

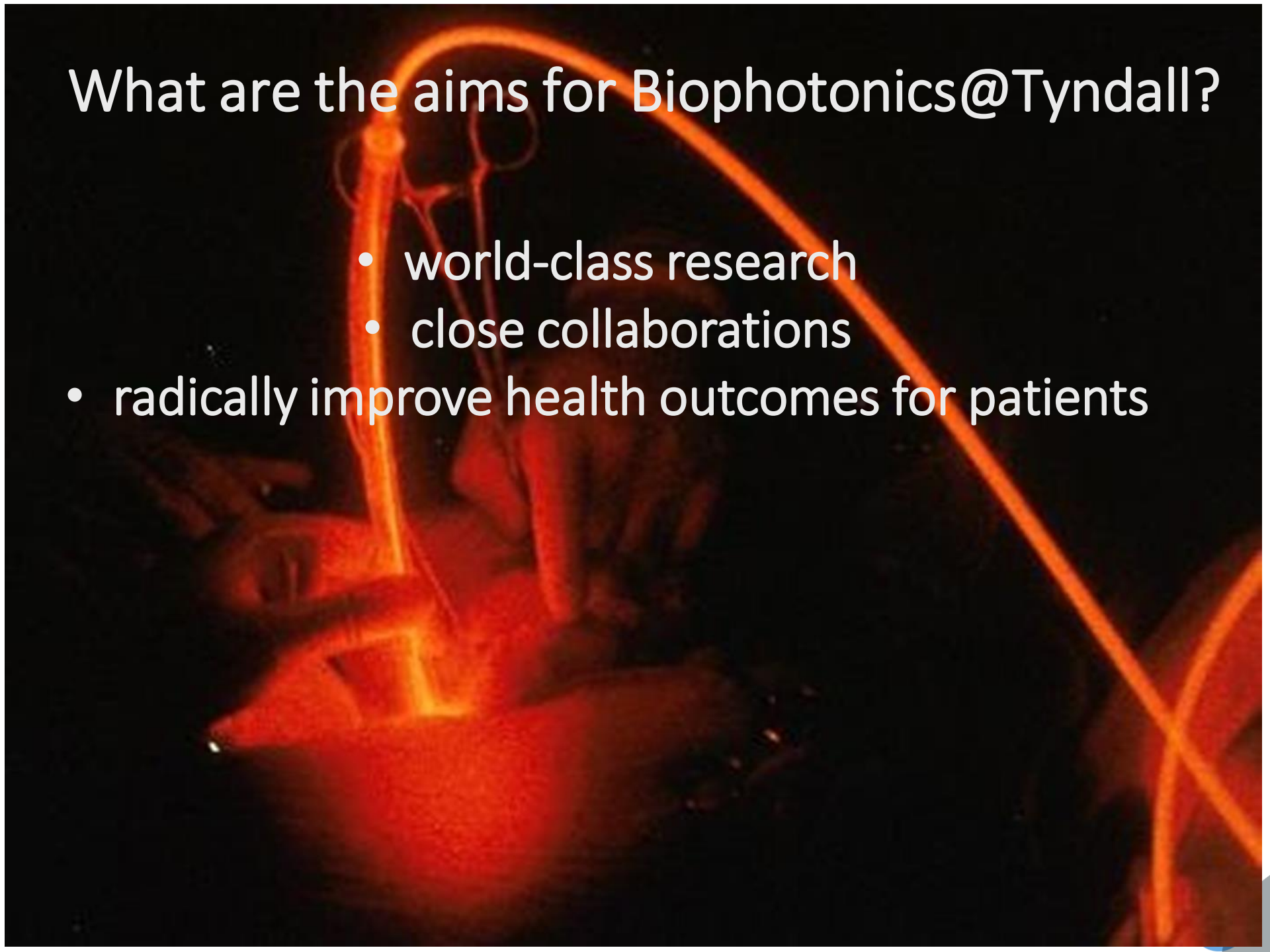


Biophotonics@Tyndall on the cutting edge - a path
from fundamental to clinical translation research

Stefan-Andersson-Engels
Professor

What are the aims for Biophotonics@Tyndall?

