LAMELIS 2017
Lasers in Medicine and Life Sciences

OPTICAL COHERENCE TOMOGRAPHY

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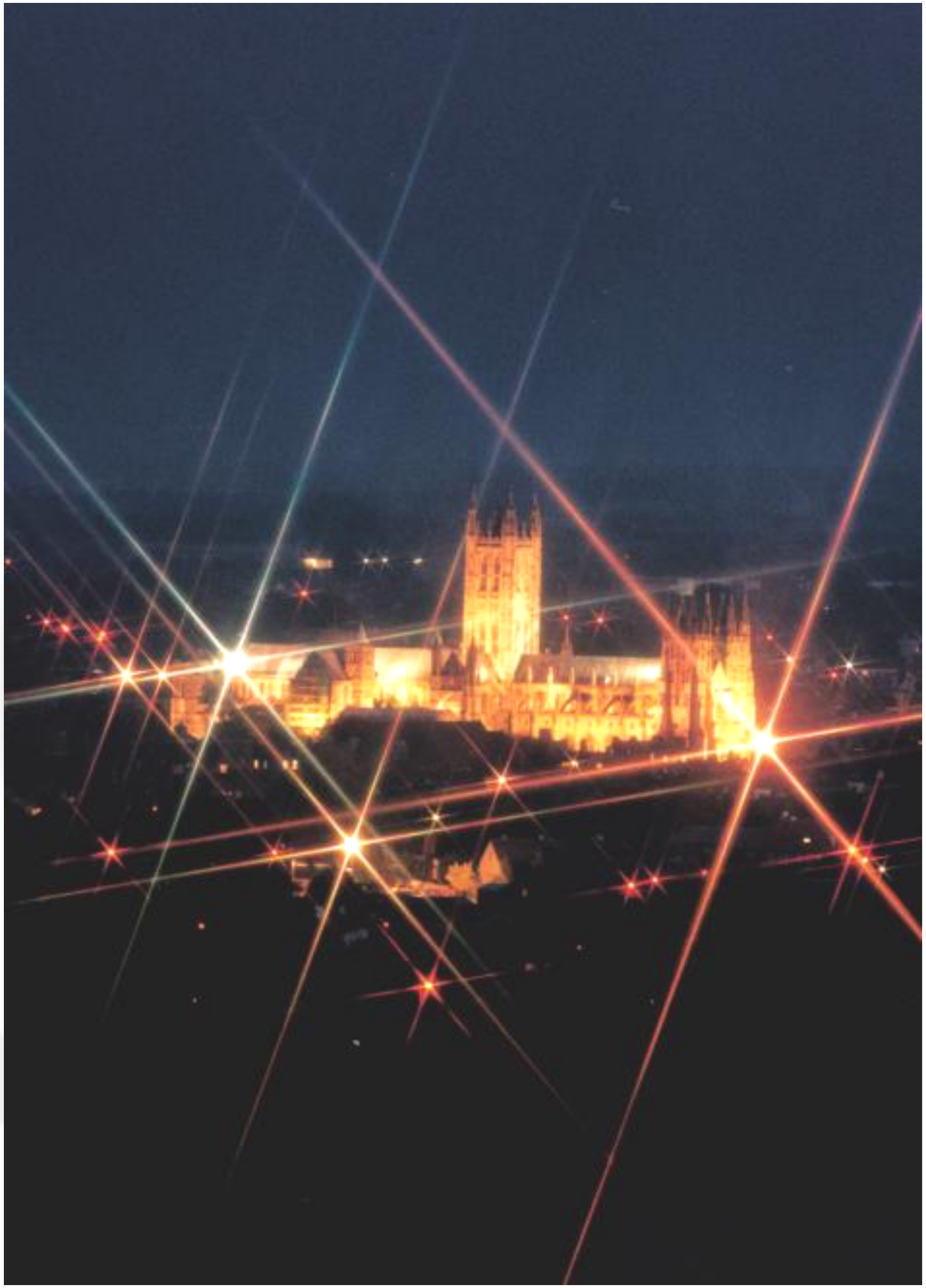
Location

