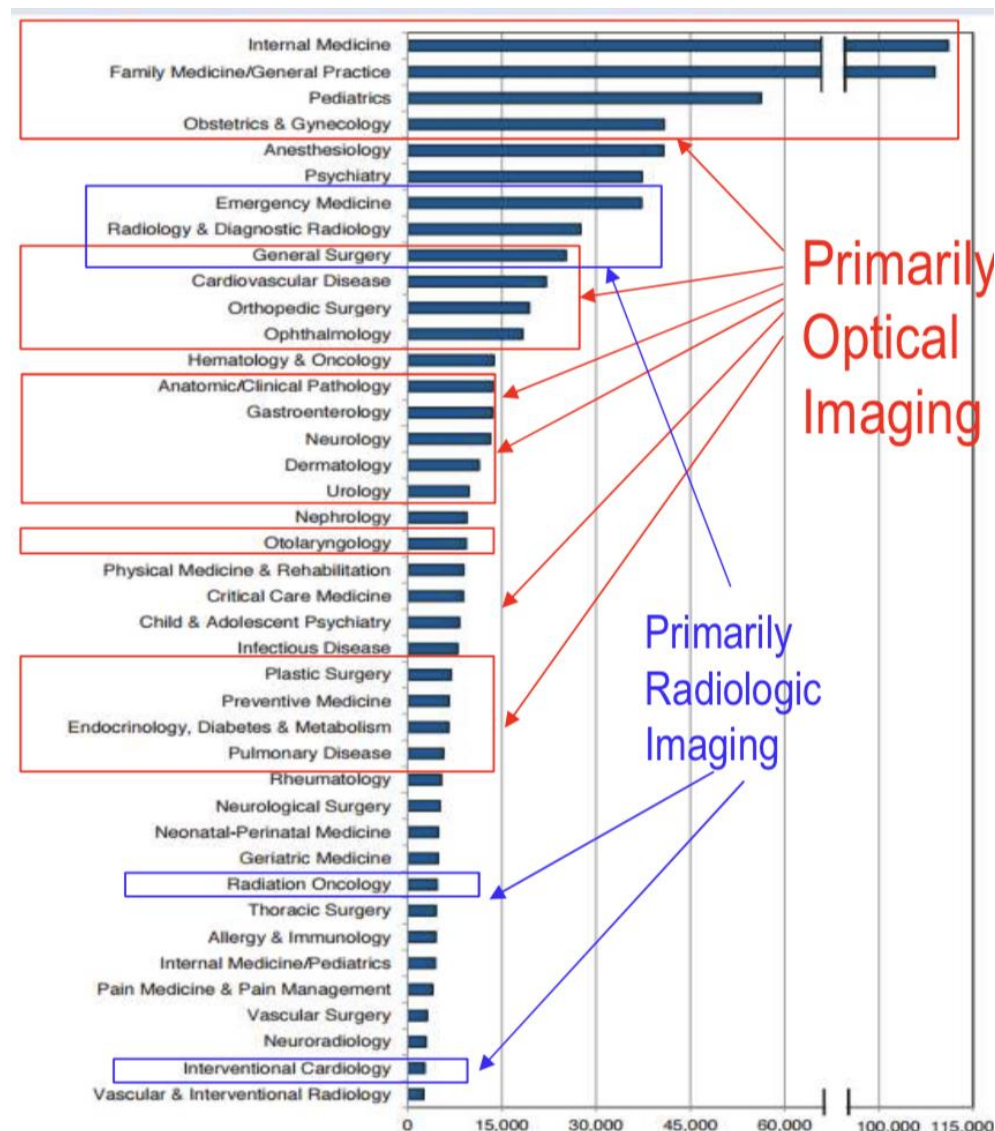


# Other Imaging modalities

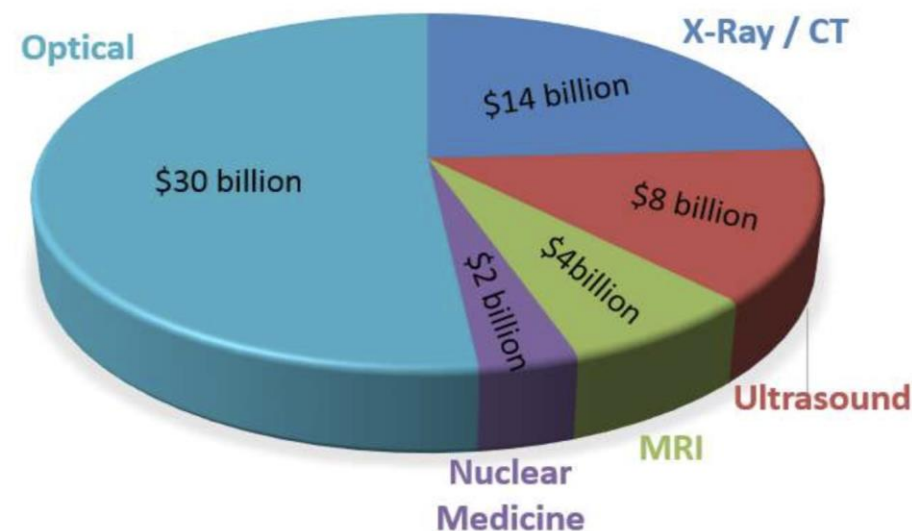
**This lecture will cover:**

- Optical Imaging
- Near-infrared Spectroscopy (fNIRS)

# How important is optical imaging?

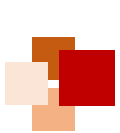


