XIV CONGRESSO SOCIETÀ OFTALMOLOGICA CALABRESE

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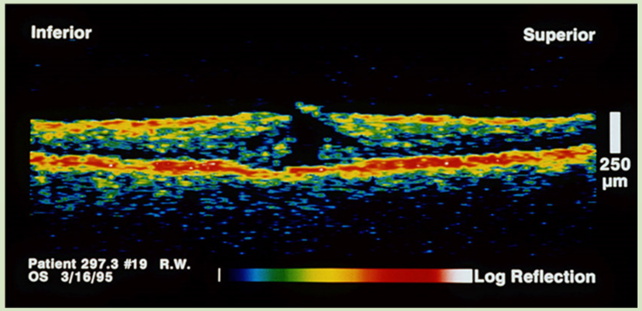
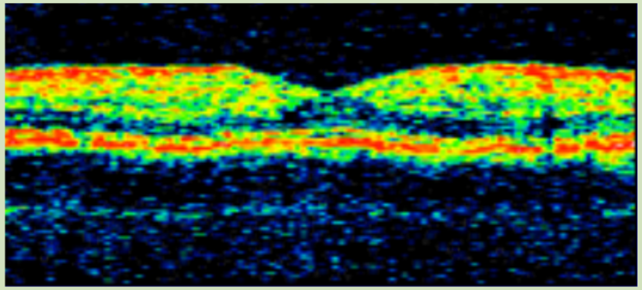
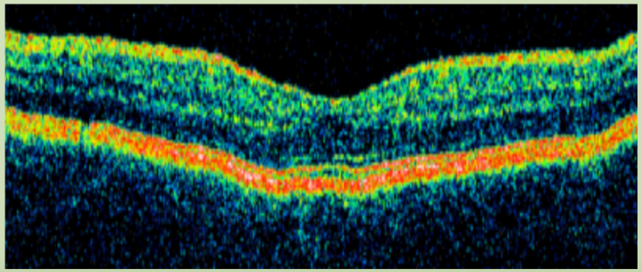
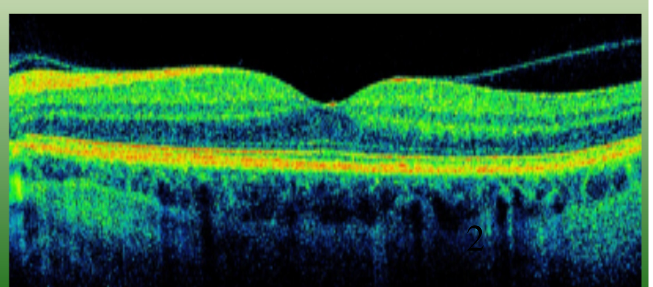
Corso teorico pratico di Semeiotica Strumentale

Responsabile Scientifico: Amedeo Lucente

Nuovi OCT: Prospettive Future

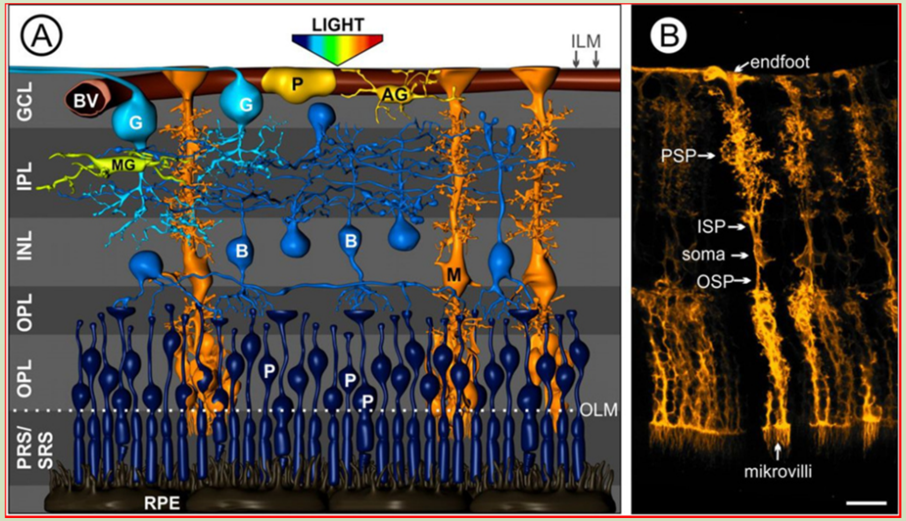
Studio Oculistico
dott. A. Lucente
in oculis salus

The author declares no competing financial interests

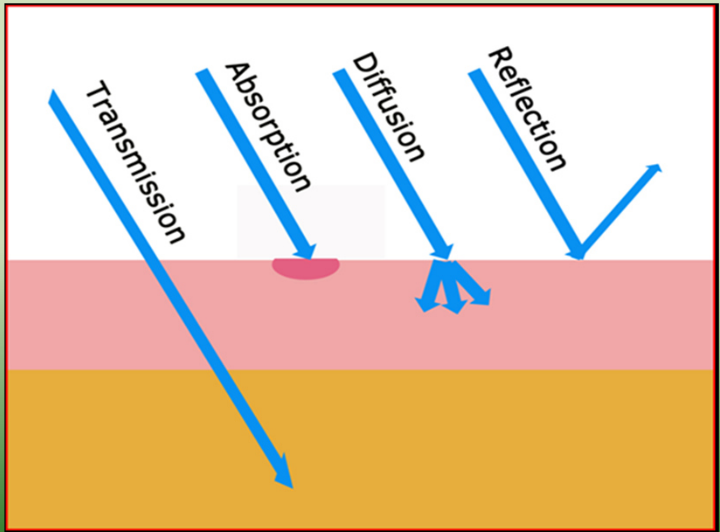
Device		Single line scan	Scans/ second	Resolution (microns)	Imaging
	**OCT 1** **1995**	100 A-scans x 500 points	100	20	
	**OCT 2** **2000**	100 A-scans x 500 points	100	20	
	**OCT 3 Stratus OCT** **2002**	512 A-scans x1024 points	500	10	
	**Cirrus HD-OCT** **2007**	4096 A-scans x 1024 points	27,000	5	