- Main campus in Canterbury
- 50 minutes by Hitachi train from London, 90 minutes by other trains or by road
- 15 minutes from the coast
- Easy access to main international airports of Heathrow and Gatwick
- Close to continental Europe - access by ferry or Channel Tunnel - 2 hours to the Paris or Brussels



CONTENT

- Principle of operation

- Comparison of Time Domain (TD) and Spectral Domain (SD)/(Fourier) Domain (FD) methods

- Flying spot versus full field

- Examples in medical imaging

3 OPTICS PILLARS of OPTICAL COHERENCE TOMOGRAPHY

OPTICAL SOURCES

OPTICAL CONFIGURATIONS

SIGNAL PROCESSING

Translation to Health, Non Destructive Testing, art conservation and forensic art

Number of publications on OCT

(CT and (ophthalmology or ophthalmoscopy or optometry or eye or cornea or retina or glaucoma or ocular))

Retina
Glaucoma
Cornea

Field: Publication Years	Record Count	% of 36998	Bar Chart
2016	5131	13.868 %	
2015	4506	12.179 %	
2014	3707	10.019 %	
2013	3418	9.238 %	
2012	3011	8.138 %	
2011	2658	7.184 %	
2010	2215	5.987 %	
2017	2092	5.654 %	
2009	1955	5.284 %	
2008	1690	4.568 %	
2007	1488	4.022 %	
2006	1142	3.087 %	
2005	1055	2.852 %	
2004	782	2.114 %	
2003	591	1.597 %	
2002	420	1.135 %	
2001	318	0.860 %	
2000	292	0.789 %	
1999	195	0.527 %	
1998	123	0.332 %	
1997	92	0.249 %	
1996	57	0.154 %	
1995	41	0.111 %	
1993	8	0.022 %	
1994	8	0.022 %	
1992	2	0.005 %	
1991	1	0.003 %	

Field: Research Areas	Record Count	% of 36998	Bar Chart
OPHTHALMOLOGY	16983	45.902 %	
OPTICS	8298	22.428 %	
CARDIOVASCULAR SYSTEM CARDIOLOGY	3908	10.563 %	
RADIOLOGY NUCLEAR MEDICINE MEDICAL IMAGING	3711	10.030 %	
ENGINEERING	3683	9.955 %	
BIOCHEMISTRY MOLECULAR BIOLOGY	1994	5.389 %	
PHYSICS	1729	4.673 %	
SURGERY	1667	4.506 %	
NEUROSCIENCES NEUROLOGY	1223	3.306 %	
SCIENCE TECHNOLOGY OTHER TOPICS	995	2.689 %	
RESEARCH EXPERIMENTAL MEDICINE	737	1.992 %	
IMAGING SCIENCE PHOTOGRAPHIC TECHNOLOGY	663	1.792 %	
GENERAL INTERNAL MEDICINE	636	1.719 %	
BIOPHYSICS	575	1.554 %	
DERMATOLOGY	556	1.503 %	
INSTRUMENTS INSTRUMENTATION	394	1.065 %	
COMPUTER SCIENCE	391	1.057 %	
MATERIALS SCIENCE	381	1.030 %	
GASTROENTEROLOGY HEPATOLOGY	324	0.876 %	
PHARMACOLOGY PHARMACY	310	0.838 %	
CHEMISTRY	272	0.735 %	
DENTISTRY ORAL SURGERY MEDICINE	253	0.684 %	
ONCOLOGY	236	0.638 %	
MICROSCOPY	230	0.622 %	
SPECTROSCOPY	212	0.573 %	
CELL BIOLOGY	208	0.562 %	
RESPIRATORY SYSTEM	178	0.481 %	
PEDIATRICS	169	0.457 %	

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Need for a high resolution imaging for the human retina demanded the innovation that lead to OCT

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Lasers in Medicine and Life Sciences