Number of Active doctors



Market analysis

Refs: BCC Research, IBIS World, AMA



# Optical imaging



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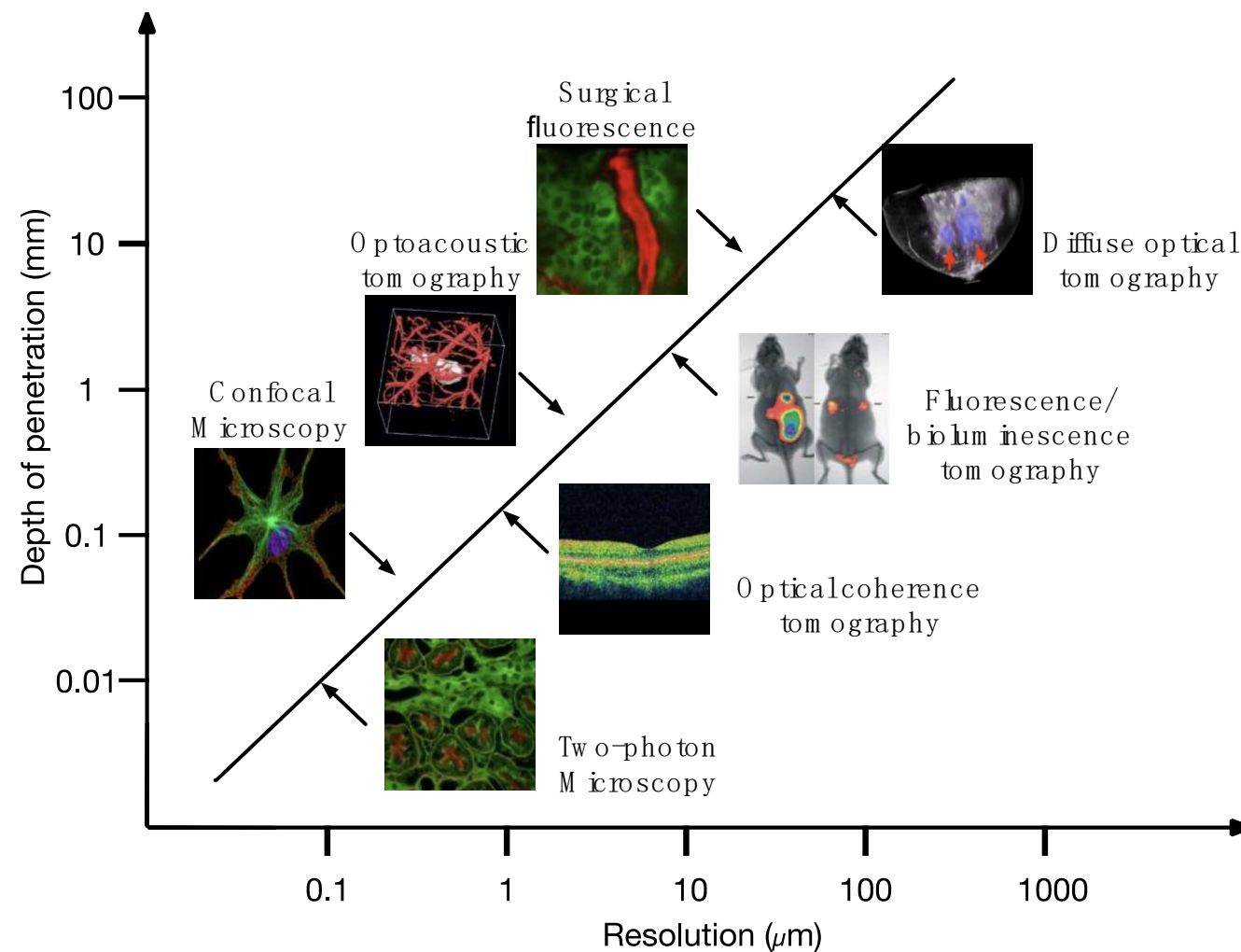
## Advantages:

High sensitivity

Rich contrast

Non-ionizing radiation

Low cost



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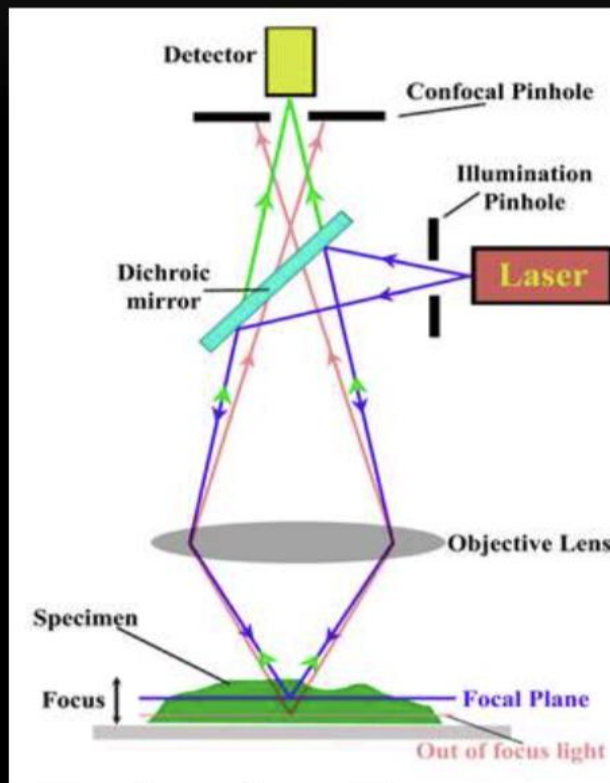


