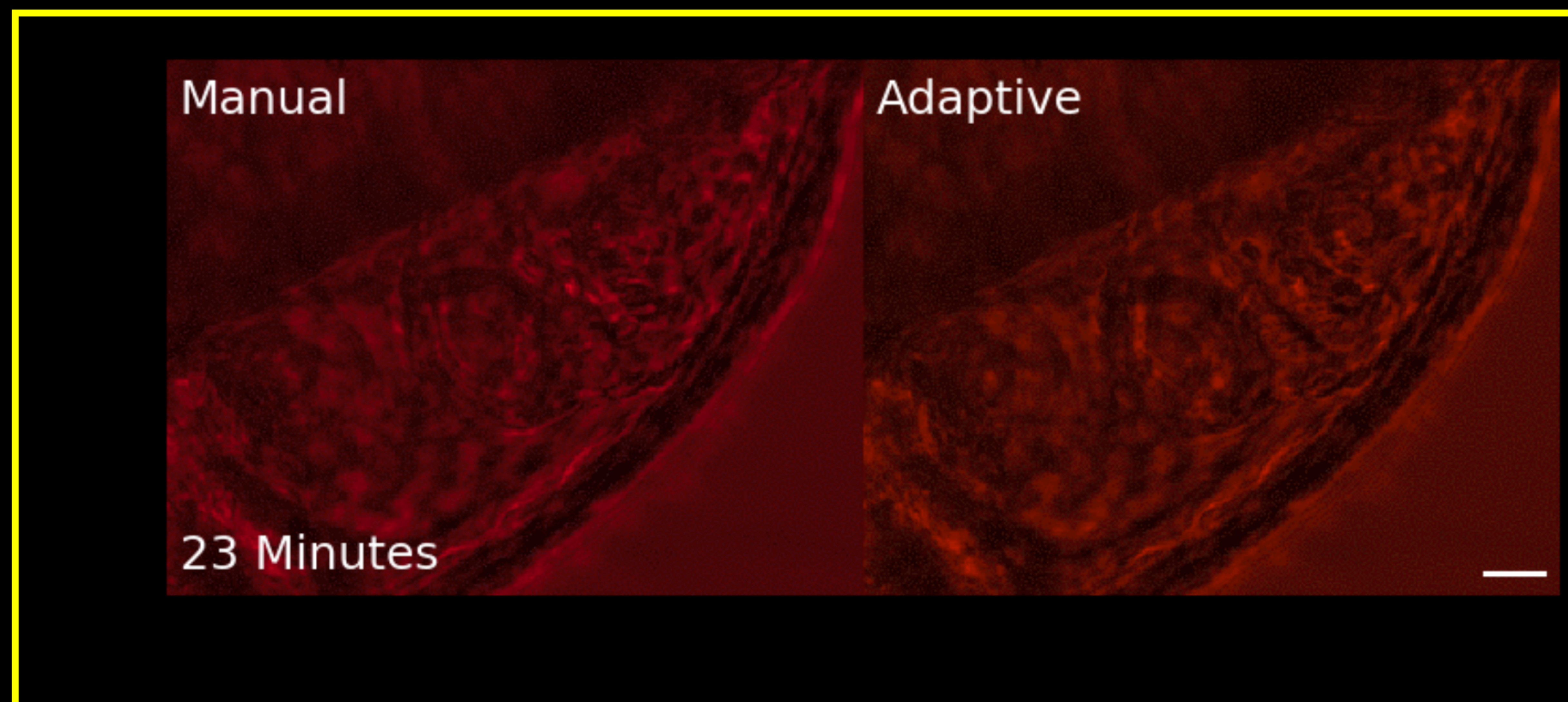


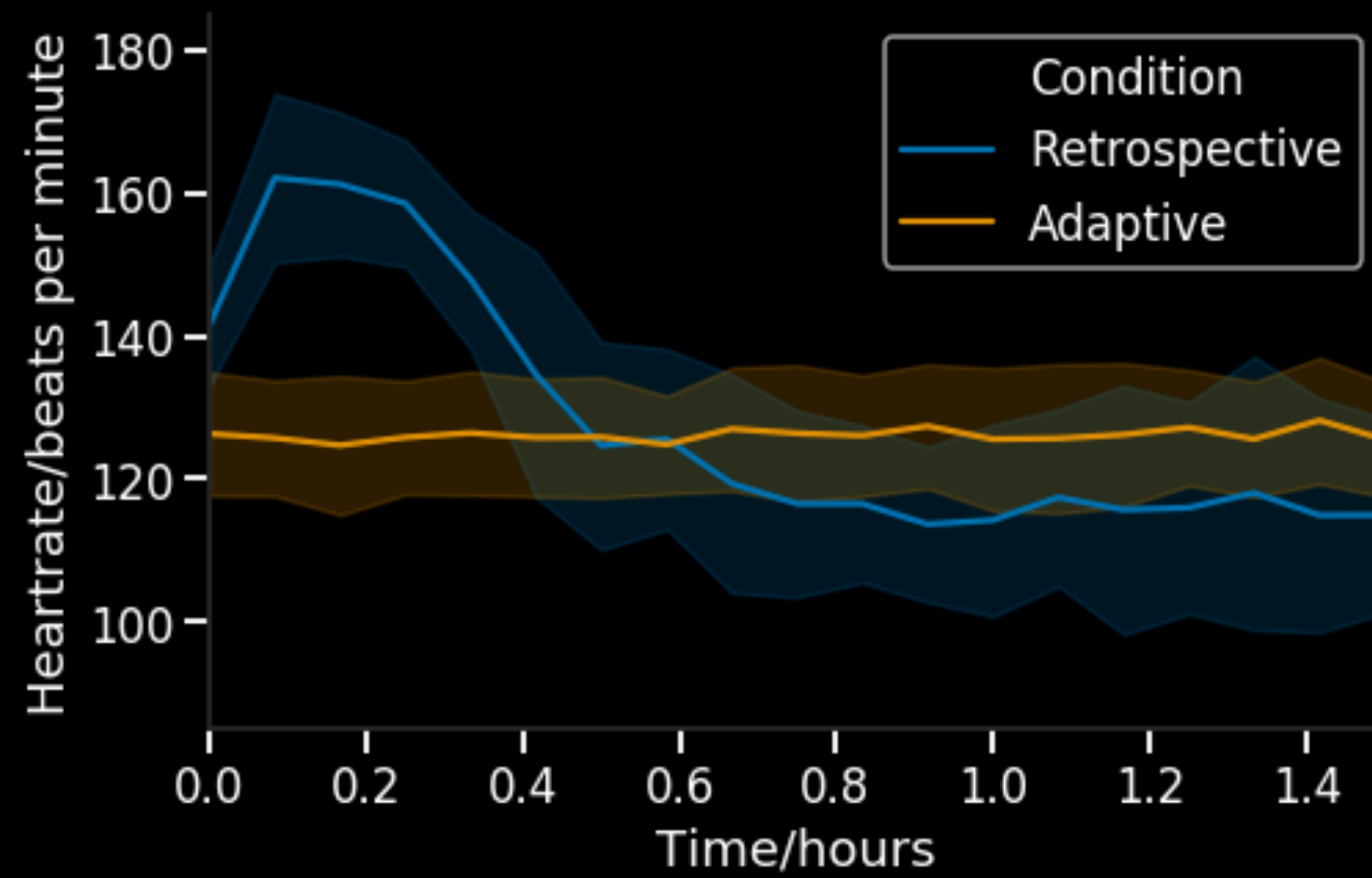


ADAPTIVE PROSPECTIVE OPTICAL GATING

Taylor *et al.* bioRxiv 526830 (2019)