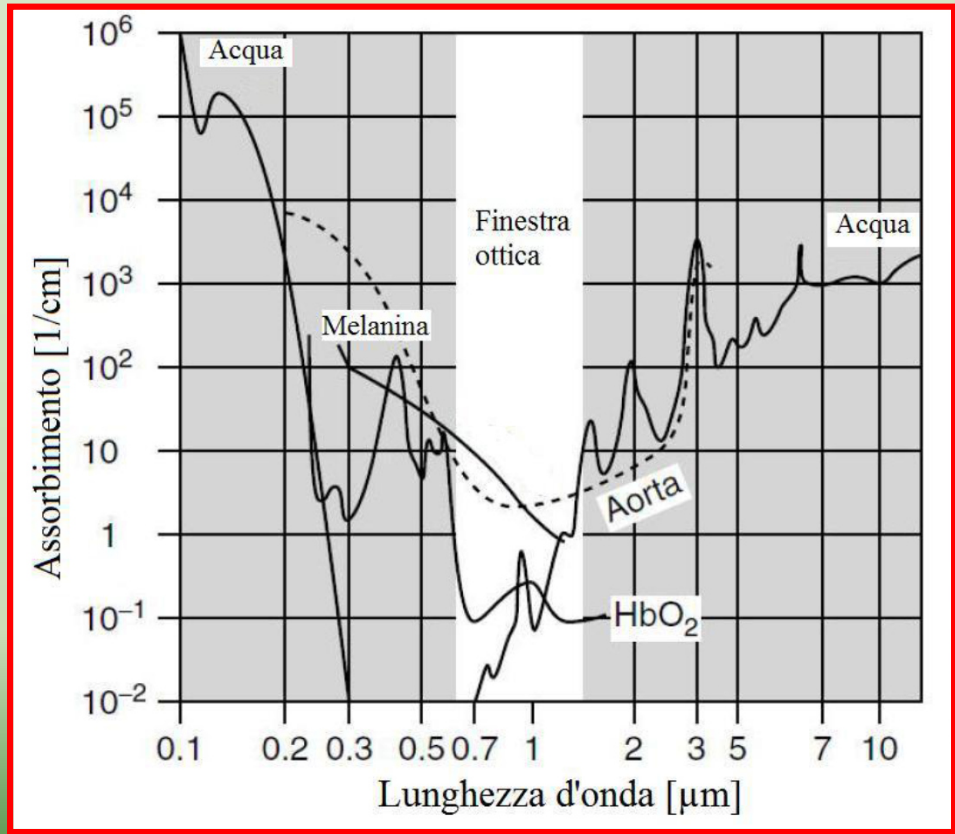
Assorbimento luce/tessuti

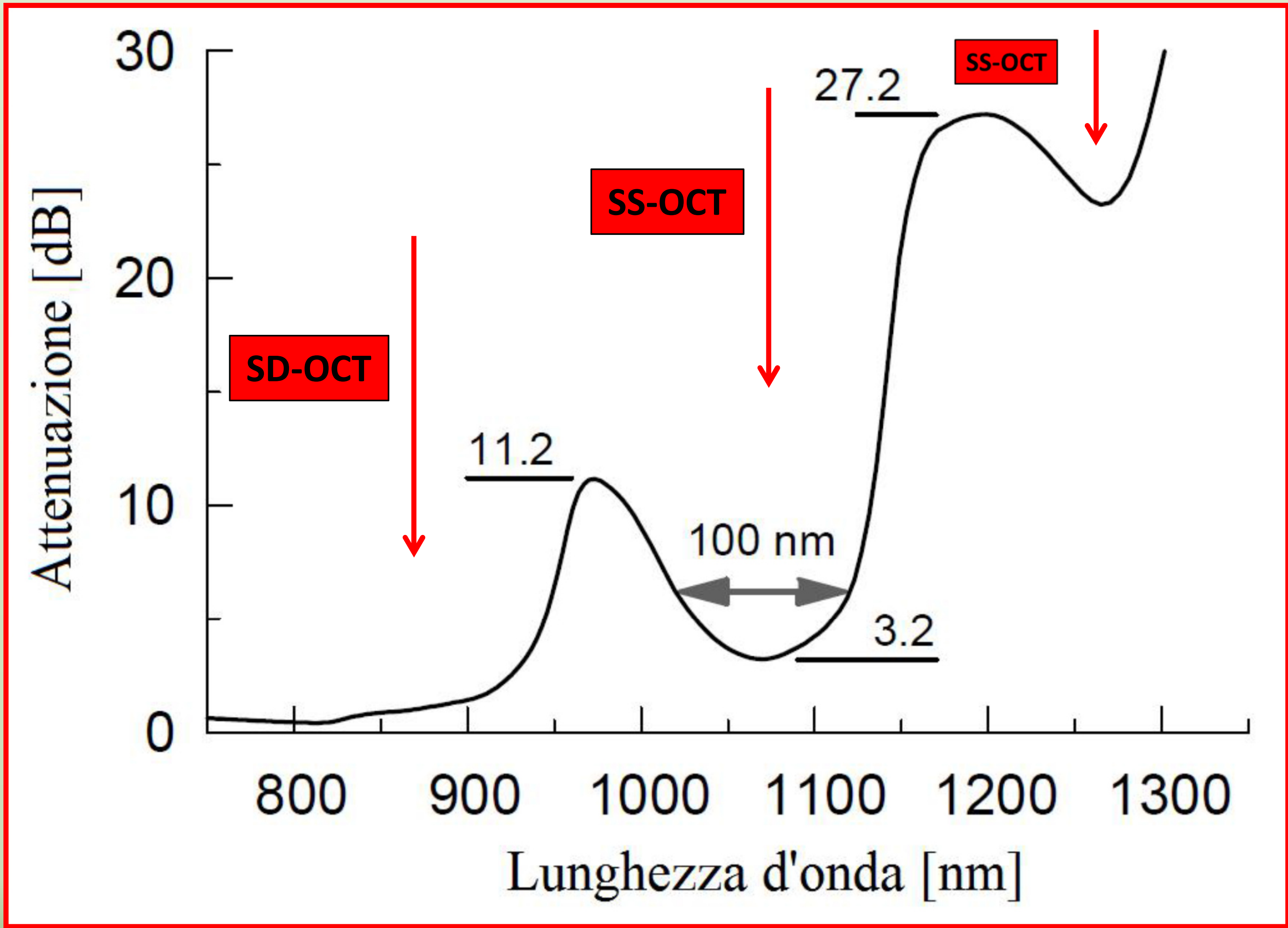
Finestra ottica d'utilizzo 600nm/1500nm



Diffusione = Dispersione = Scattering = Sparpagliamento

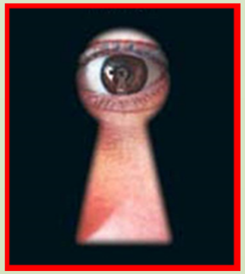






Andamento dell'attenuazione dovuto a 50 mm di acqua, in funzione della lunghezza d'onda; 50 mm di acqua corrispondono circa al percorso di andata e ritorno attraverso l'occhio umano

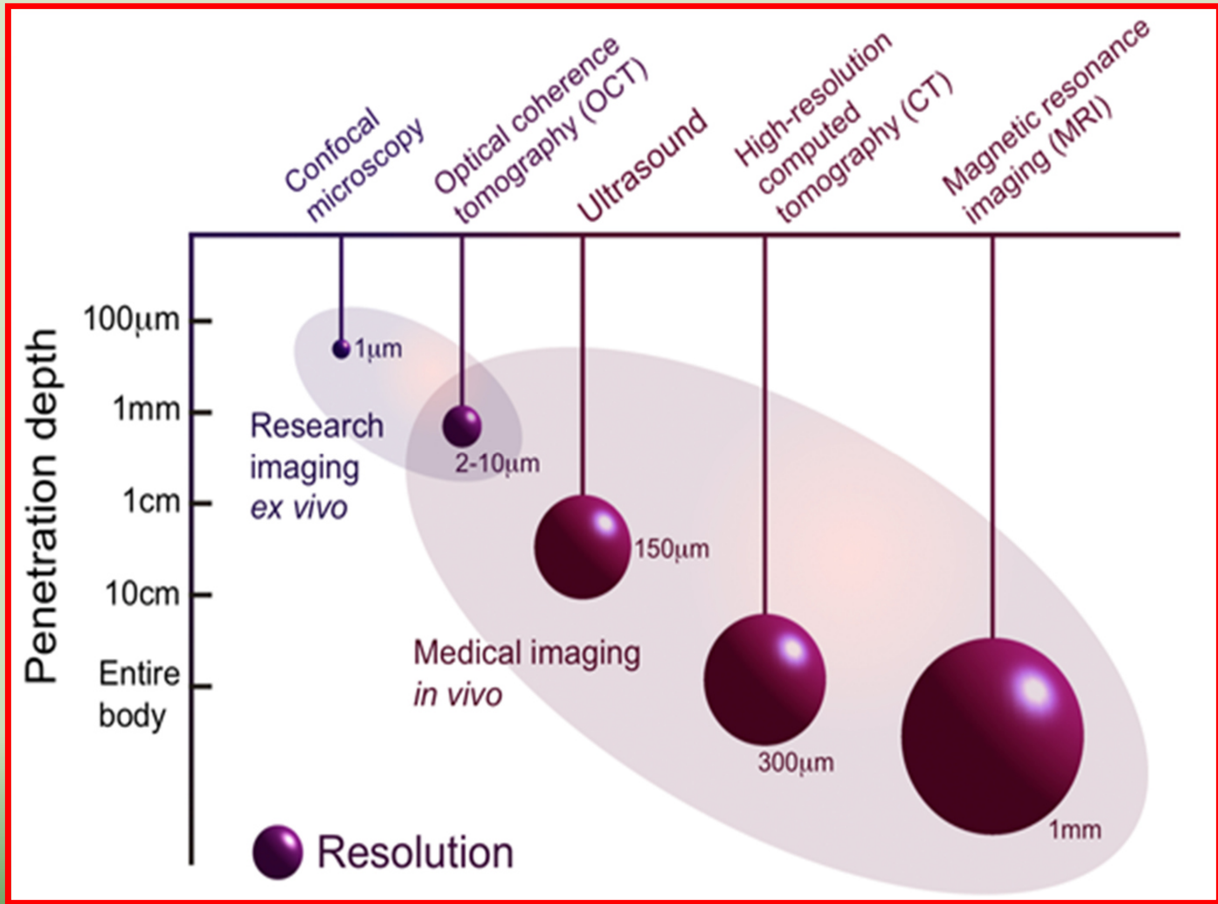
Comparison of OCT resolution and imaging depths to those of alternative techniques; the ***"pendulum" length*** represents imaging depth, and the ***"sphere" size*** represents resolution