# Confocal Microscopy (共聚焦显微镜)



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Confocal microscopy



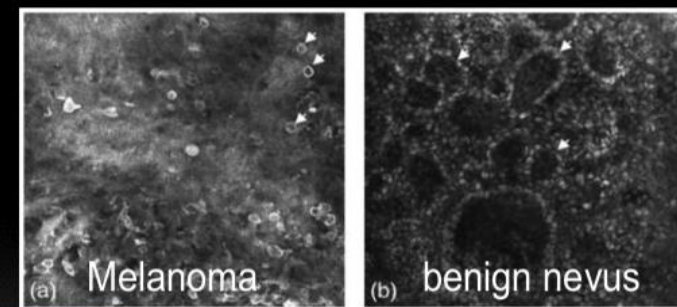
<https://www.jic.ac.uk/>

In vitro



Resolution  $\cong 0.20 \mu\text{m}$   
Penetration  $\cong 40 \mu\text{m}$

In vivo



Resolution  $\cong 2.0 \mu\text{m}$   
Penetration  $\cong 400 \mu\text{m}$

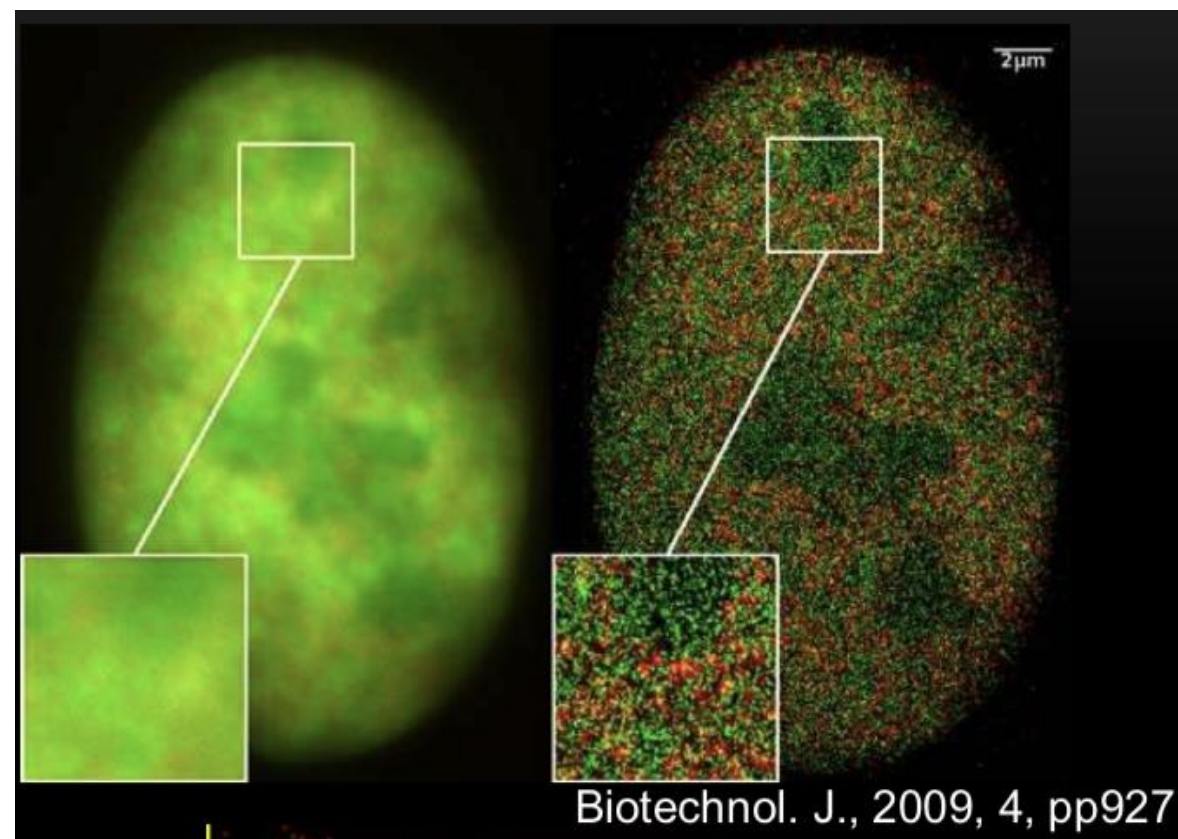
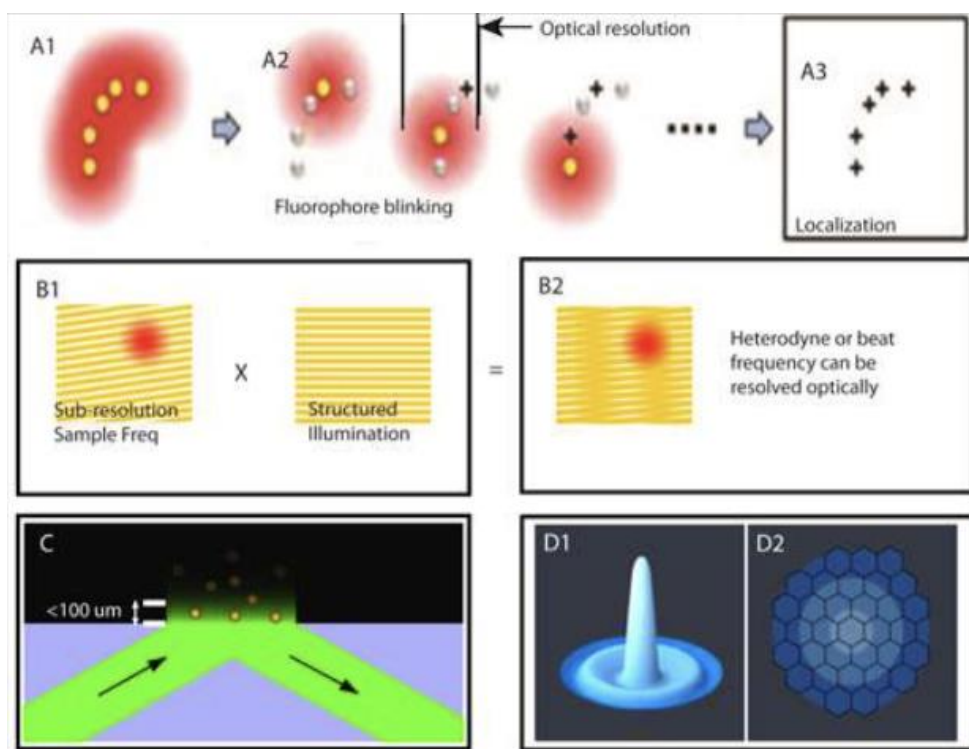