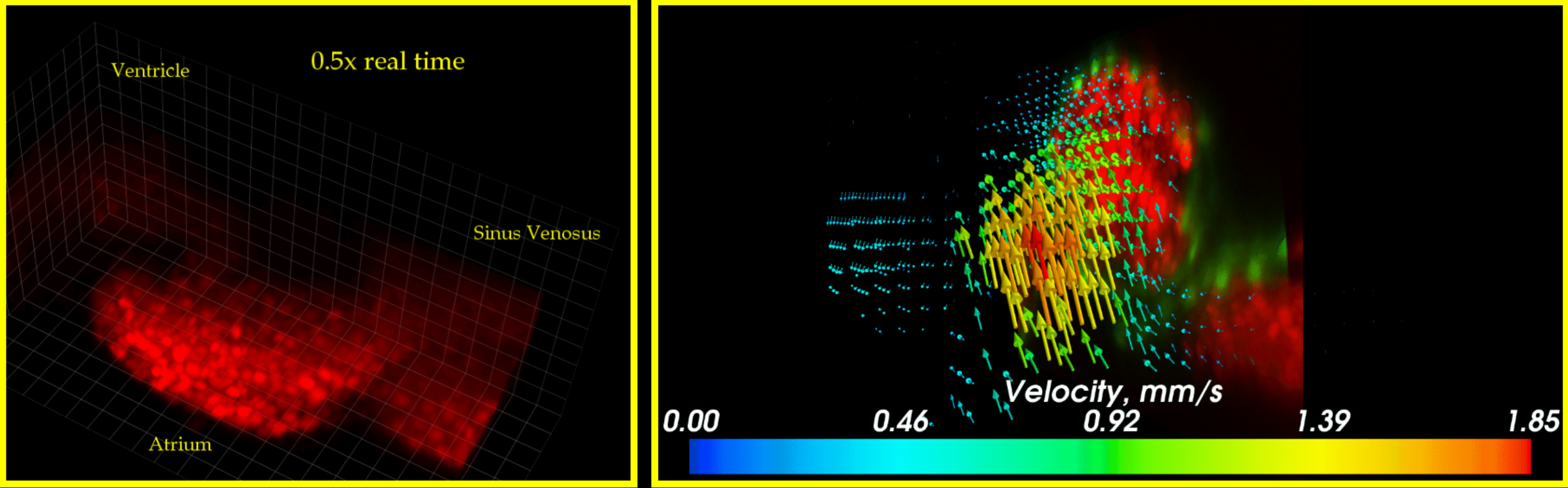


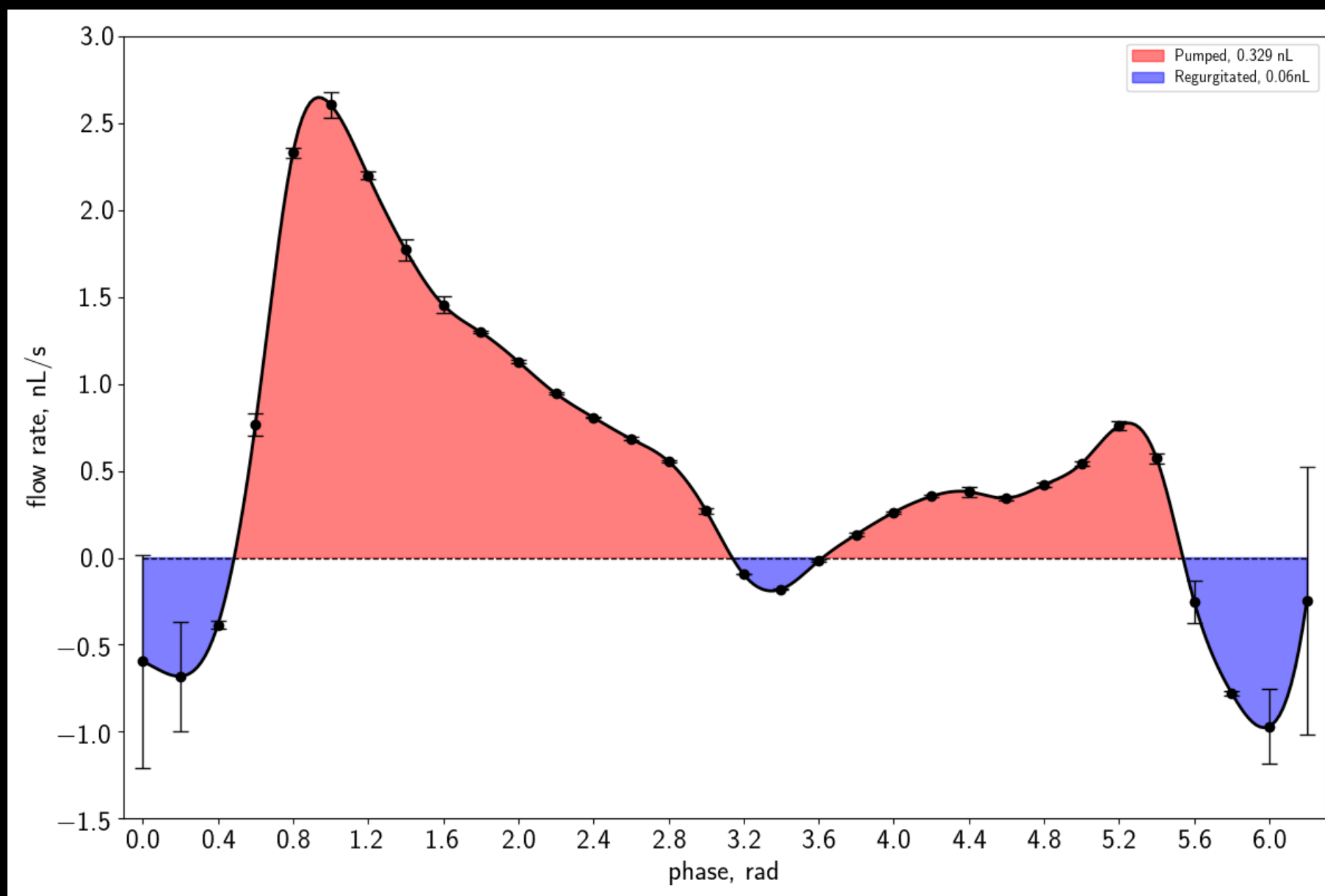


WHAT?