Occhio umano
0,1mm = 100 µm

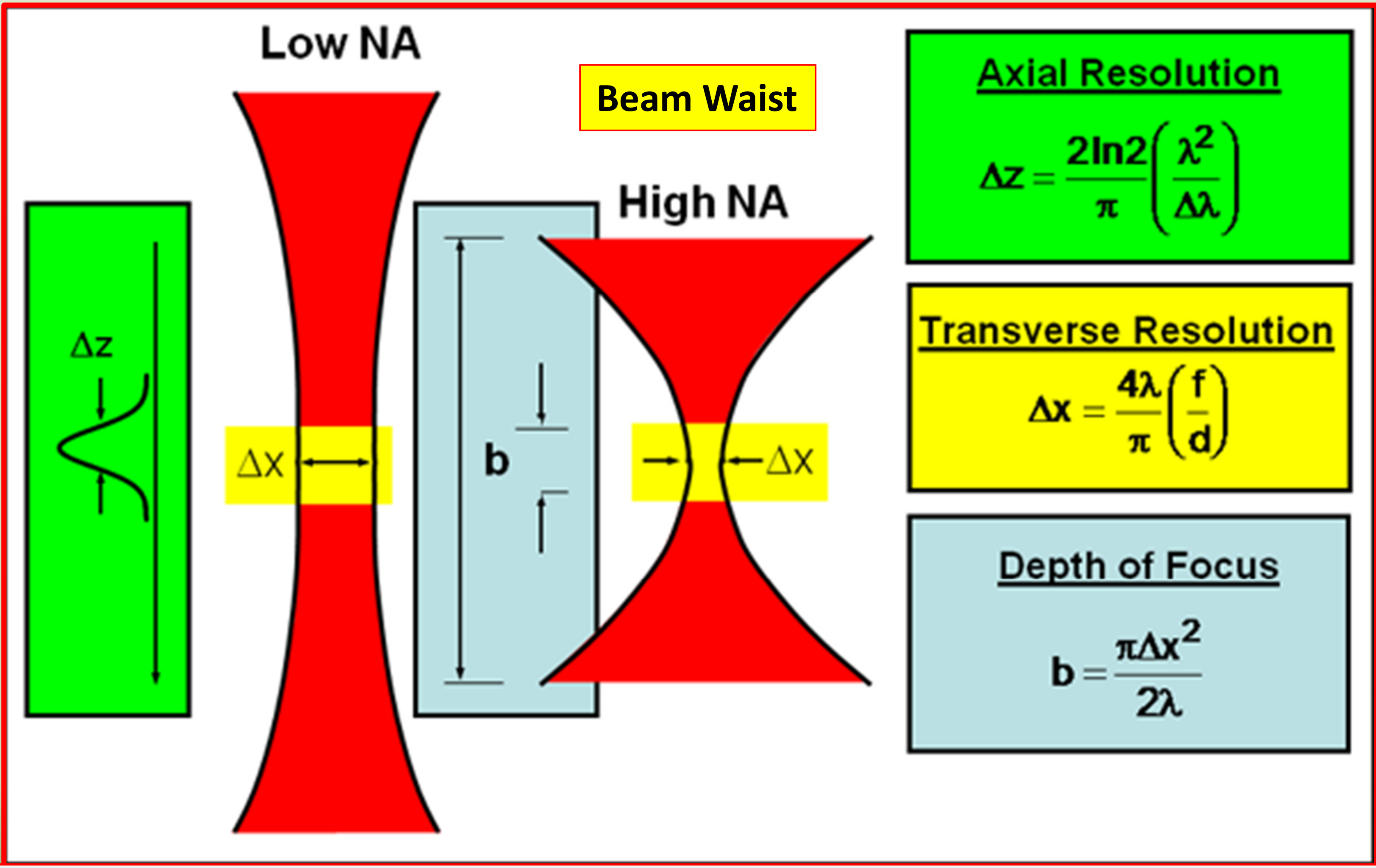
Microscopio Ottico
0,2 µm
1 µm = 0,001mm