# ■ Super resolution Microscopy (超分辨显微镜)



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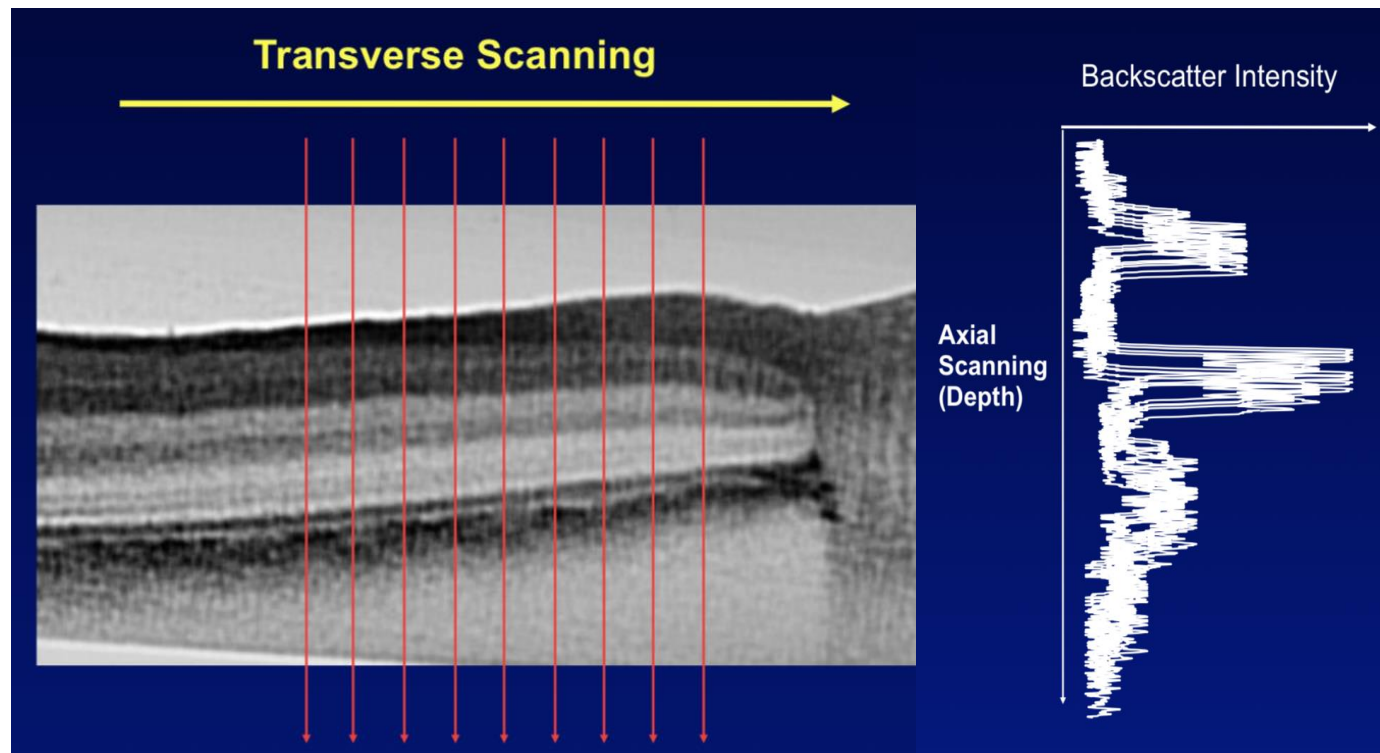
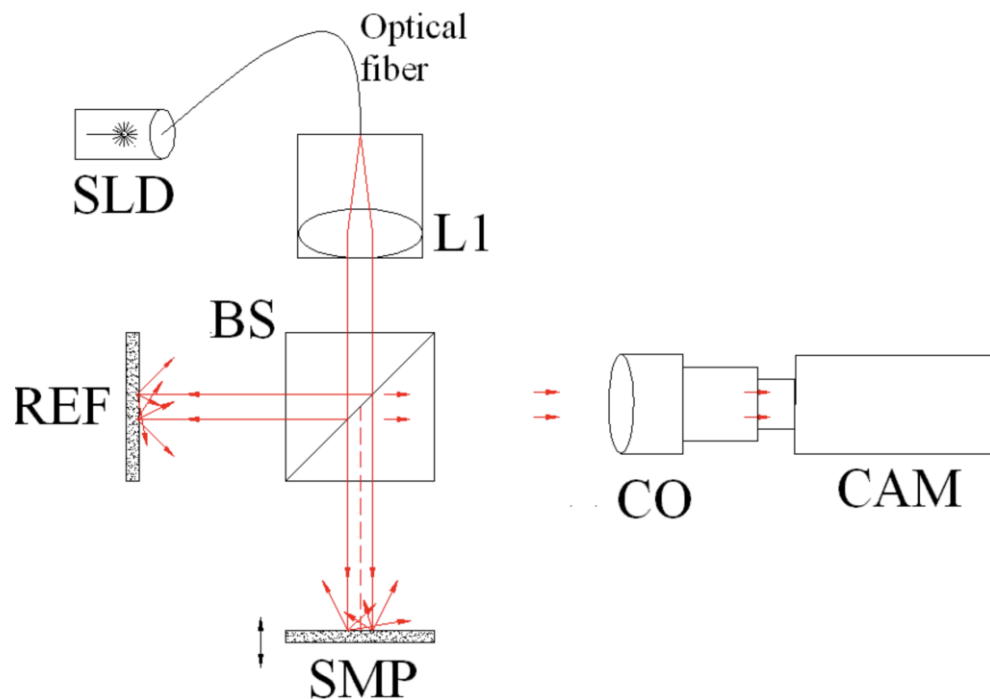
- Stimulated Emission Depletion Microscopy (STED)
- Photoactivated localization microscopy (PALM), Stochastic optical reconstruction microscopy (STORM)