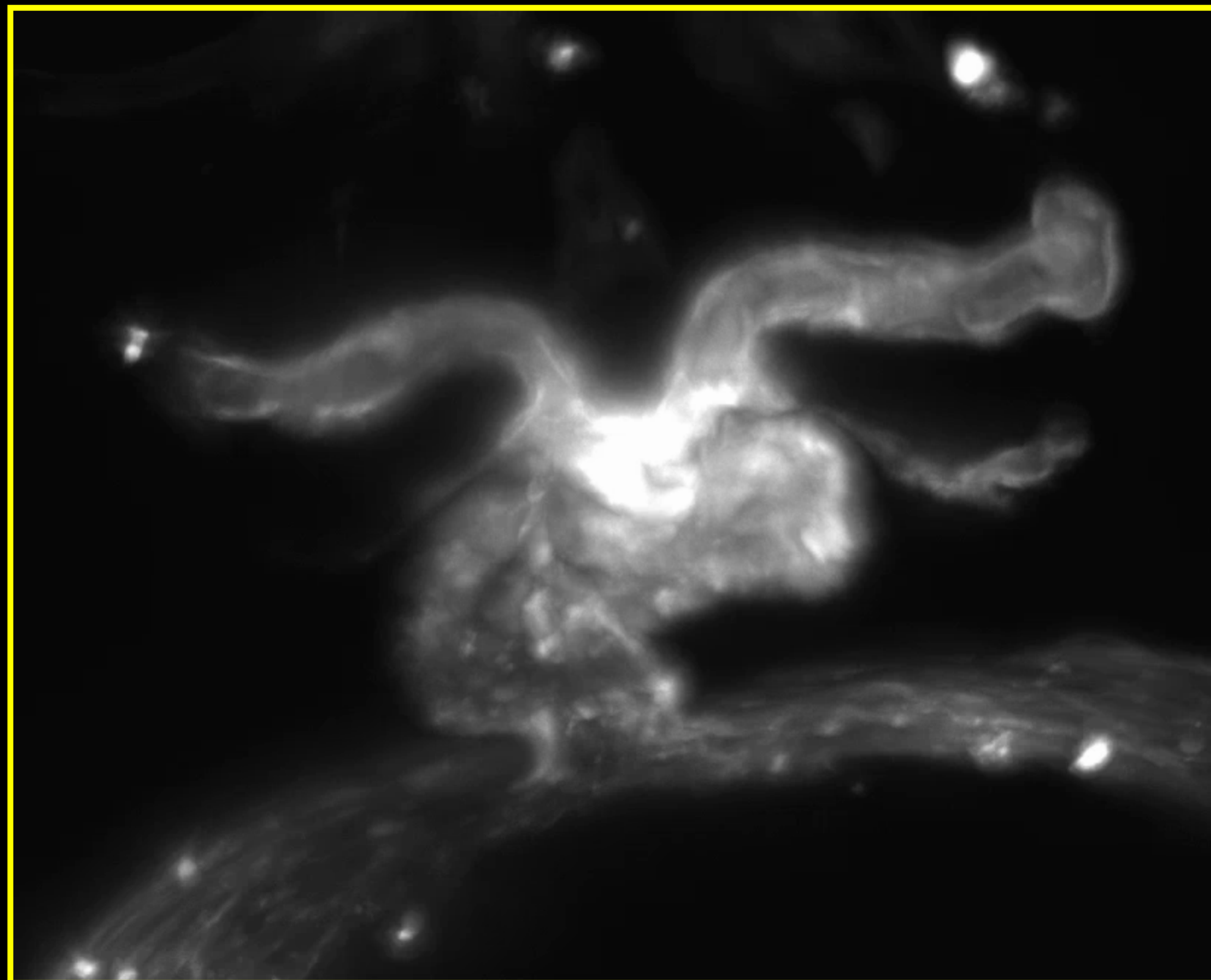
QUANTIFYING BLOOD FLOW

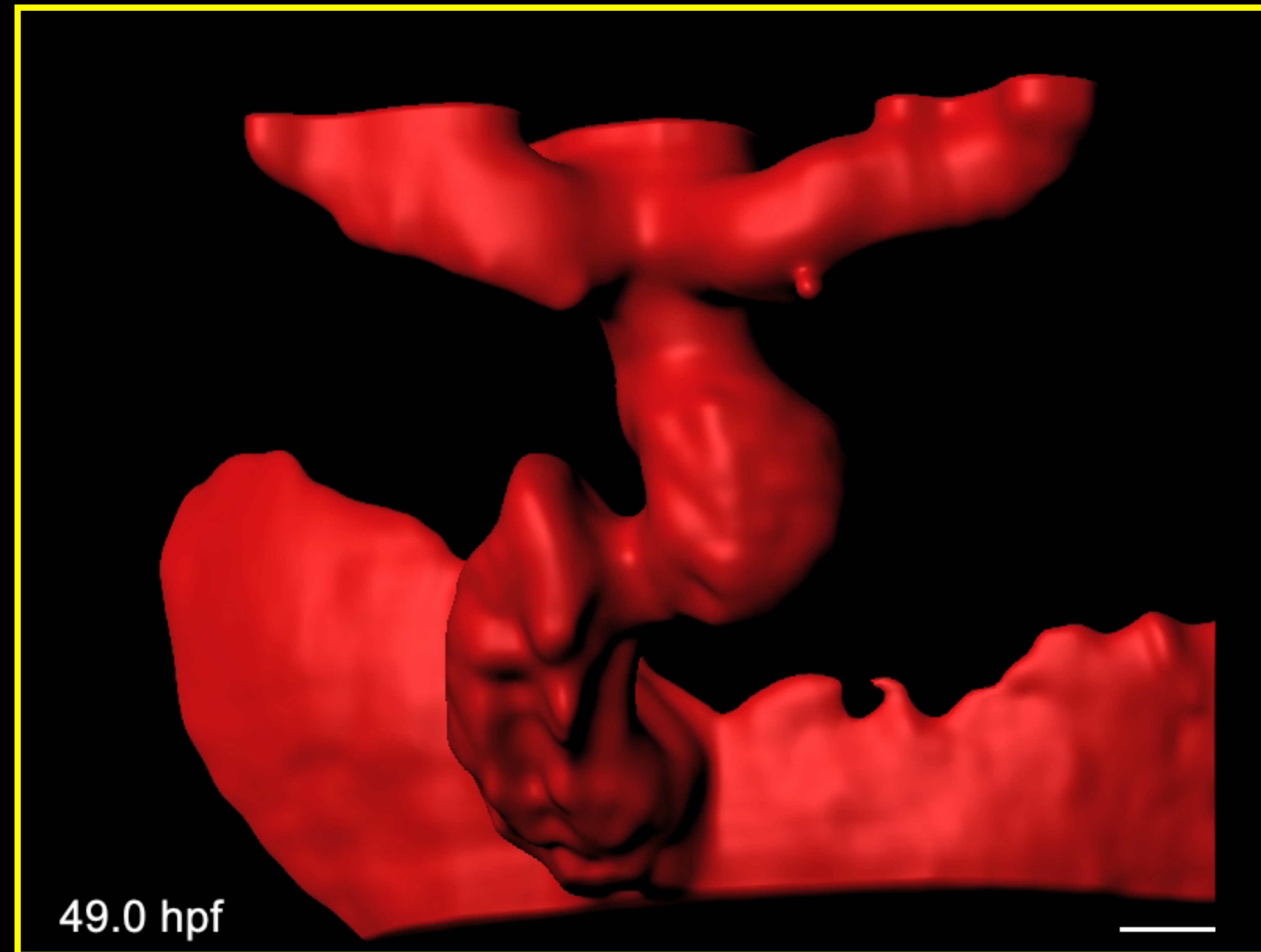
Zickus & Taylor Biomedical Optics Express (2018)