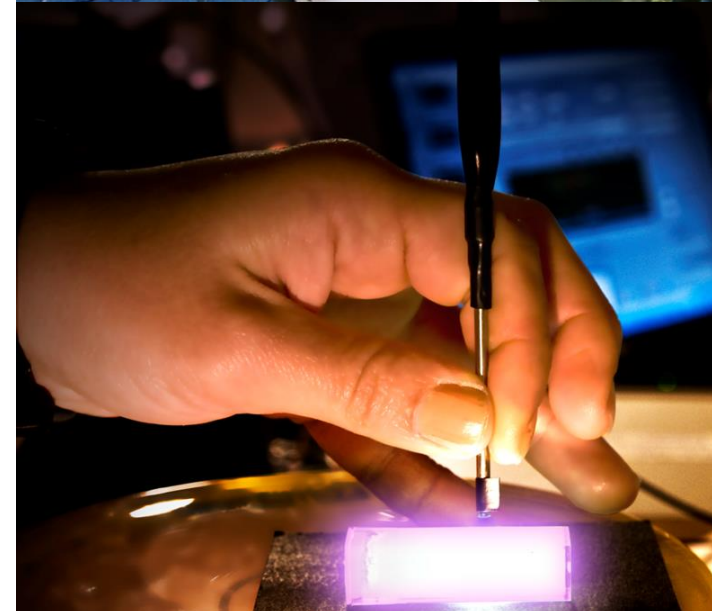
- world-class research
- close collaborations
- radically improve health outcomes for patients



What do we add to the photonics landscape in Ireland?

Expertise within the team

- **Tissue Optics**
- **Modelling** of light propagation in turbid media
- Developing **concepts** for tissue diagnostics/photoactivation
- **Spectroscopy** for tissue diagnostics, including diffuse reflectance, fluorescence, Raman, photoacoustics
- Multispectral **imaging** diagnostics
- **Photodynamic** and **photothermal** therapy
- Developing **research prototypes** for translational studies
- Ability to efficiently lead and contribute to **multidisciplinary** research
- Experience in **translational** biomedical research
- Multivariate data **analysis**, optical tomographic reconstruction and image analysis
- Experience from developing **industrial prototypes**



Academic collaborators

- System integration team at IPIC (Peter O'Brien)
- Team on III-IV materials and devices at IPIC (Brian Corbett)
- Biochemistry & Cell Biology at UCC Cork (Dmitri Papkovsky)
- Photonics at UL Limerick (Elfed Lewis)
- Quantum Information and Biophotonics (Stefan Kröll and Karin Wårdell)
- Photoacoustics team at CALTECH (Lihong Wang)
- Medical Physics at University of Toronto (Brian Wilson)
- Biophotonics at A*STAR Singapore (Malini Olivo)
- Biomedical Engineering at National University of Singapore (Zhang Yong)

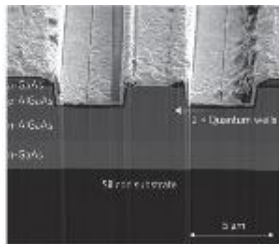
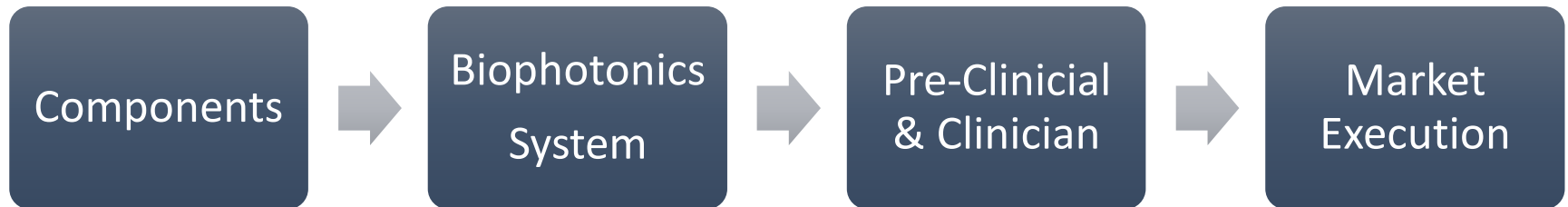