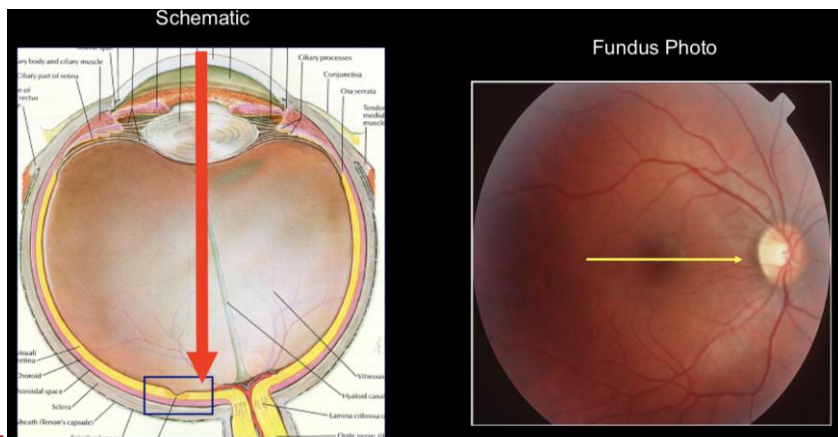
# Optical Coherence Tomography (光学相干断层扫描技术)



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~1 um resolution (micron)



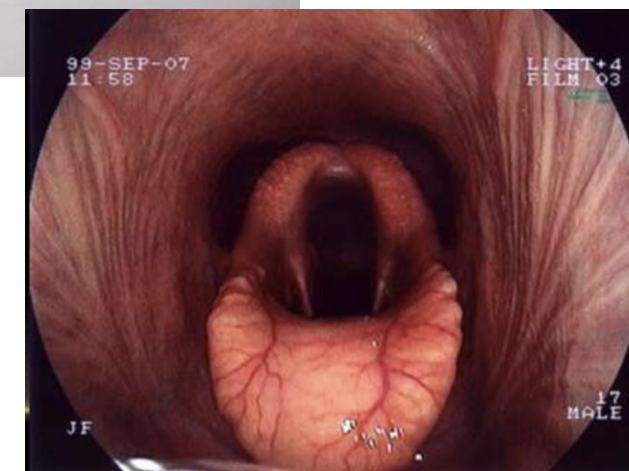
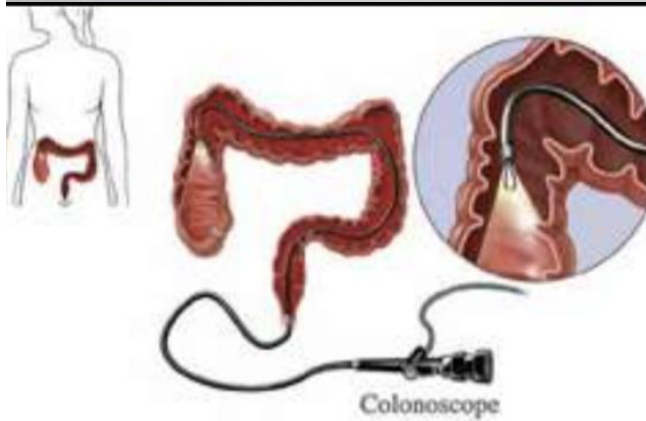
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# ■ Endoscopy (内窥镜)