Microscopio Elettronico
0,1nm
1nm = 0,001 µm



Resolution: limits of OCT

MEDIZINISCHE UNIVERSITÄT WIEN

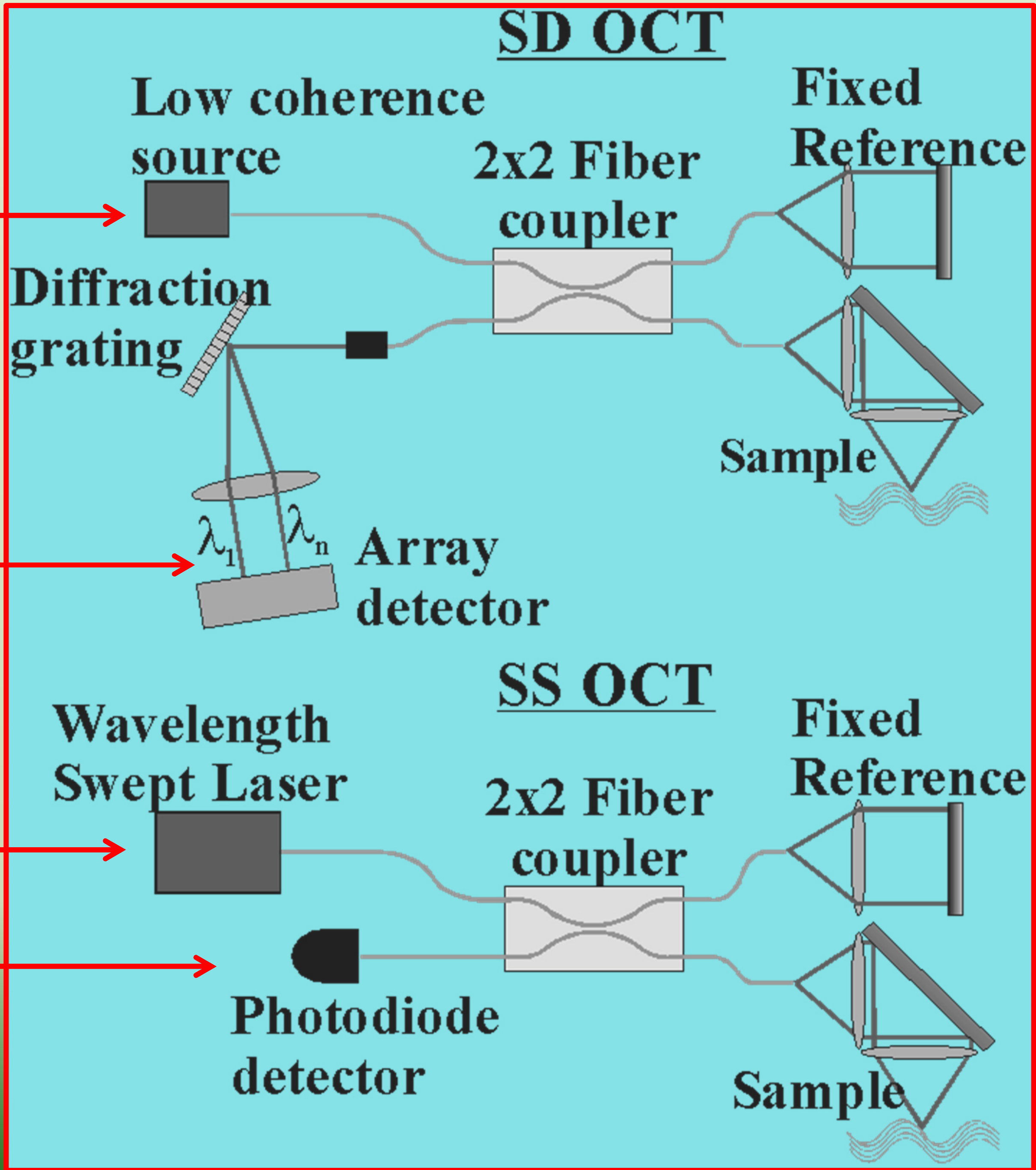


OCT can achieve high axial resolutions independent of numerical aperture. Using low coherence interferometry, the axial resolution is inversely proportional to the bandwidth of the light source. The transverse resolution is given by the focus spot size. The depth of field is determined by the confocal parameter of the focused beam

Performance of OCT

- ***Roll-off di performance*** riduzione della potenza del segnale OCT con l'aumentare della profondità **(~ 20dB/profondità di 2 mm)**
- ***Sensibilità*** rapporto segnale/rumore SNR **~ 95dB**
- ***Velocità d'acquisizione o d'imaging*** A-scan rate
- ***Range dinamico*** rapporto di potenza del segnale, tra la più forte e la più debole riflessione A-scan che può essere misurata **(~ 40-50dB)**

A banda larga



A banda stretta

Swept Source v/s Sepctral Domine OCT

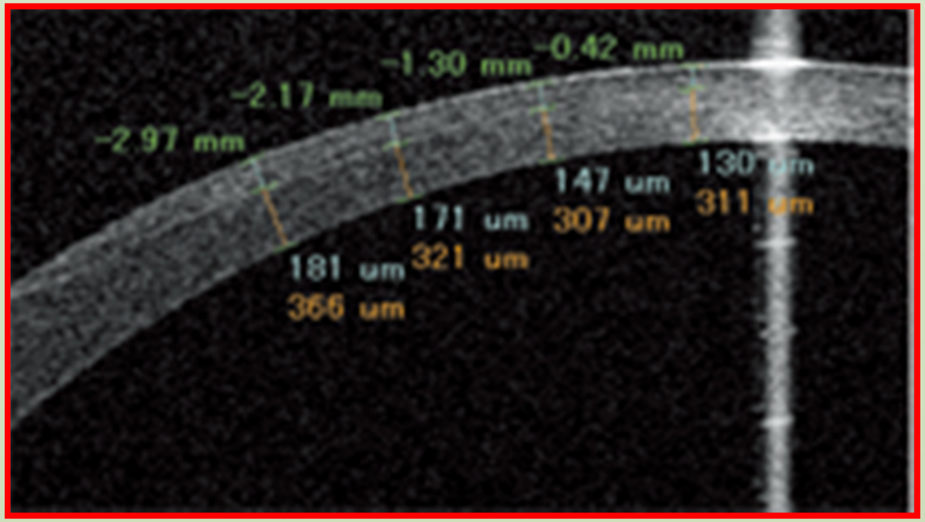
	SS-OCT	SD-OCT
Light source	Swept laser	SLD
Center wavelength	**1,050 nm**	840 nm
A-scan rate	**100,000 Hz**	50,000 Hz
Resolution (x)	20 um	20 um
Resolution (z)	8 um	6 um
B-scan measurement time	1.0 sec (96x)	1.0 sec (50x)
Imaging depth	**2.6 mm**	2.3 mm

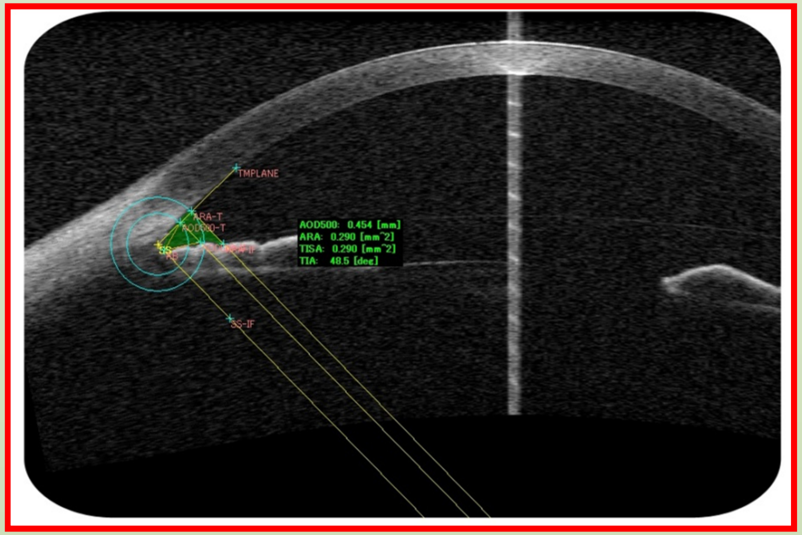
Complete 360° circumferential SSOCT gonioscopy of the iridocorneal angle

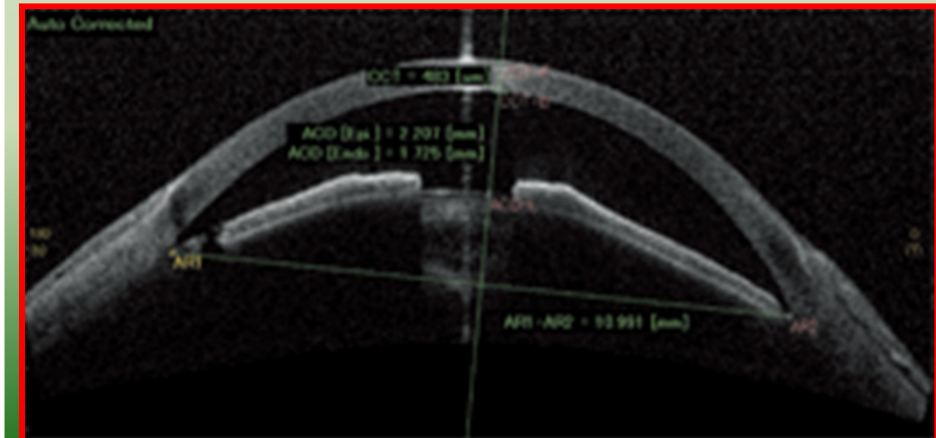
Ophthalmic Technologies XXIV, 89300I ***(28 February 2014)***

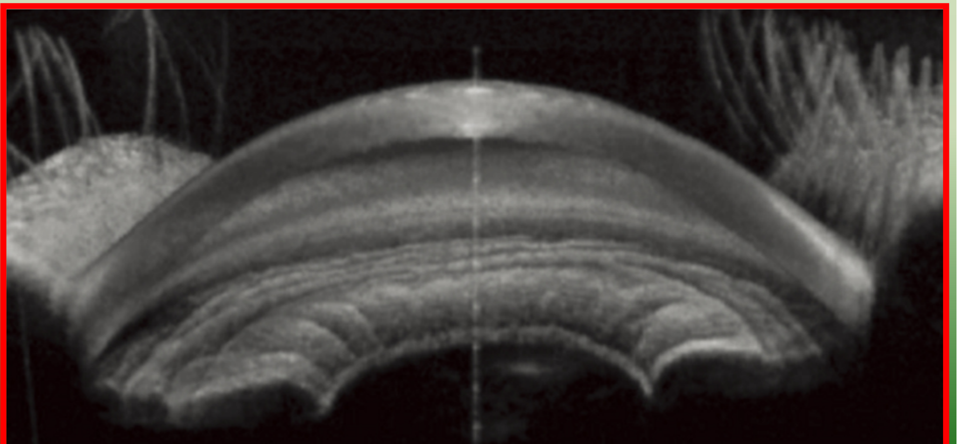
Author(s): Ryan P. McNabb; Anthony N. Kuo; Joseph A. Izatt