Focusing light with a lens

Spot on the retina

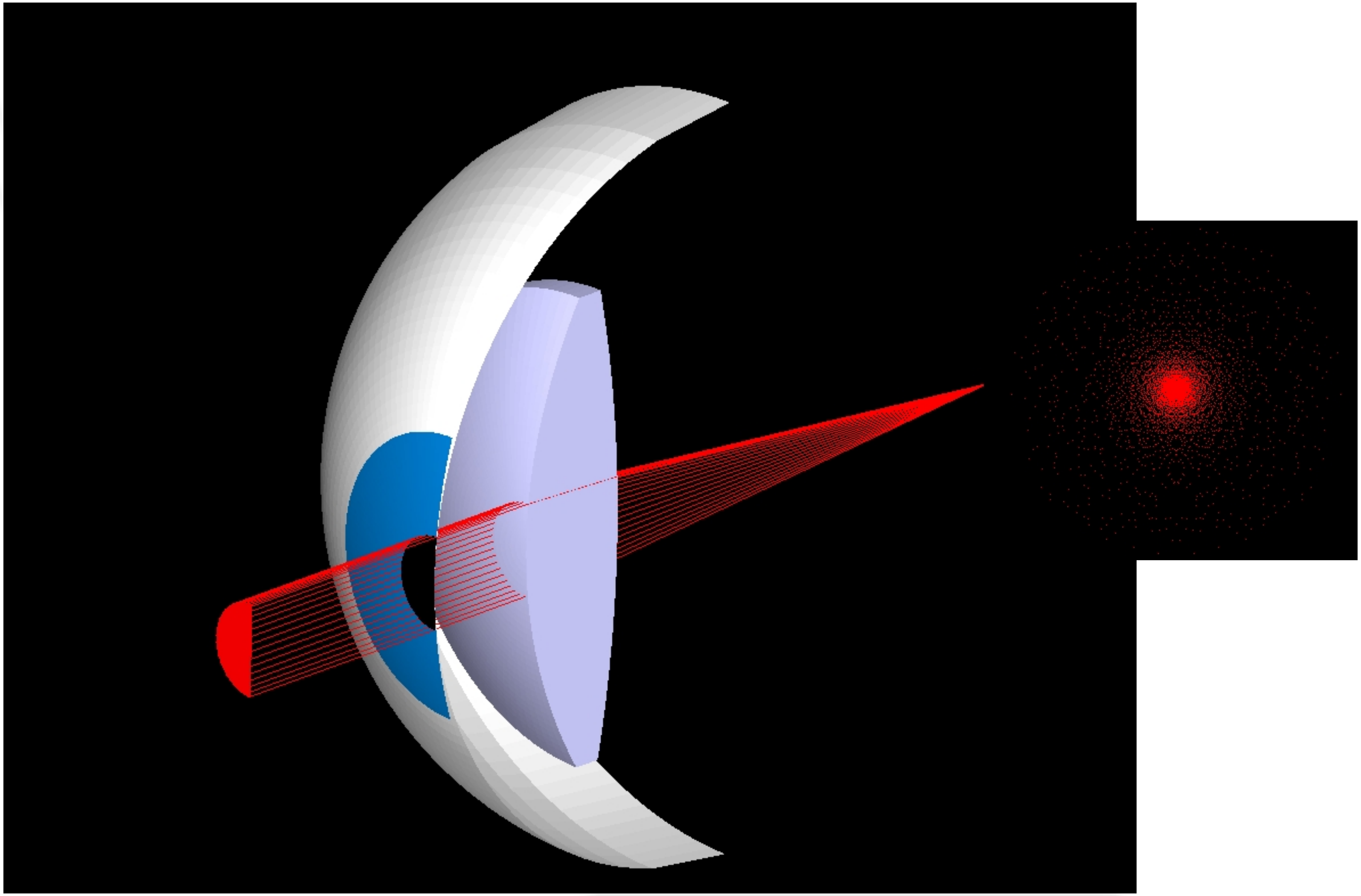
University of Szeged
Where knowledge and challenge meet