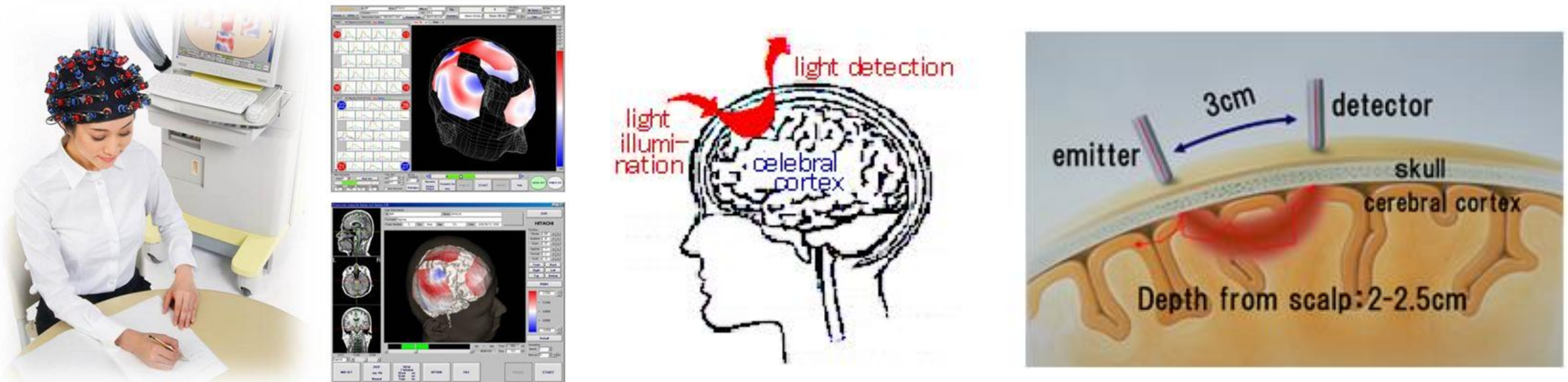


Resolution =  $\sim 0.10$  mm  
Penetration =  $\sim 2$  mm



# Introduction to fNIRS

- Near-infrared spectroscopy: irradiating the subject with light in the near-infrared region and examining the change in absorbance of light;
- Measuring the changes of cortical deoxygenated and oxygenated hemoglobin concentrations

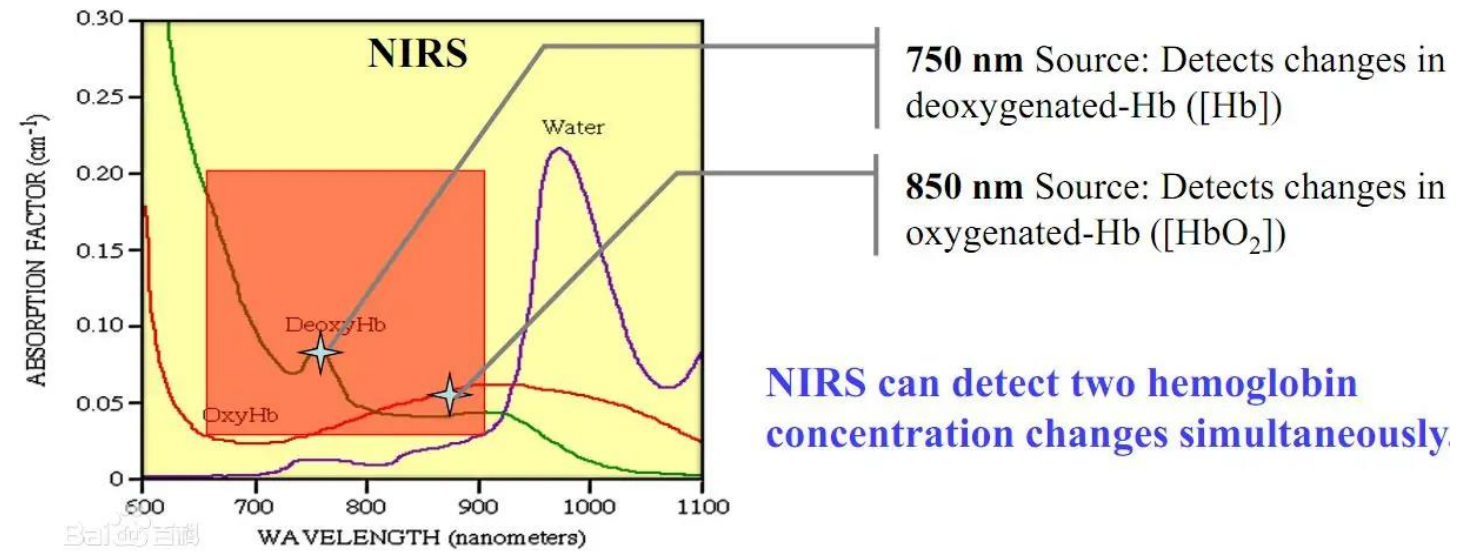
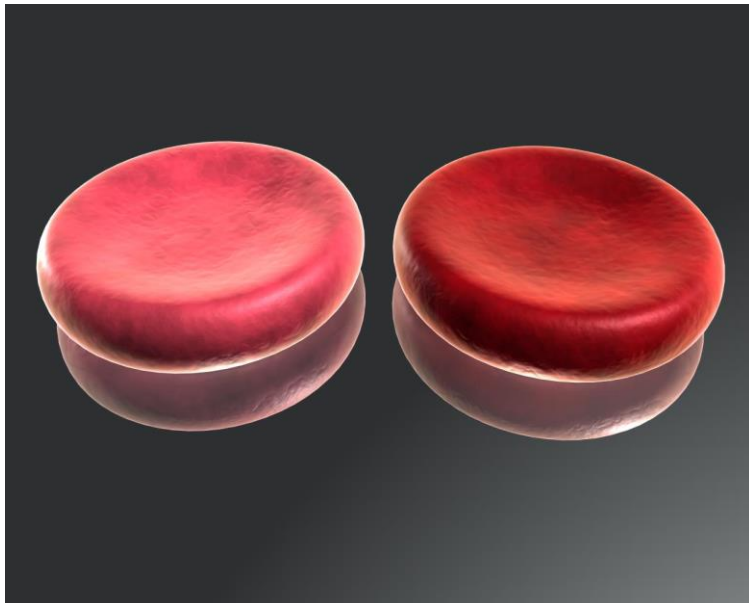