Resolution Imaging of	**10 µm Axial; 30 µm Transverse**
High speed scanning of	**30,000 A-scans/sec**



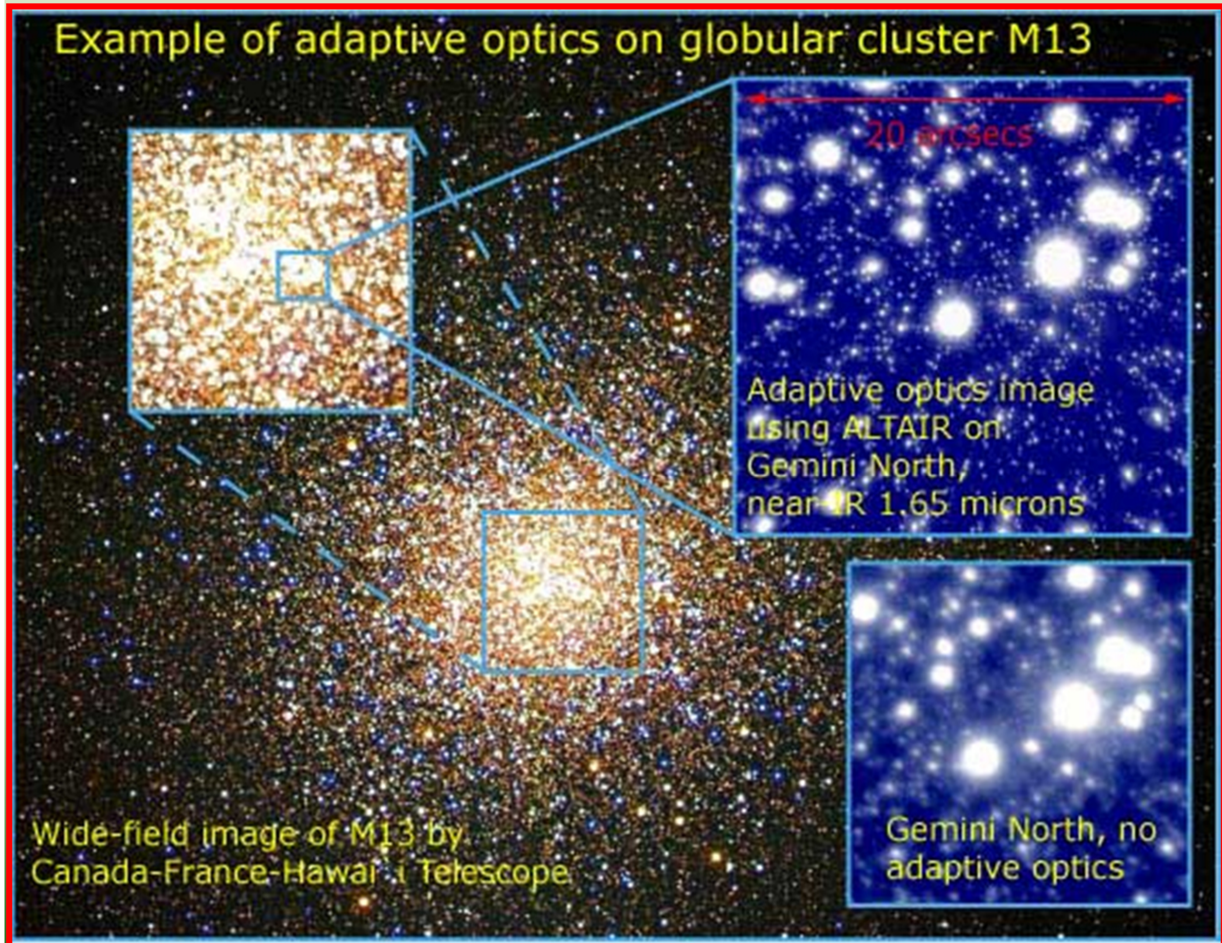






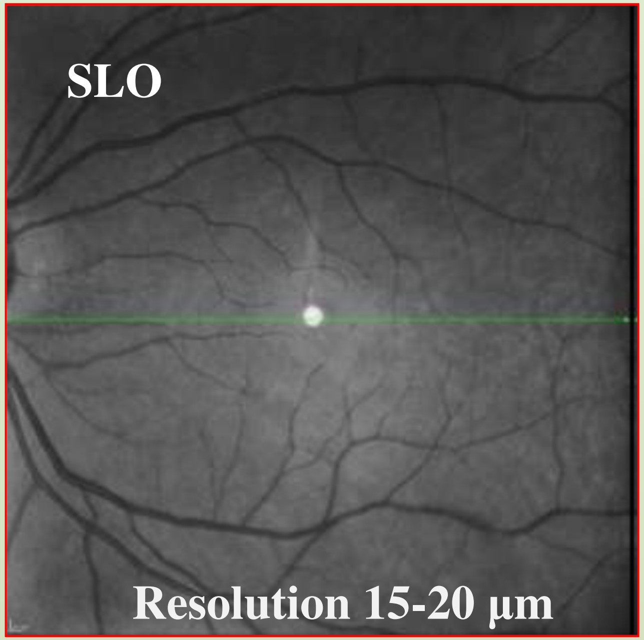
AO & *Gemini Observatory*

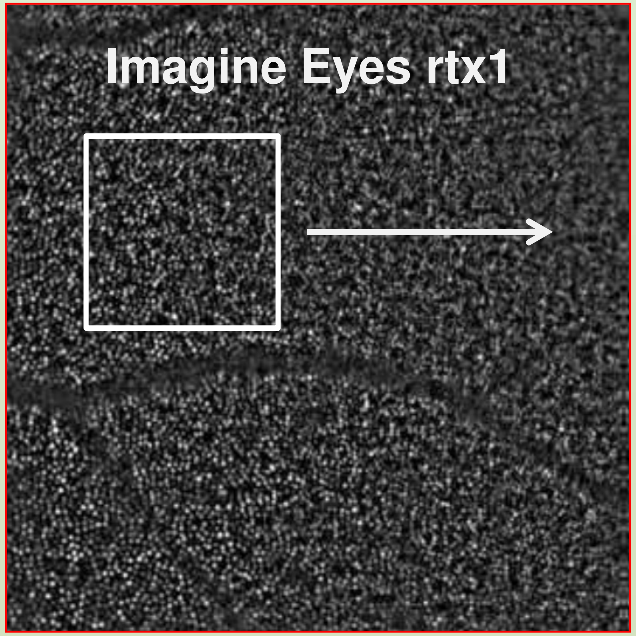
184 milioni di dollari
40 000 dollari/die per ognuno dei Telescopi.