Clinical collaborators

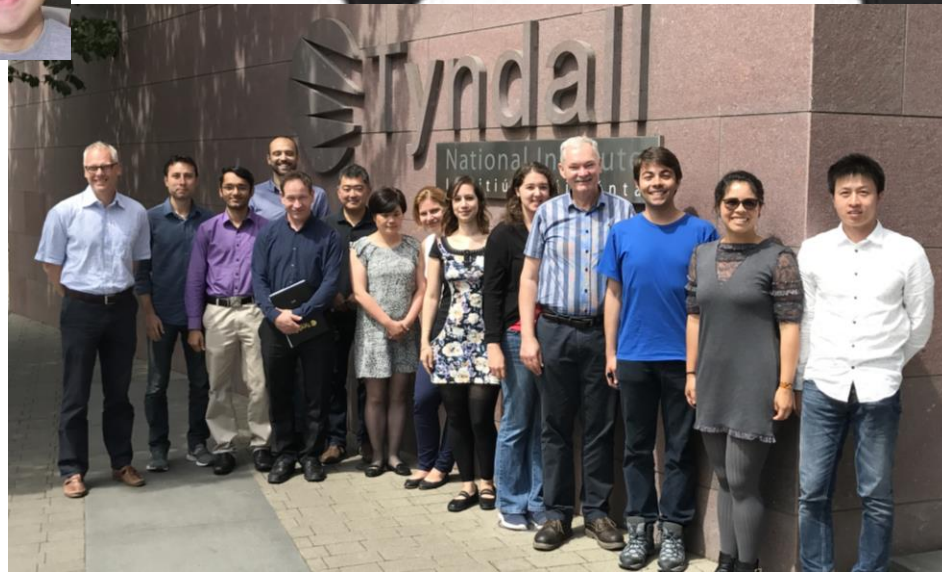
- General Surgery at CUH Cork (Micheal O'Riordain)
- Otolaryngology at University College Hospital Galway (Ivan Keogh)
- Neonatology and INFANT at CUH, Cork (Eugene Dempsey, Geraldine Boylan)
- The APC Microbiome Institute Cork (Silvia Melgar, Fergus Shanahan)



Biophotonics Innovation Chain



Biophotonics Team



What do I mean with Biophotonics?