DEVELOPMENTAL BIOLOGY

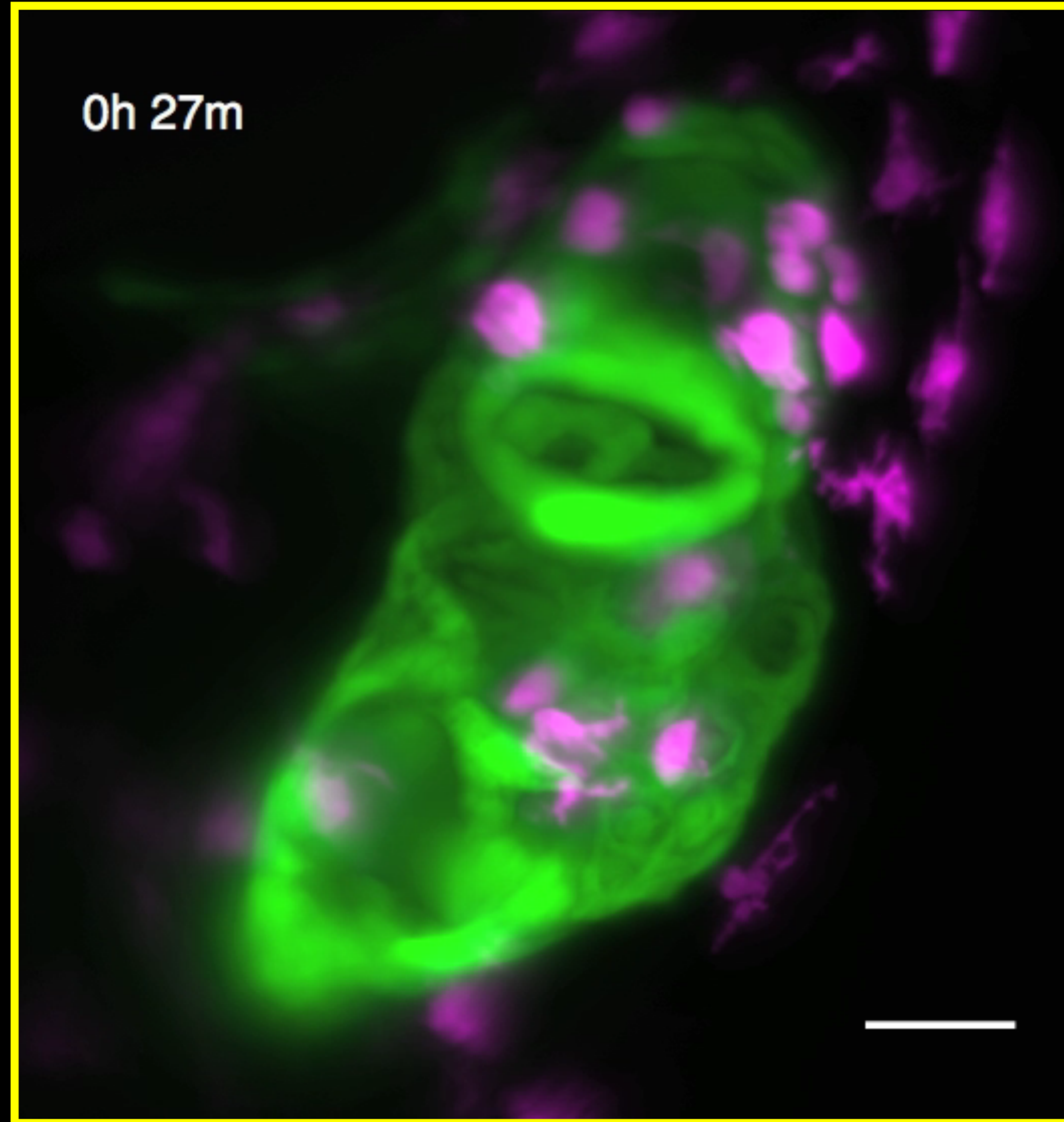




24h 3D timelapse
imaging of
trabeculation
in the beating heart

INJURY RESPONSE





FUTURE RESEARCH

SEEING GRAPHS