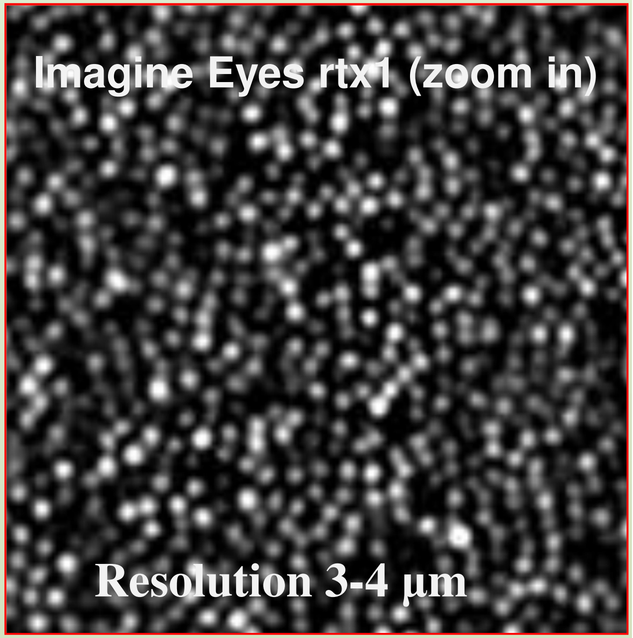


Télescope Gemini North
sur le Mauna Kea (**Hawaii**)

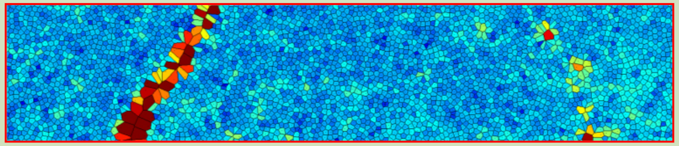
Télescope Gemini South
sur le Cerro Pachon (**Chili**)