Applications



Tools



Opportunities
Challenges

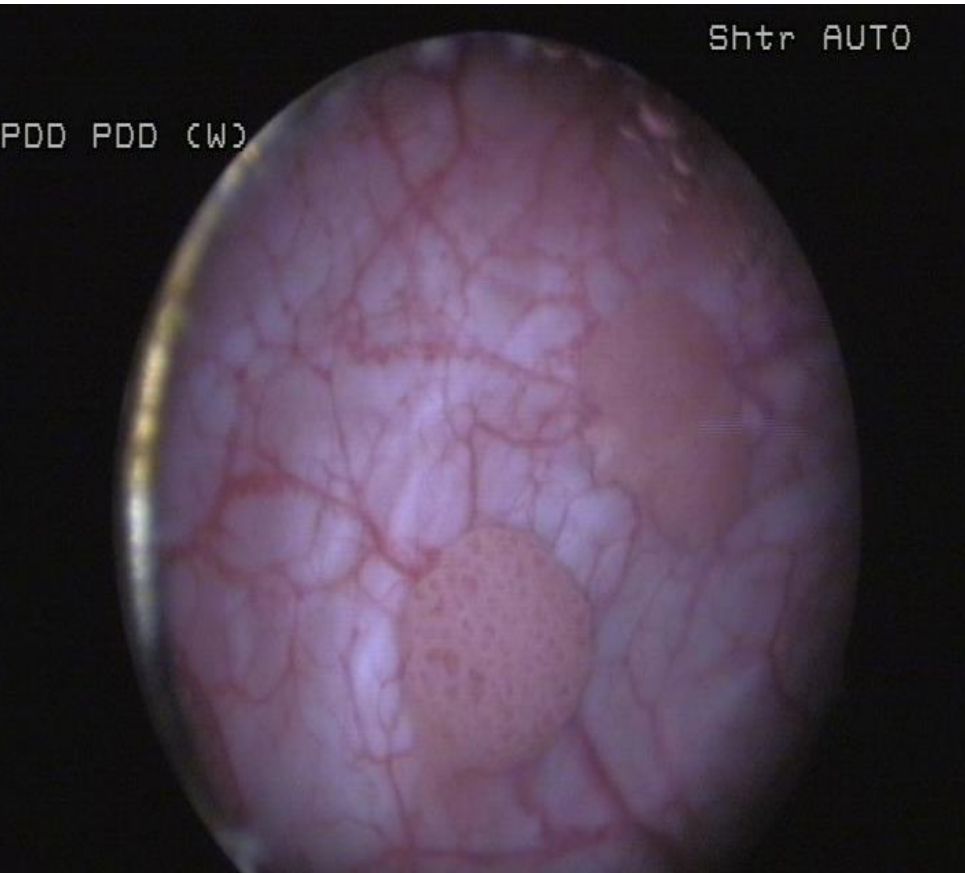


Urinary bladder tumour diagnostics

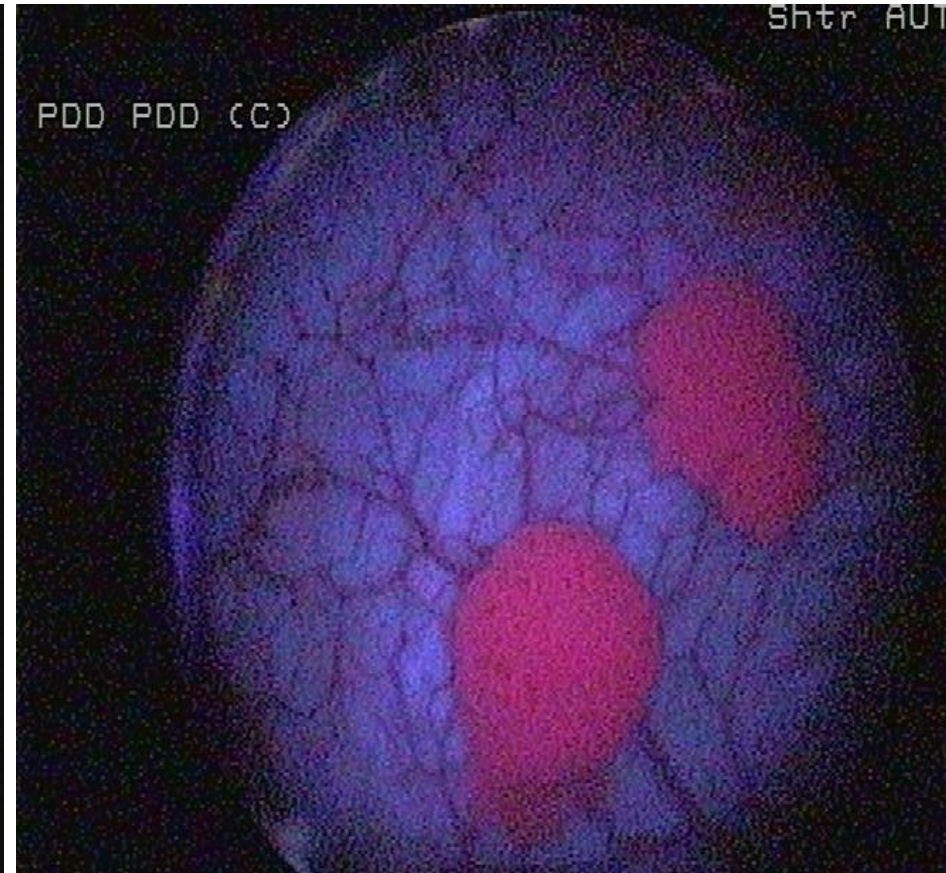


Bladder cancer delineation

Fluorescence diagnostics



Normal white light examination

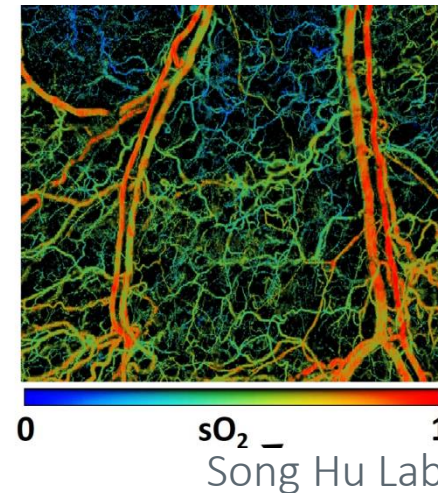


Blue light examination

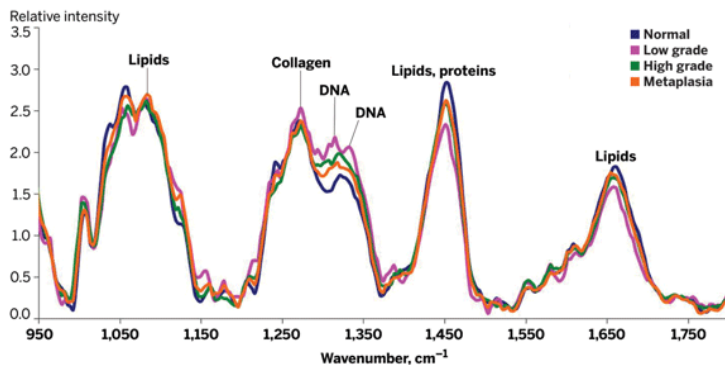
What are the biomedical photonics tools?

- Optical Coherence Tomography (OCT) – depth imaging
- Fluorescence – good sensitivity
- Raman – good specificity
- Near/Mid-Infrared (NIR/MIR) Spectroscopy and Imaging
- Diffuse Light and Scattering Spectroscopy - simple
- Photoacoustics – 3D imaging
- Acousto-optics – deep 3D imaging
- In vivo microscopies – good resolution
- Micro-Endoscopy – compact and good resolution
- *In vitro* assays – simple with good specificity