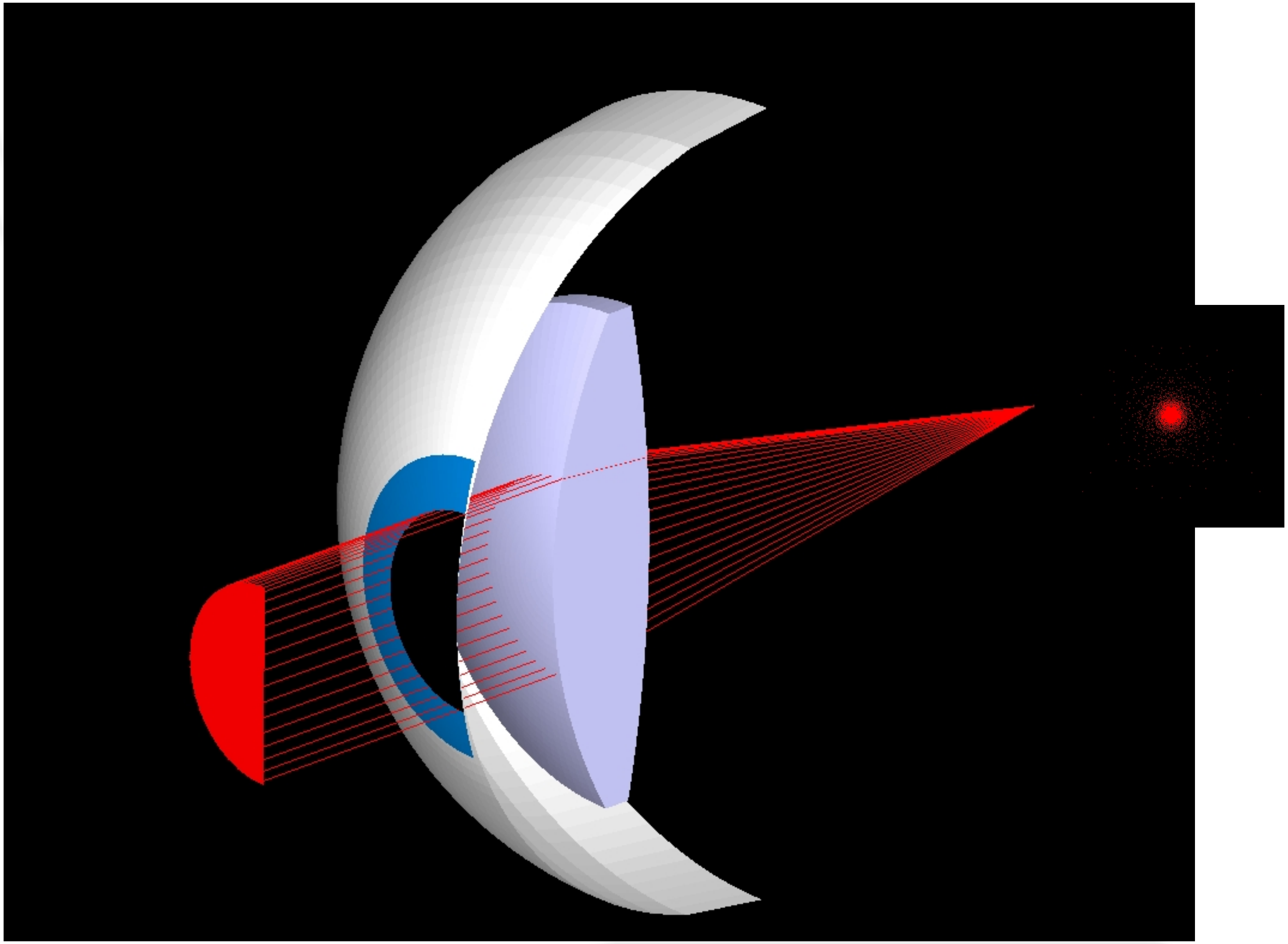
Laserlab Europe

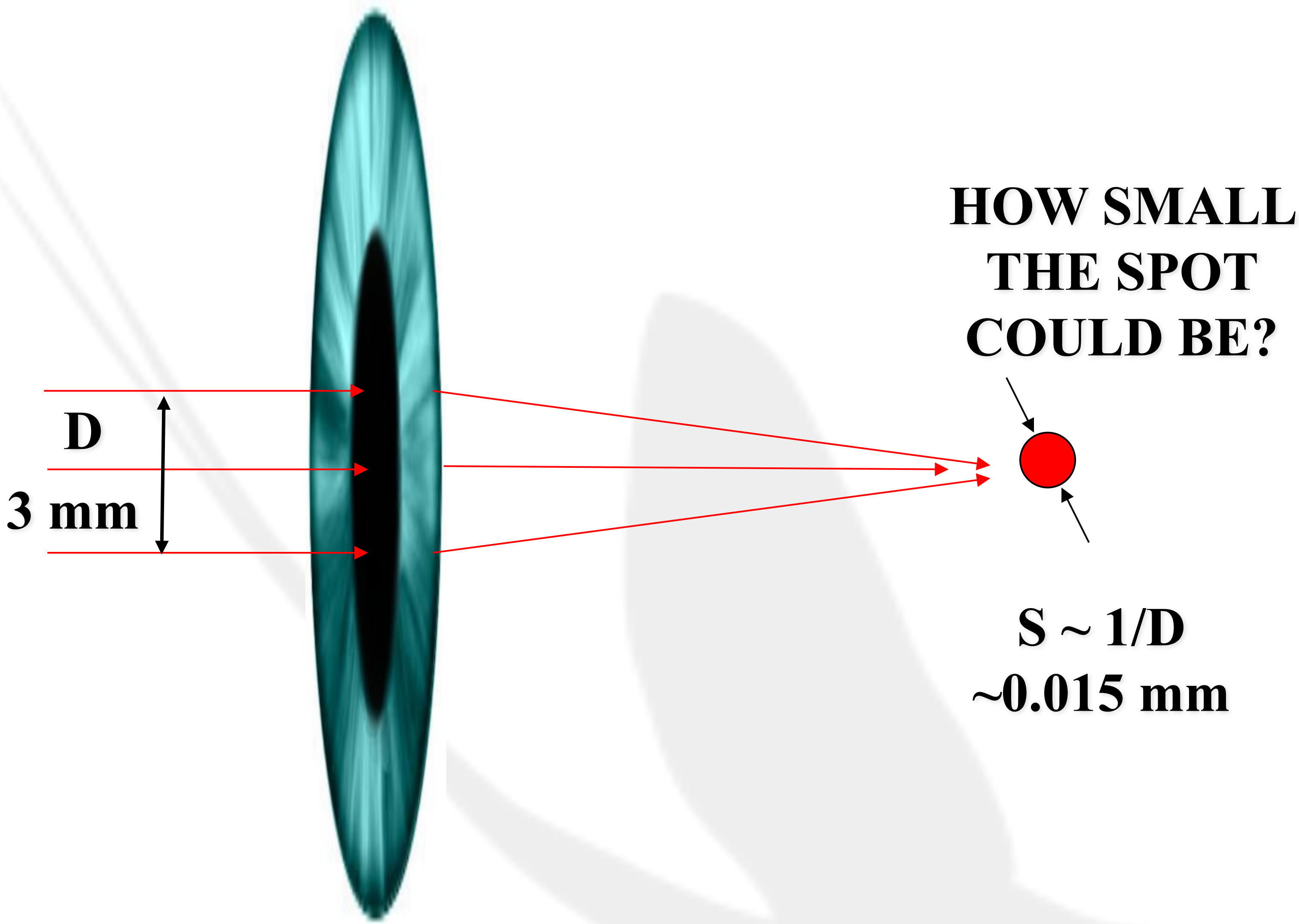