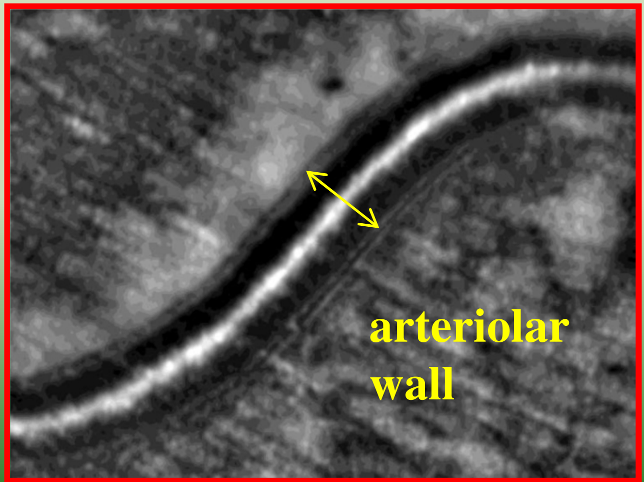


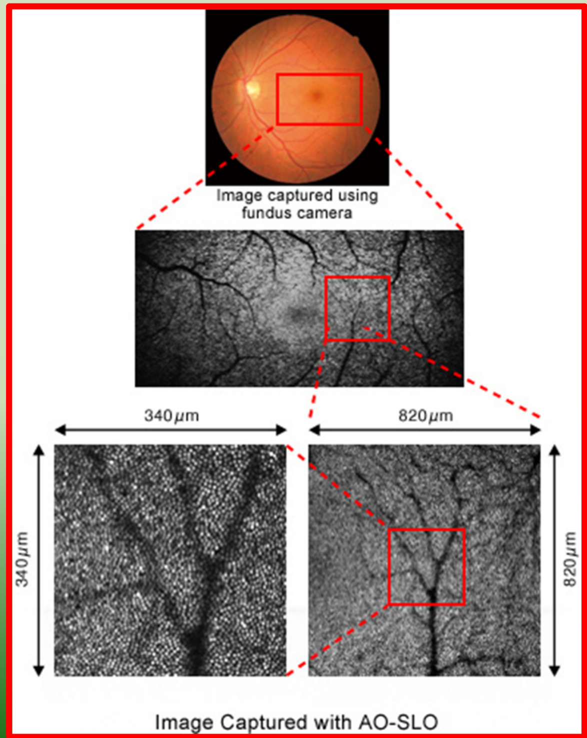




50 µm







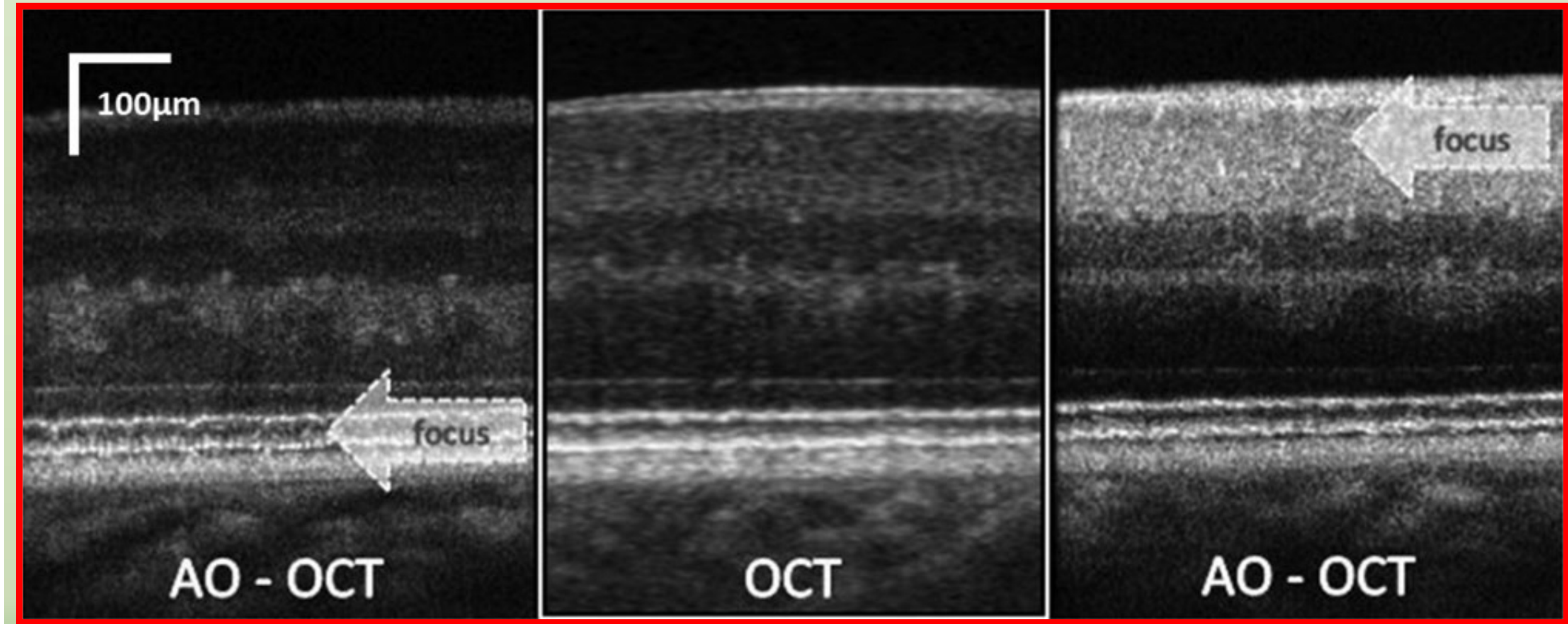
AOimage™

AOdetect™-mosaic

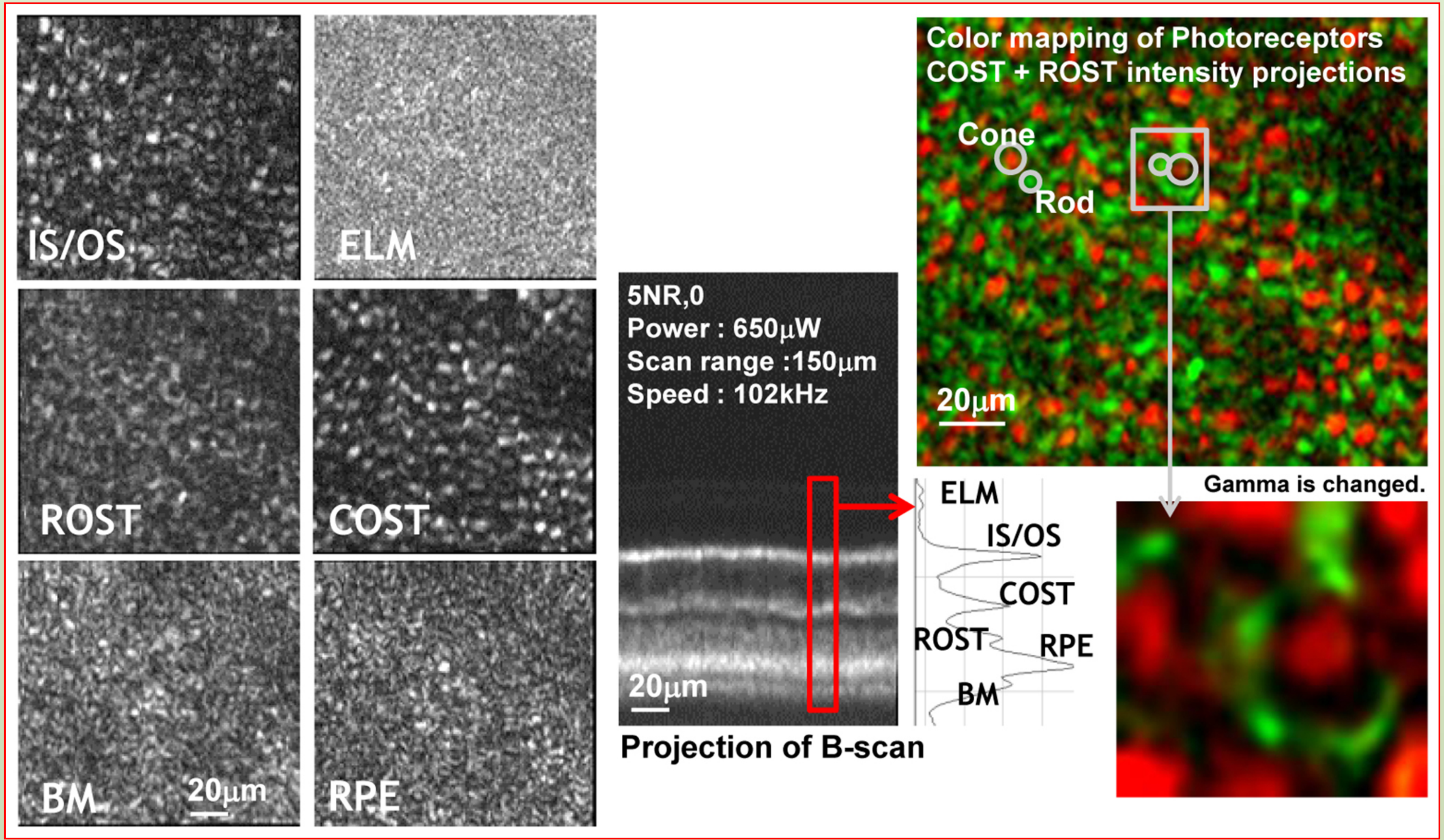
AOdetect™-artery

i2k Retina Stitching

AO-OCT



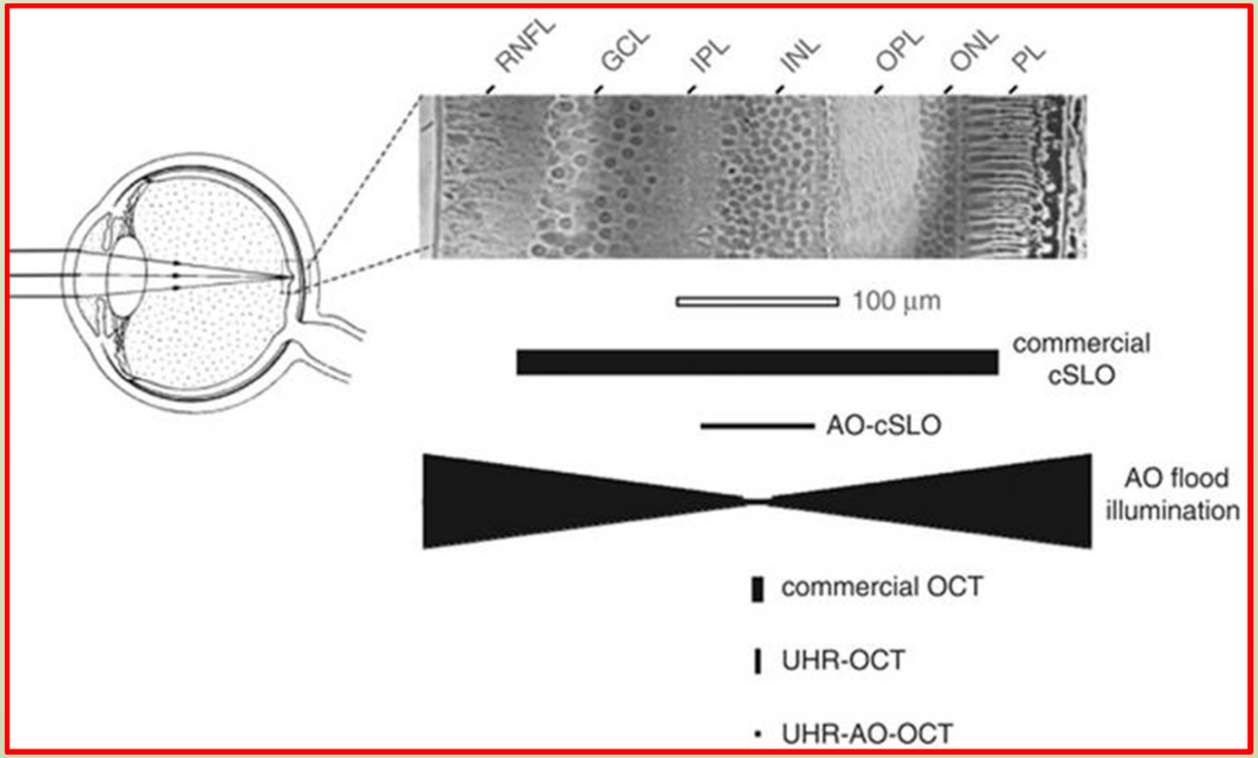
Robert J. Zawadzki IEEE JOURNAL OF SELECTED TOPICS IN QUANTUM ELECTRONICS, VOL. 20, NO. 2, MARCH/APRIL 2014



Intensity projections of different retinal layers from a single **AO-OCT** volume focused on outer retina. **ELM** – external limiting membrane; **IS/OS** – photoreceptors inner/outer segment junction, **COST** – cone outer segments tips; **ROST** rod outer segments tips, **RPE** – retinal pigment epithelium, **BM** – Bruch's membrane by: Sang-Hyuck Lee, John S. Werner, and Robert J. Zawadzki, 2013

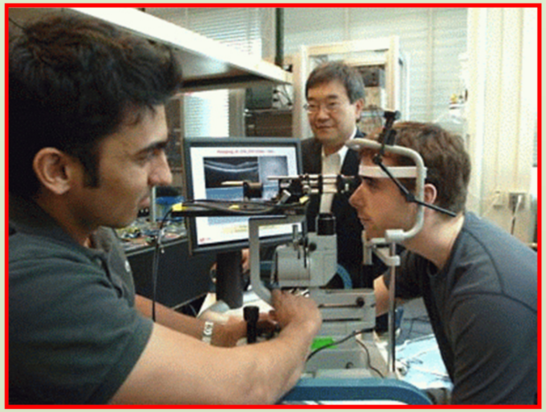
Benefit of Adaptive Optics

a) Increased lateral resolution
b) Reduced speckle size (granular artifact)
c) Increased sensitivity to weak reflections