Metabolic photoacoustic microscopy

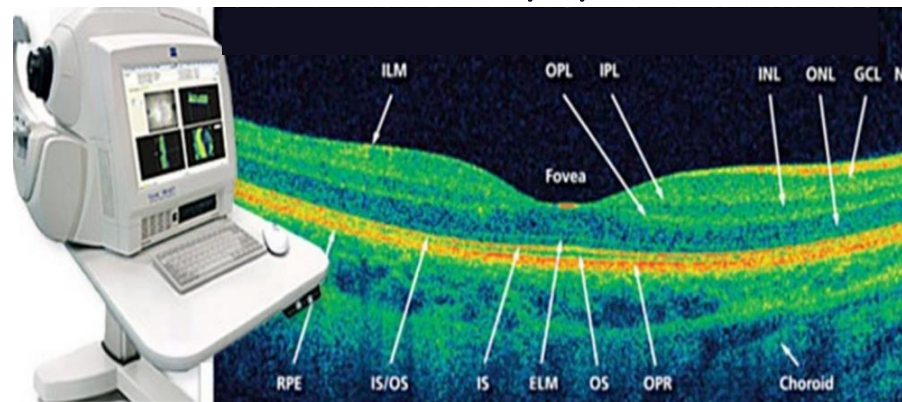


Raman spectroscopy of cervical cancer



Arnaud C&EN (2010)

HD-OCT scan of Healthy Eye



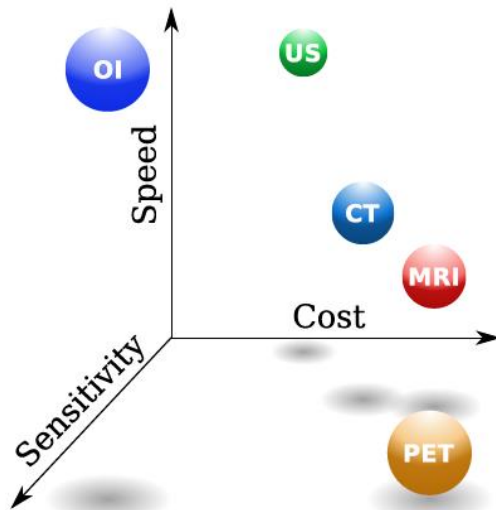
Envision Optical, Carl Zeiss

What are the opportunities and challenges?



Opportunities

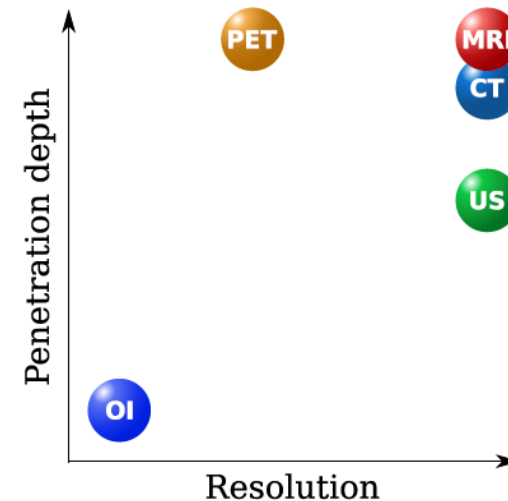
- Molecular sensitivity
- Can be cost-effective
- Possible to integrate
- Great clinical need