eli attosecond

HUNGARIAN BIOPHYSICAL SOCIETY

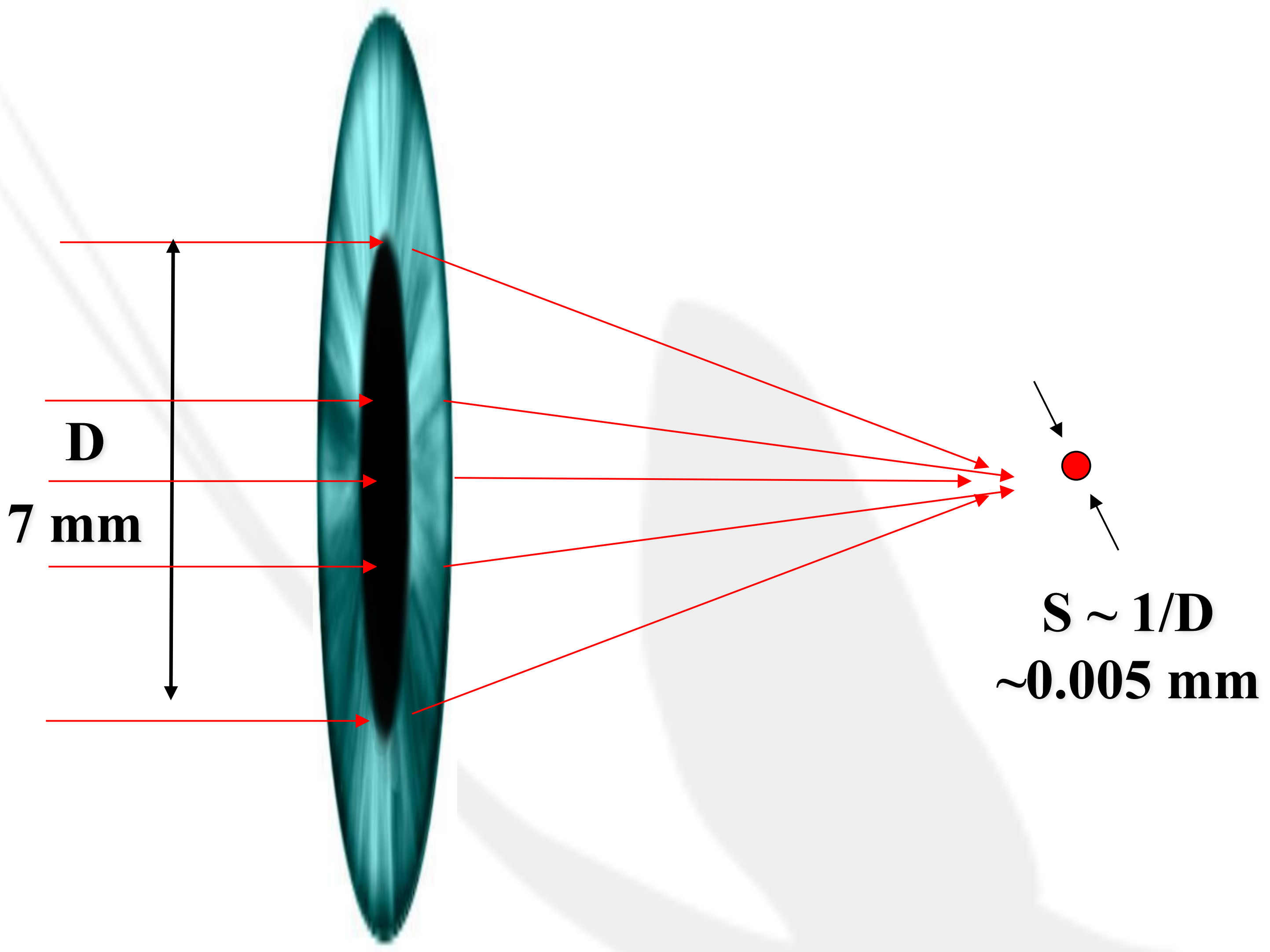