COMBINING GRAPH THEORY AND MICROSCOPY TO UNDERSTAND HOW VISION DEVELOPS

What?

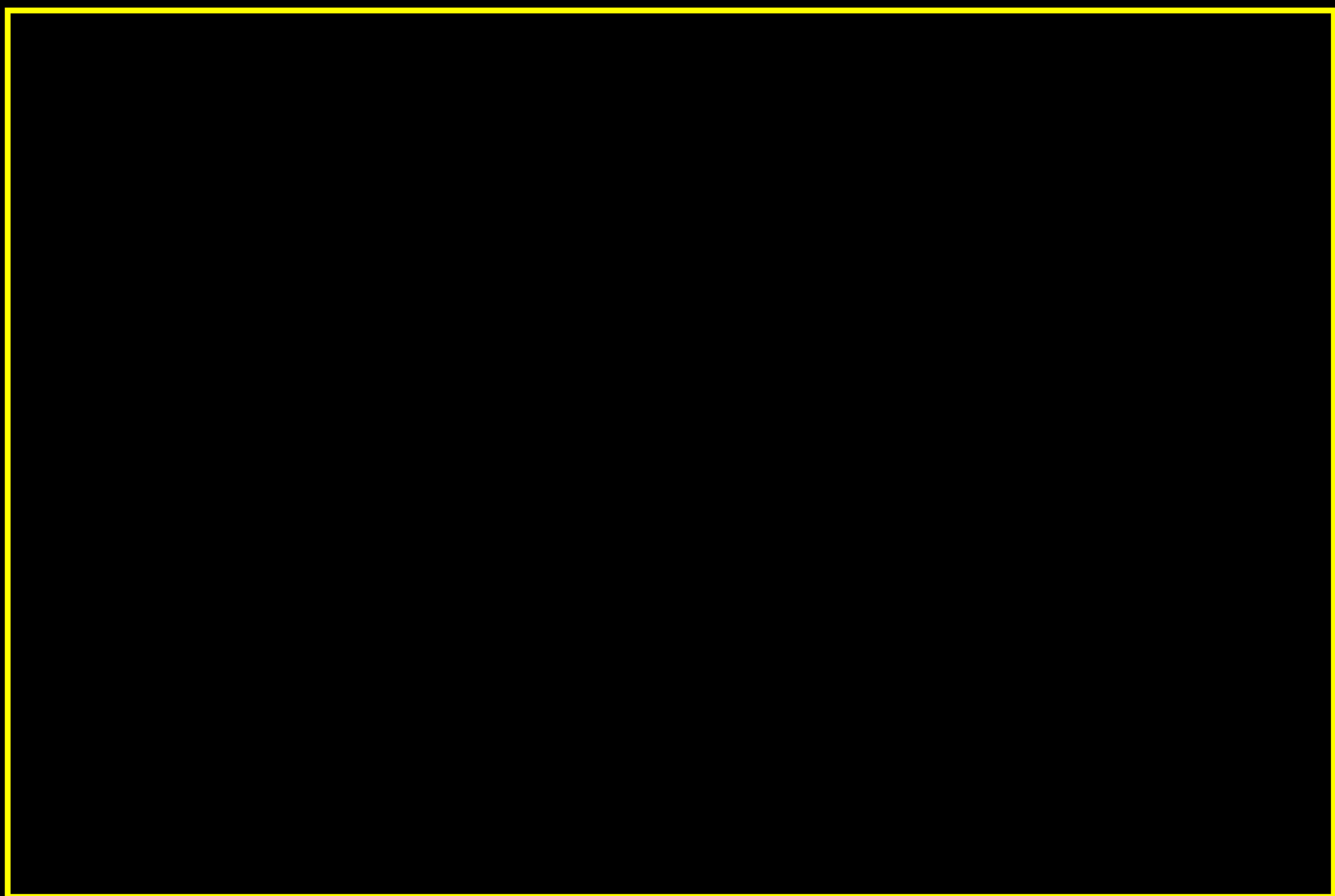
Quantify how spontaneous activity is able to 'teach' the retina to process stimuli at birth.

Why?