**Fig.** Demonstration of percutaneous measurement of cerebral cortex beneath the skull using fNIRS.



# Optical Window

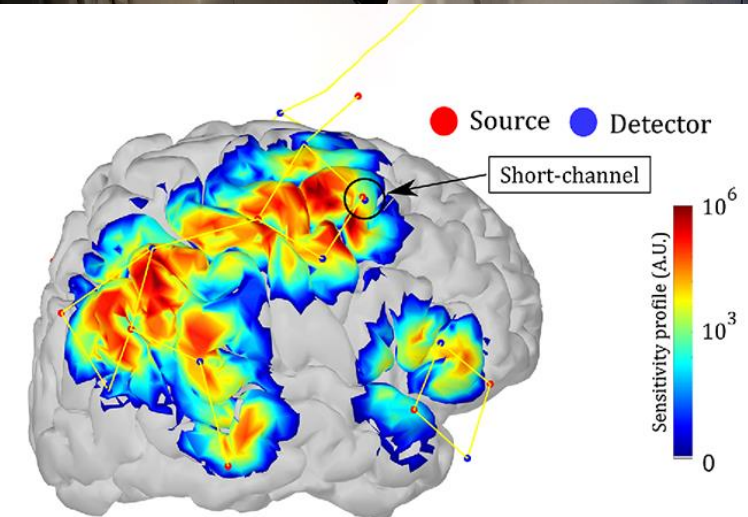
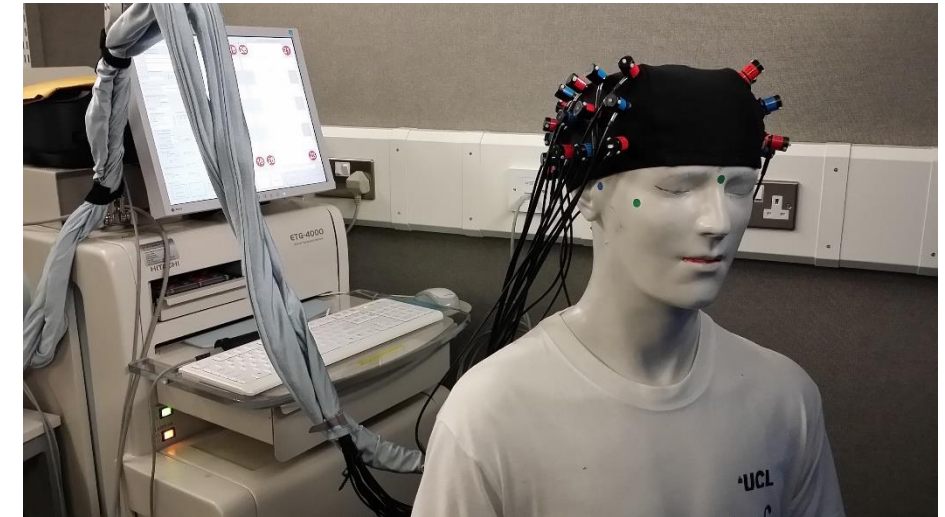
- 650–900 nm spectral interval;
- skin, tissue, and bone are mostly transparent;
- Hemoglobin (Hb) and deoxygenated-hemoglobin (deoxy-Hb) are strong absorbers



**Fig.** (Left) Oxygenated and Deoxygenated Hemoglobin; (Right) Absorption spectra for oxy-Hb and deoxy-Hb for near-infrared wavelengths.

# Features

- Techniques: continuous Wave, frequency Domain, time-Domain
- Advantages: wearable and portable, noninvasiveness, low-cost modalities, perfect safety, high temporal resolution, full compatibility with other imaging modalities, and multiple hemodynamic biomarkers.
- Disadvantage: low brain sensitivity, low spatial resolution, and shallow penetration depth



**Fig.** (Top) a fNIRS system. (bottom) fNIRS brain imaging