EÖTVÖS LORÁND FIZIKAI TÁRSULAT 1891



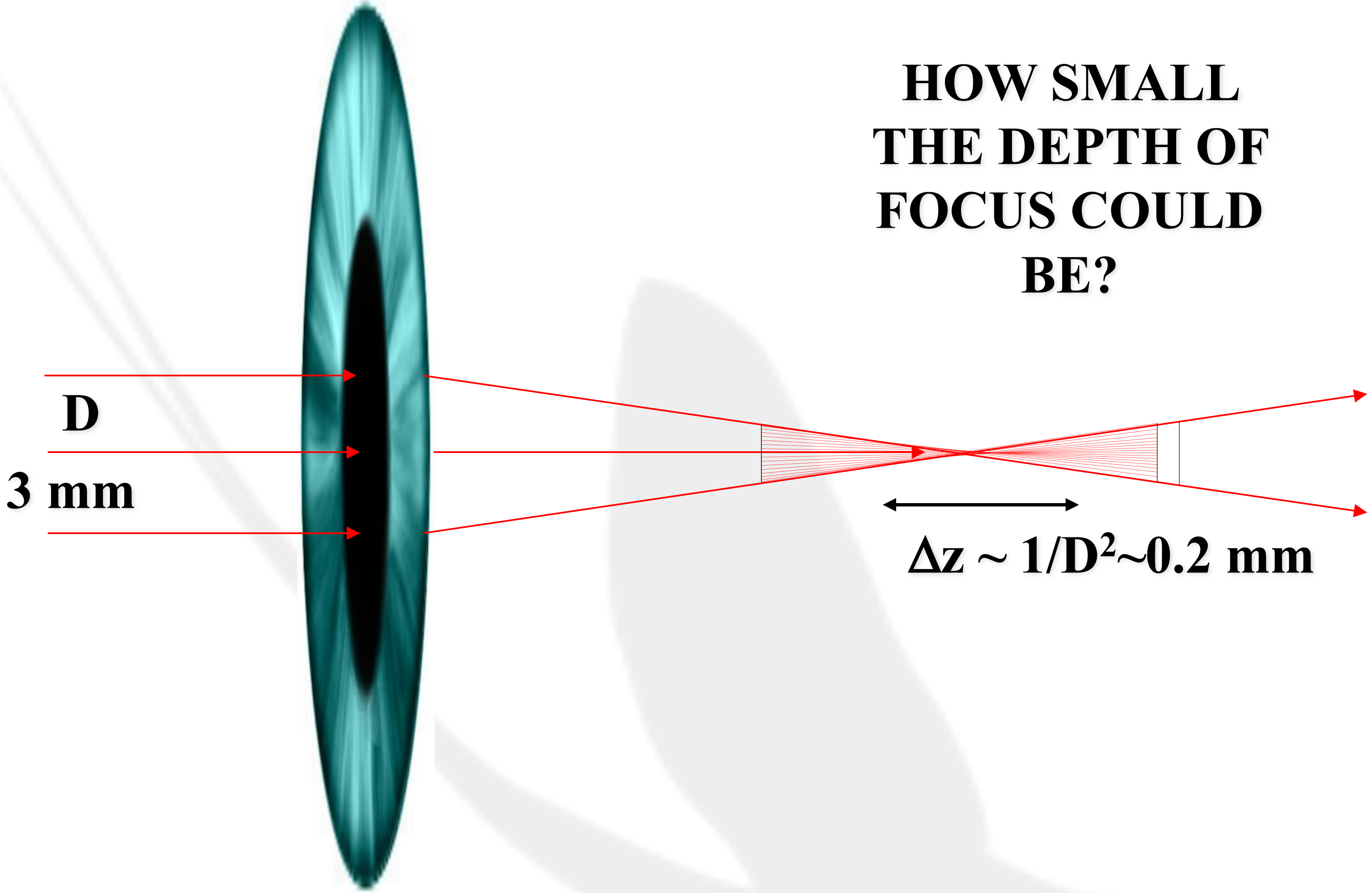