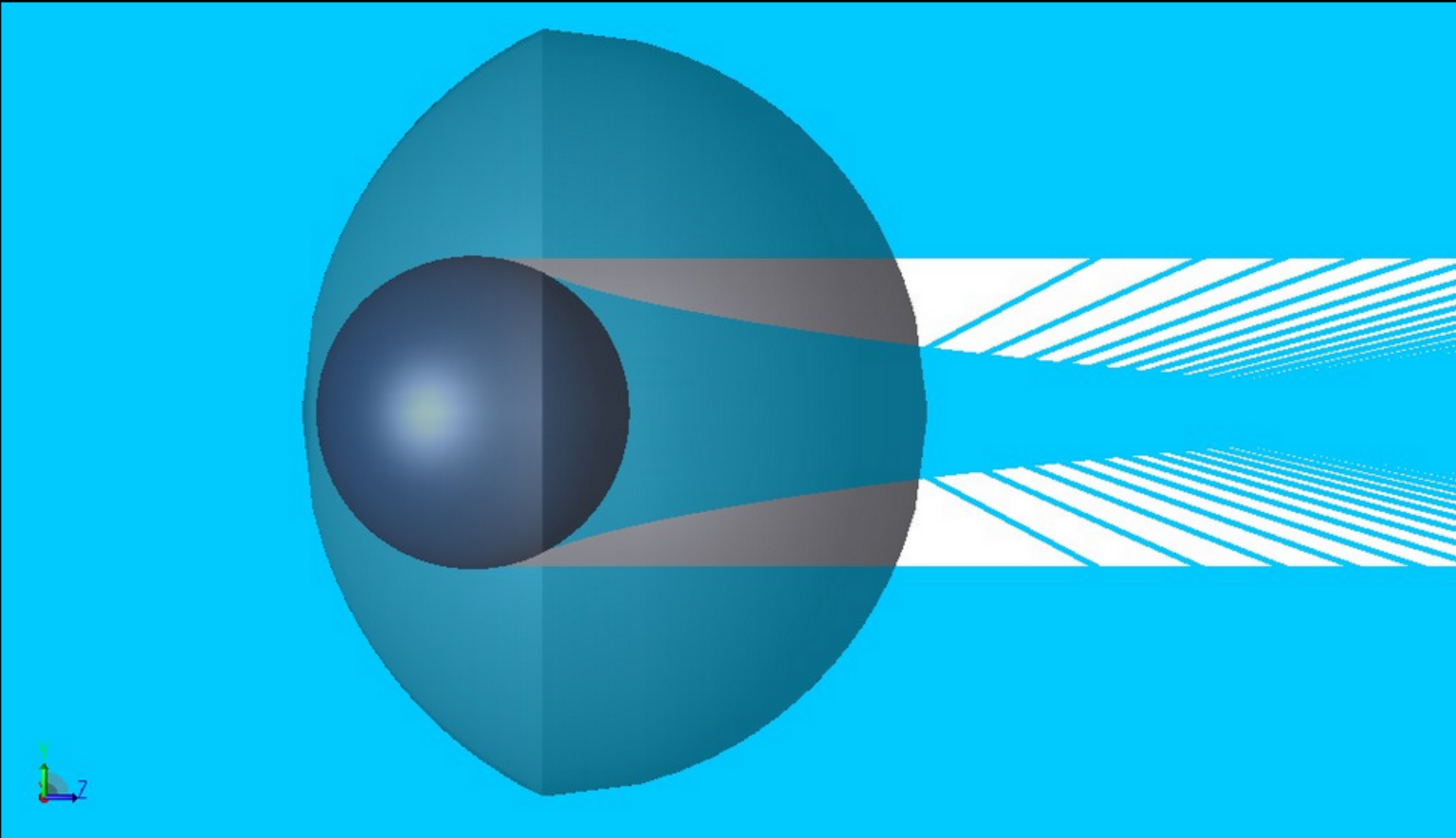
Further fundamental understanding of vision, the brain and biological computations.

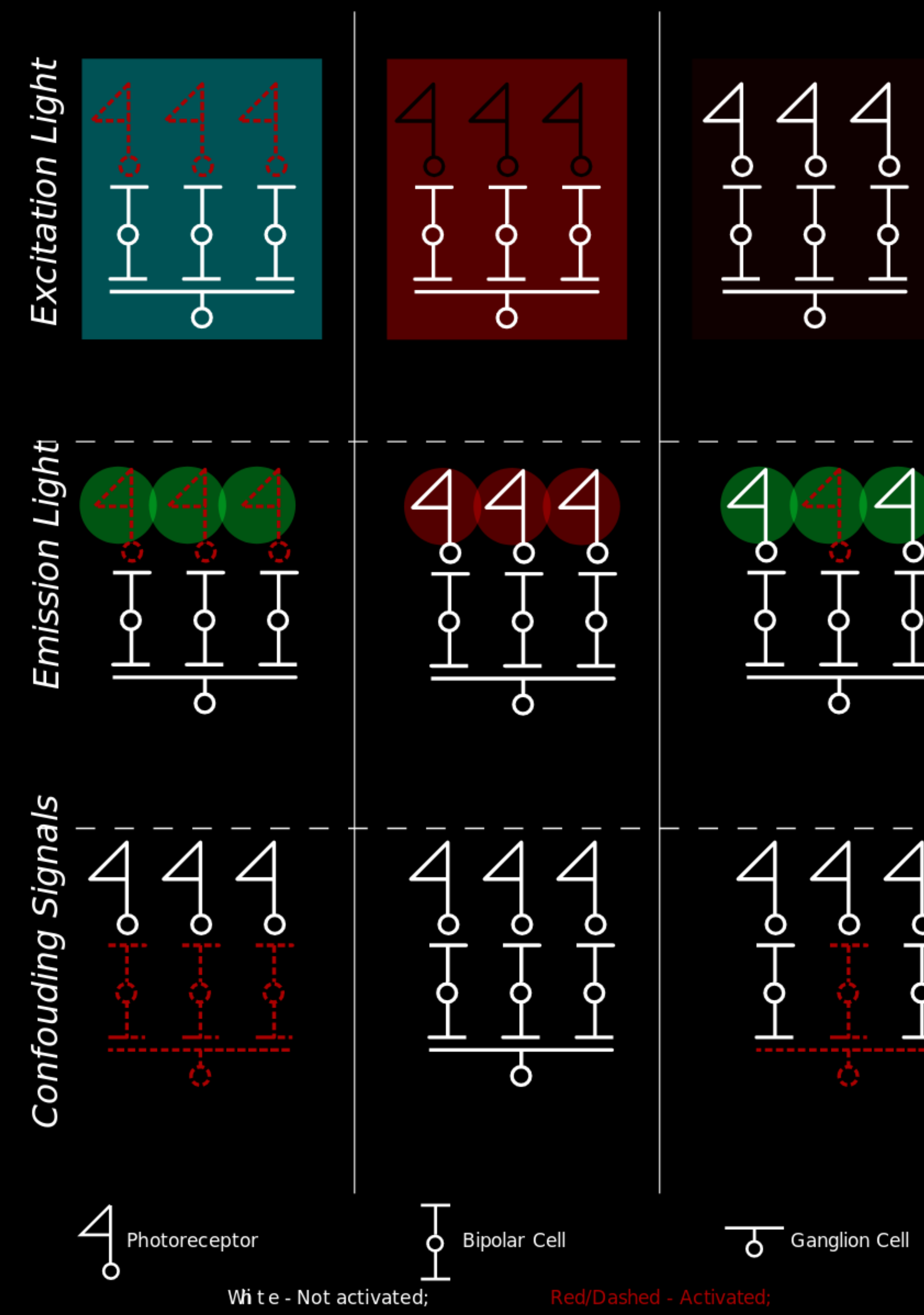
How?