Challenges



- High attenuation
- Poor spatial resolution
- Shallow sensitivity



Strong Scattering in biological tissue

One scattering event per 100 μm

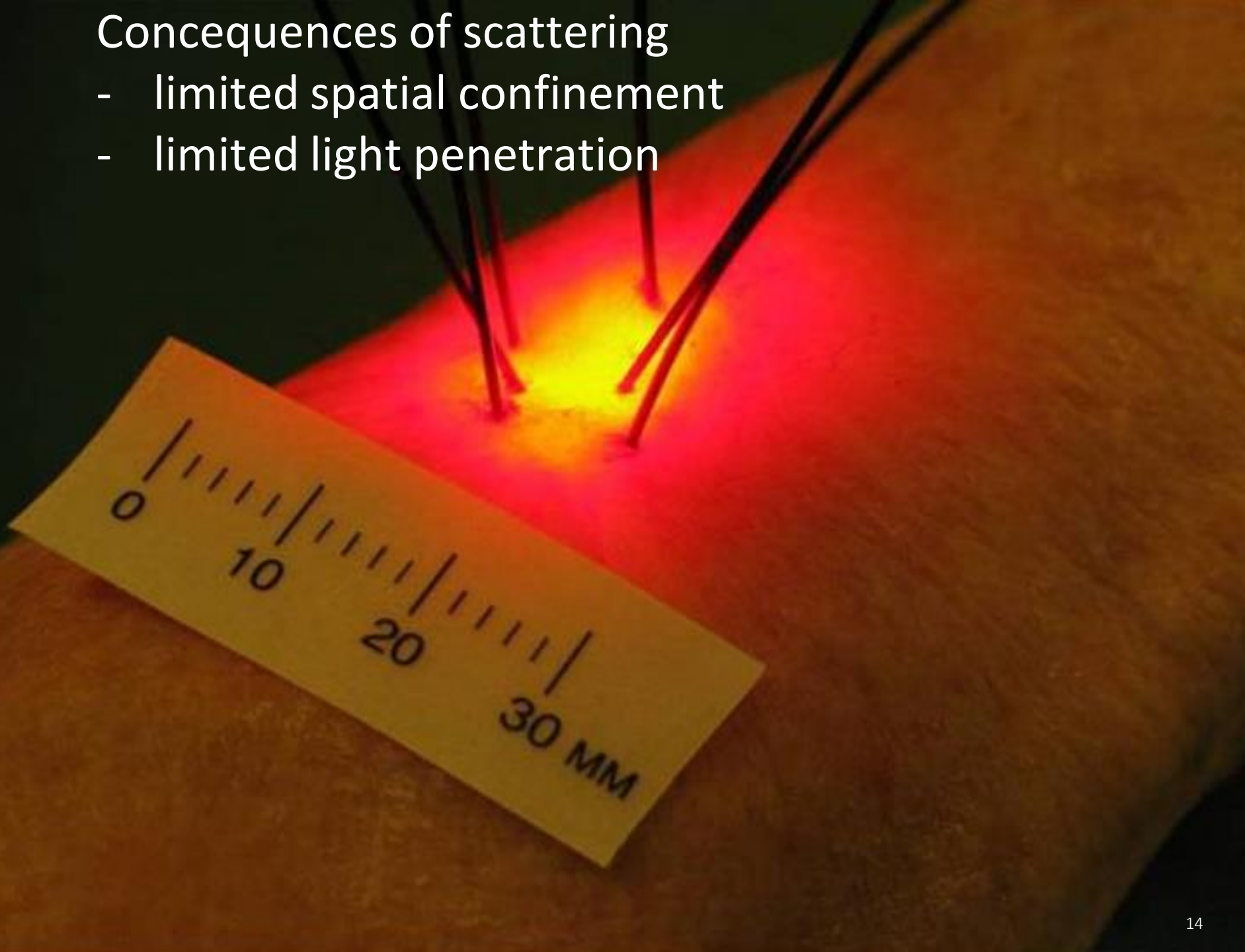


Nadia Jonning

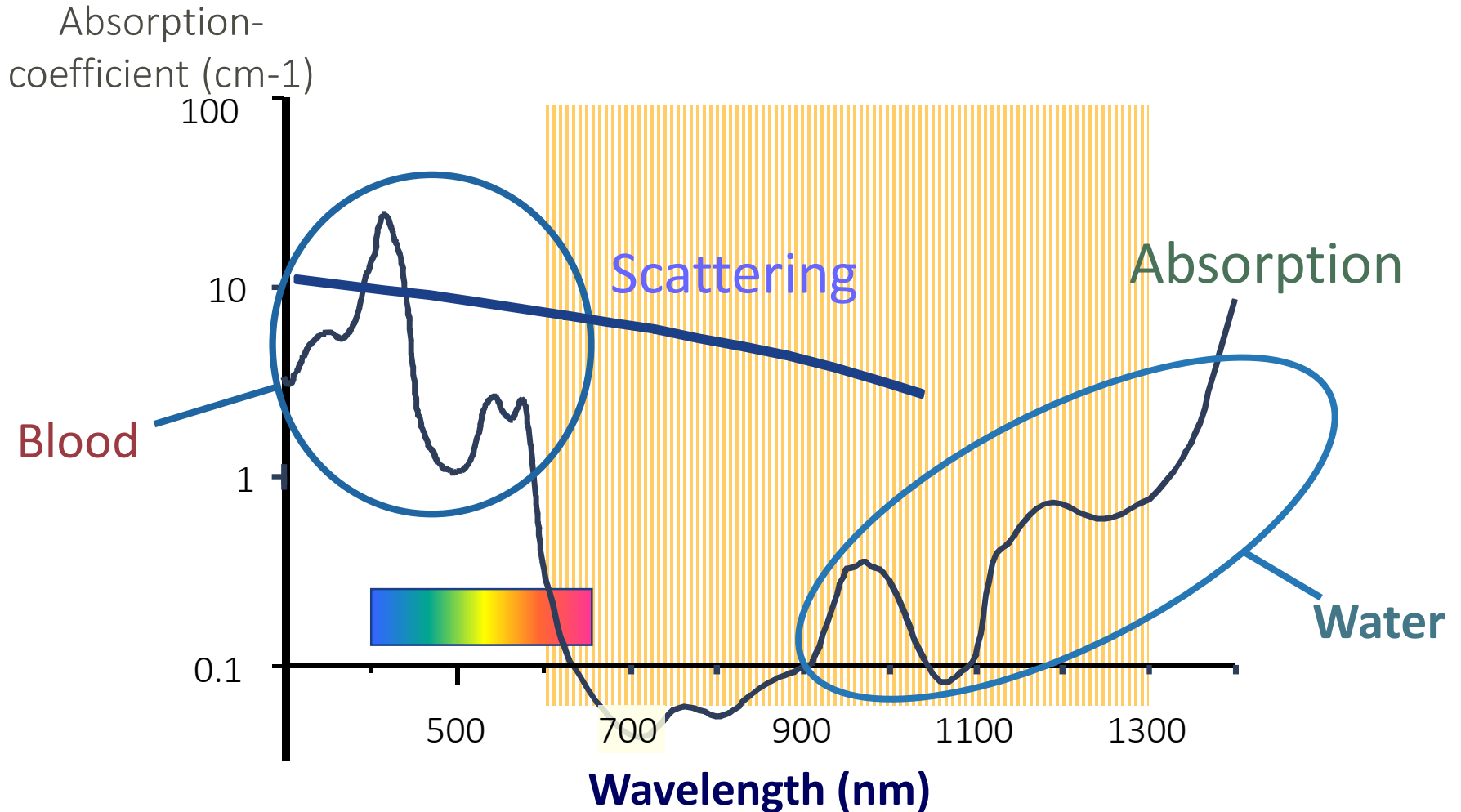
Thickness of a hair between
scattering events