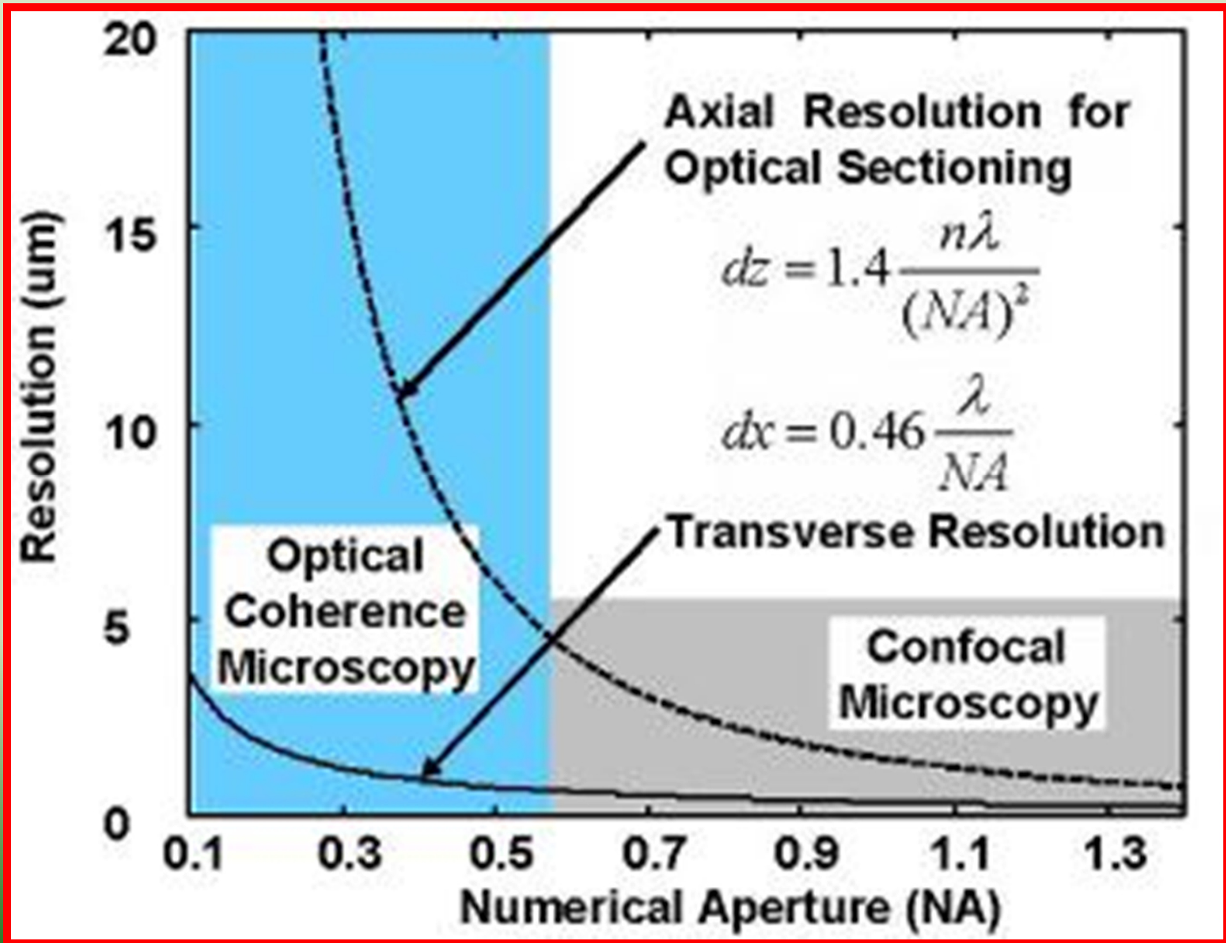
Examples shown include the commercial confocal scanning laser ophthalmoscope (**cSLO**), confocal scanning laser ophthalmoscope with adaptive optics **(AO–cSLO),** flood illumination with adaptive optics, commercial OCT, ultrahigh-resolution **OCT (UHR–OCT**), and ultrahigh-resolution OCT with adaptive optics **(UHR–AO–OCT**).
Miller DT et al. Eye (Lond). 2011 Mar;25(3):321-30. doi:10.1038/eye.2011.1.

Optical Coherence Microscopy (OCM) **combines** the coherent detection methods of **OCT with confocal microscopy**. OCM provides **enhanced penetration depth** compared to standard confocal microscopy, while **dramatically improving the resolution** over cross-sectional OCT imaging. **James G. Fujimoto**



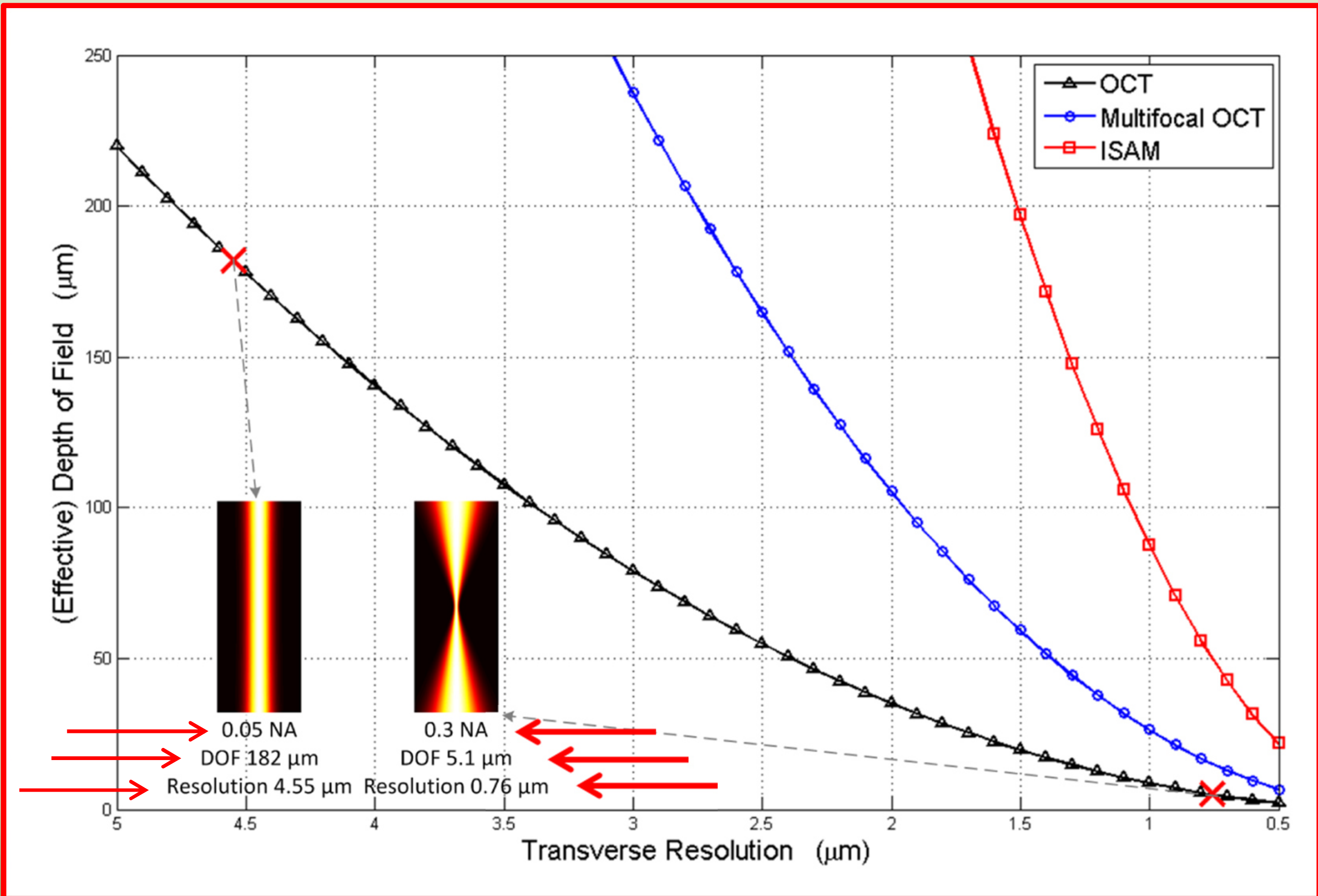
RLE ***Research Laboratory of Electronics***

MIT ***Massachusetts Institute of Technology***



Yang Xu et al. published 27 Jun 2014 OPTICS EXPRESS

MISAM *Multifocal Interferometric Synthetic Aperture Microscopy*



Trade-off between the effective **DOF**, **Depth Of Field**, and **Transverse Resolution** in **OCT Multifocal OCT** and **ISAM**, **Interferometric Synthetic Aperture Microscopy**, at **wavelength** of **1 μm** and whth refractive index of 1.4

Thanks for

Your attention

Studio Oculistico

dott. A. Lucente

in oculis salus