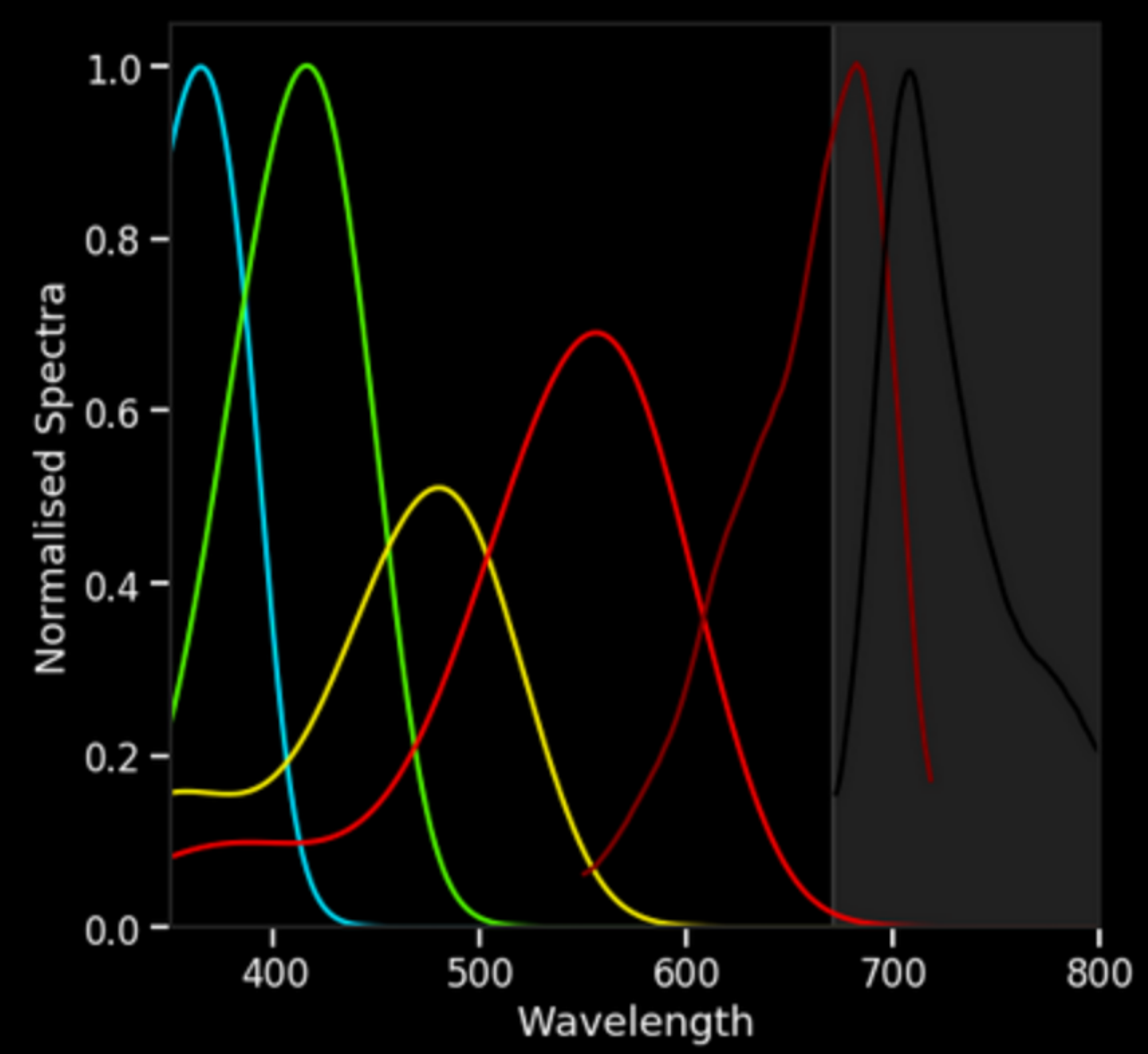
- 4D specialised *light sheet microscopy*,
- graph theory *analysis of extracted networks*
- and information theory models.