Consequences of scattering

- limited spatial confinement
- limited light penetration



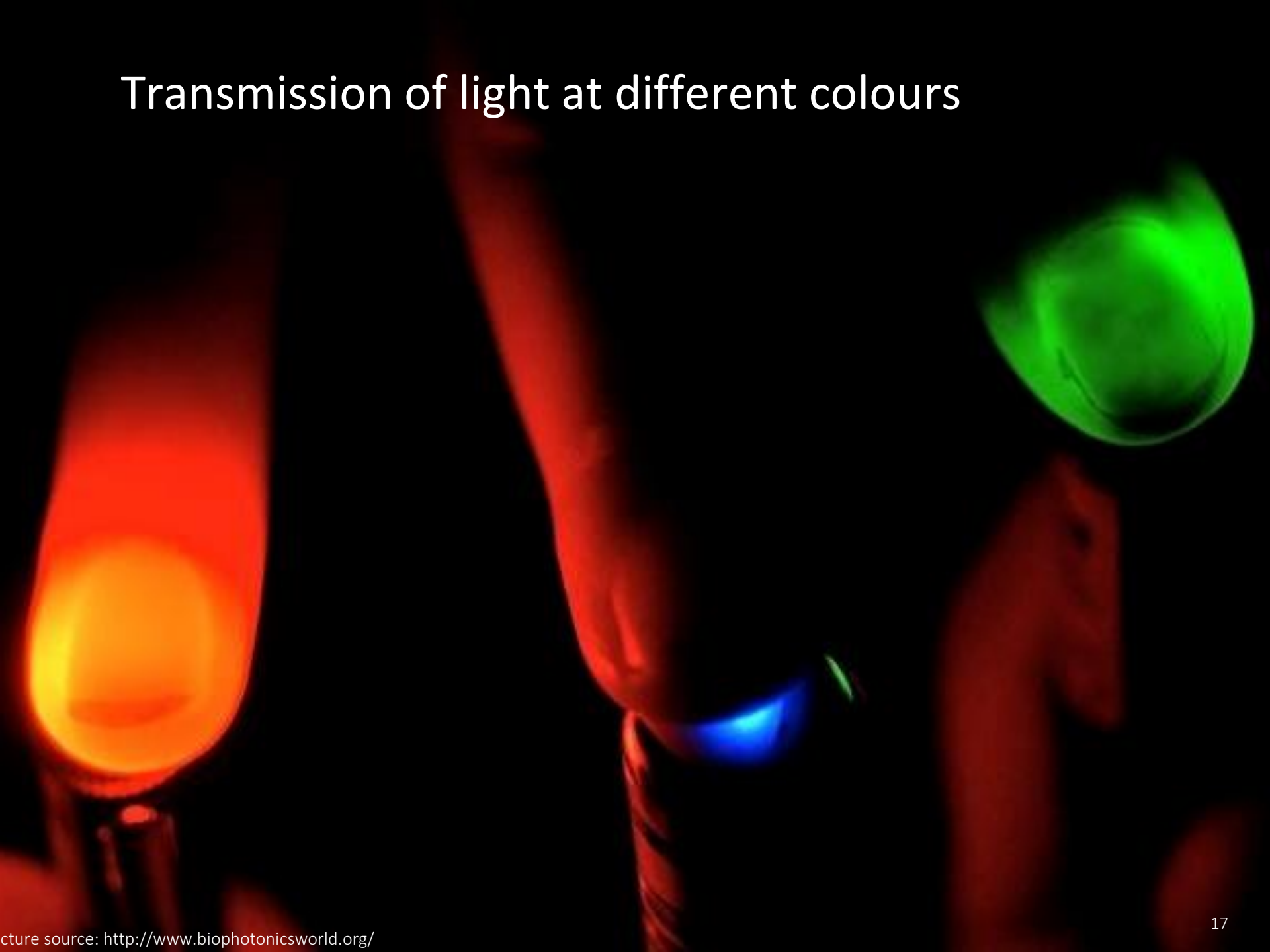
What is absorbing in human tissue?



Wavelength matters!



Transmission of light at different colours



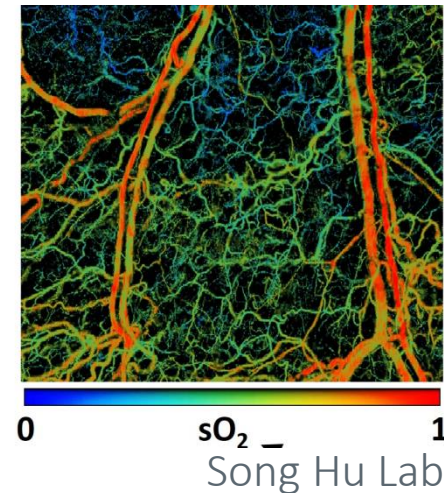
What can we do at Tyndall?



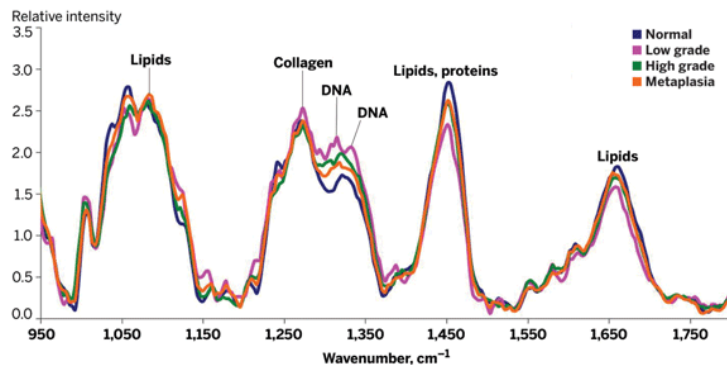
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Metabolic
photoacoustic
microscopy

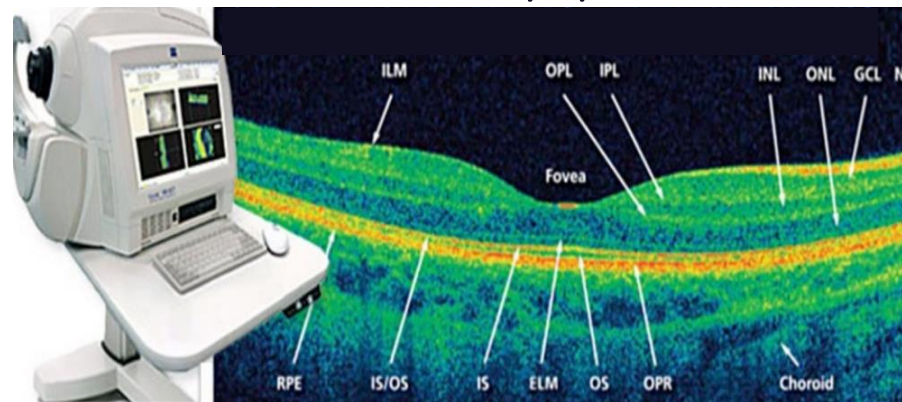


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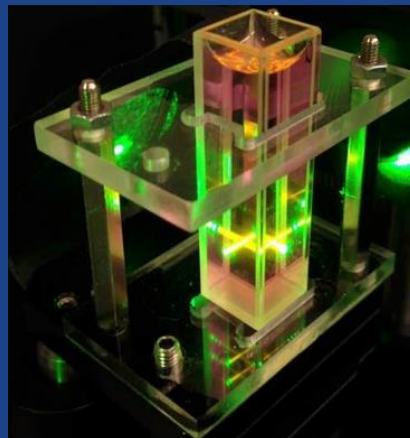
Envision Optical, Carl Zeiss



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United Nations
Educational, Scientific and
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International
Year of Light
2015