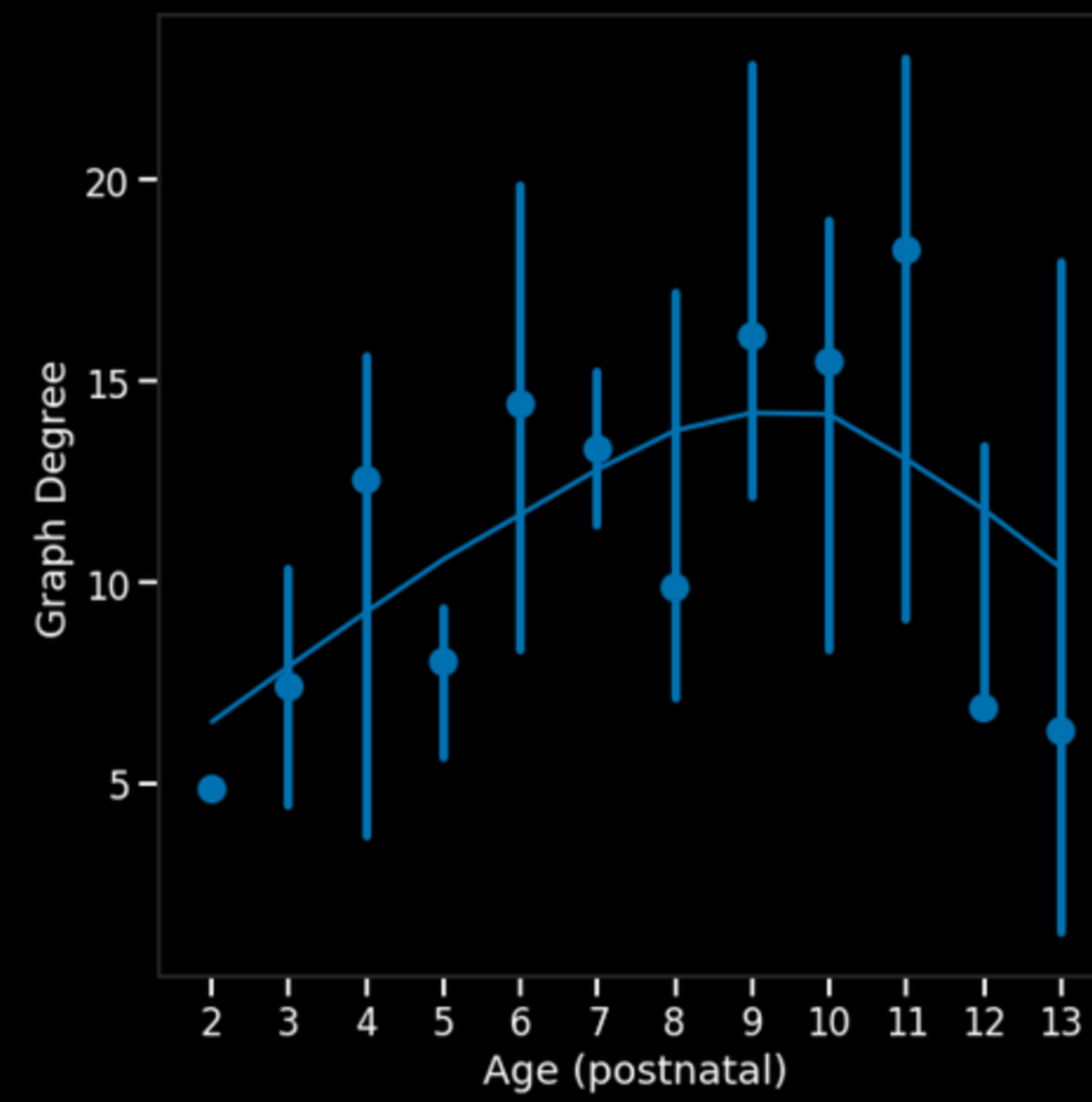
- 4D specialised *light sheet microscopy*,





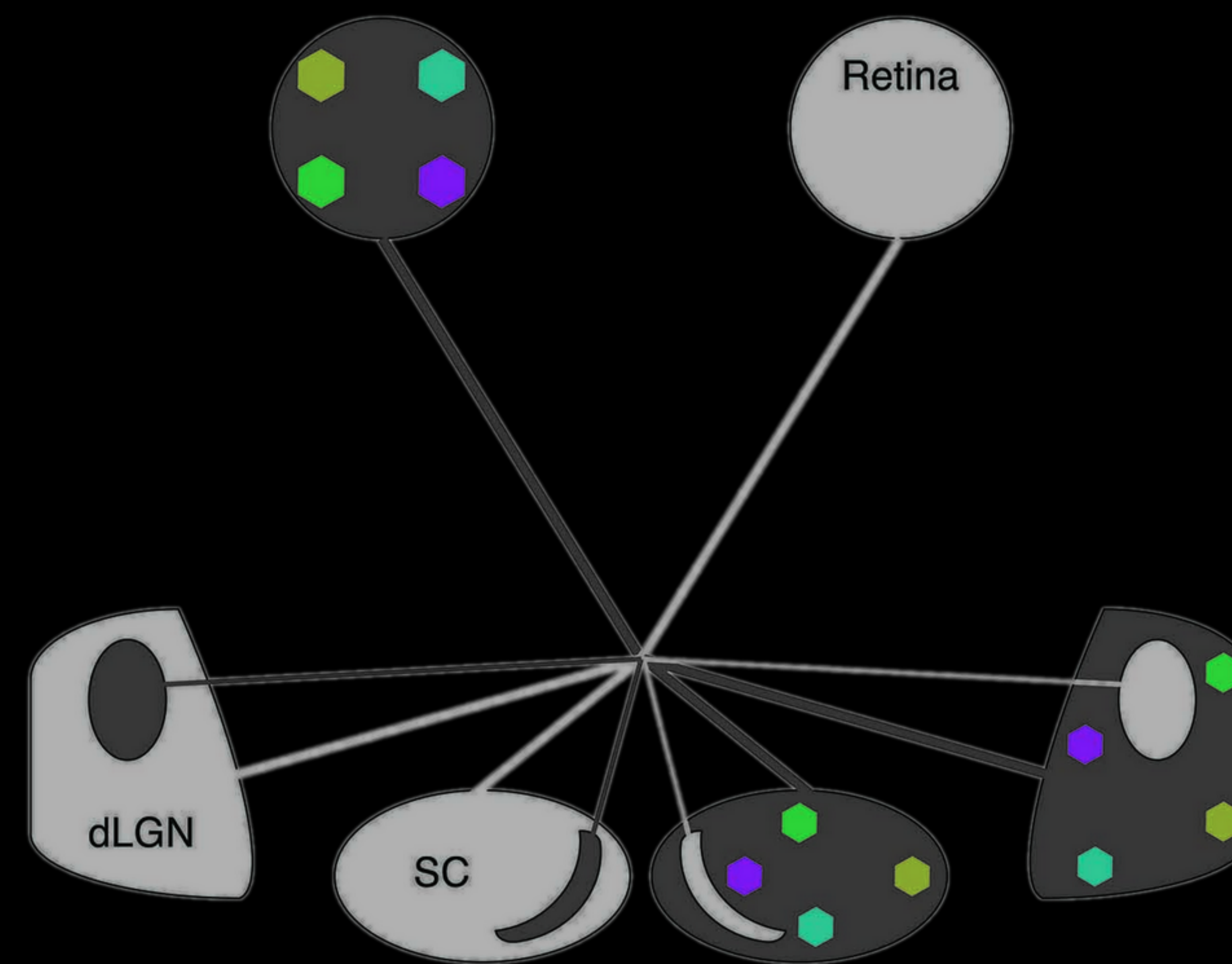


- Graph theory *analysis of extracted networks*,



- Information theory models,

THE TEN YEAR PLAN



Arroyo and Feller, 2016



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