IN THE CASE OF THE EYE, 3 mm PUPIL, 15 MICRONS LATERAL

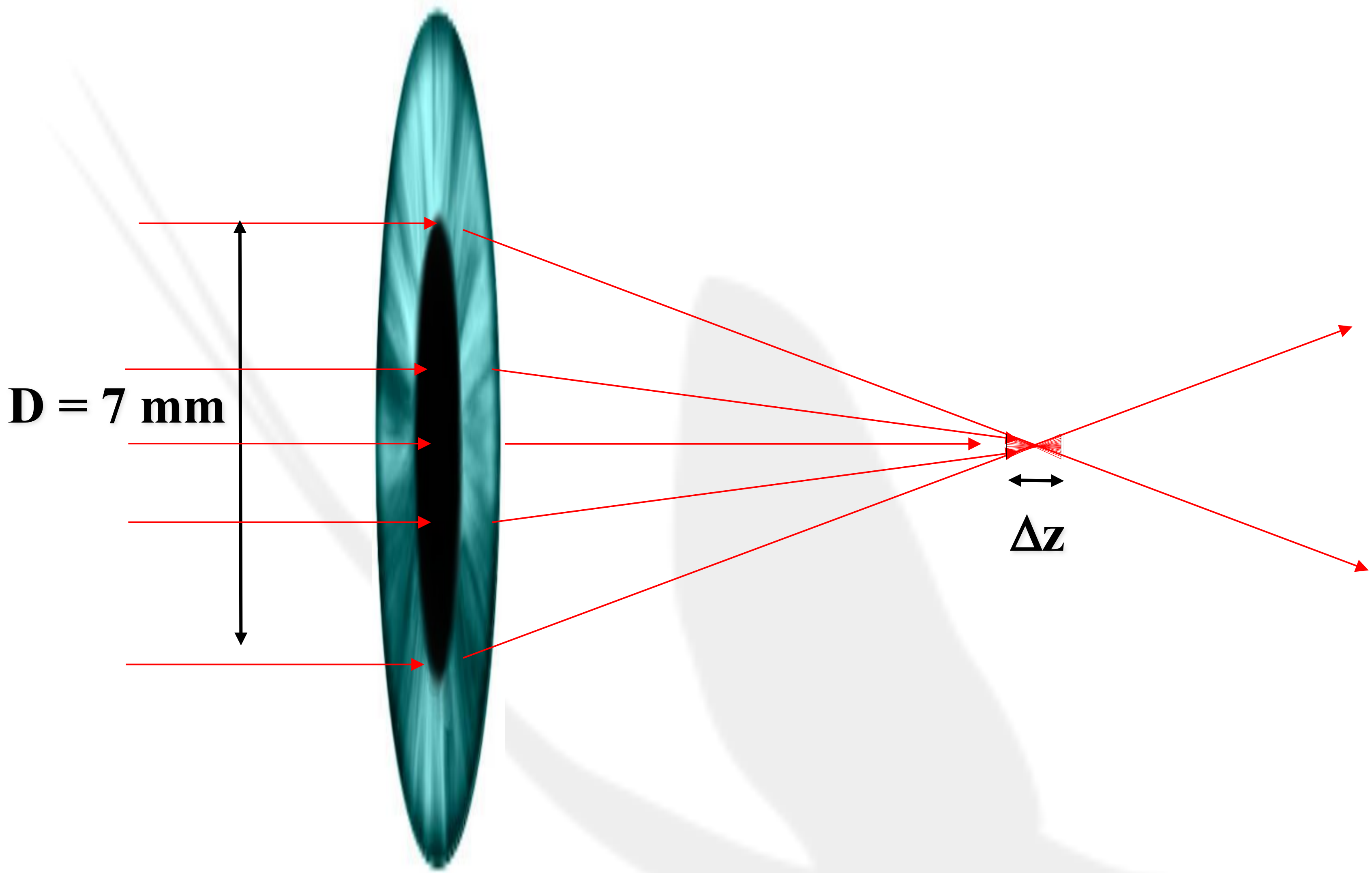


Increasing D to 7 mm,
S could become less than 5 microns

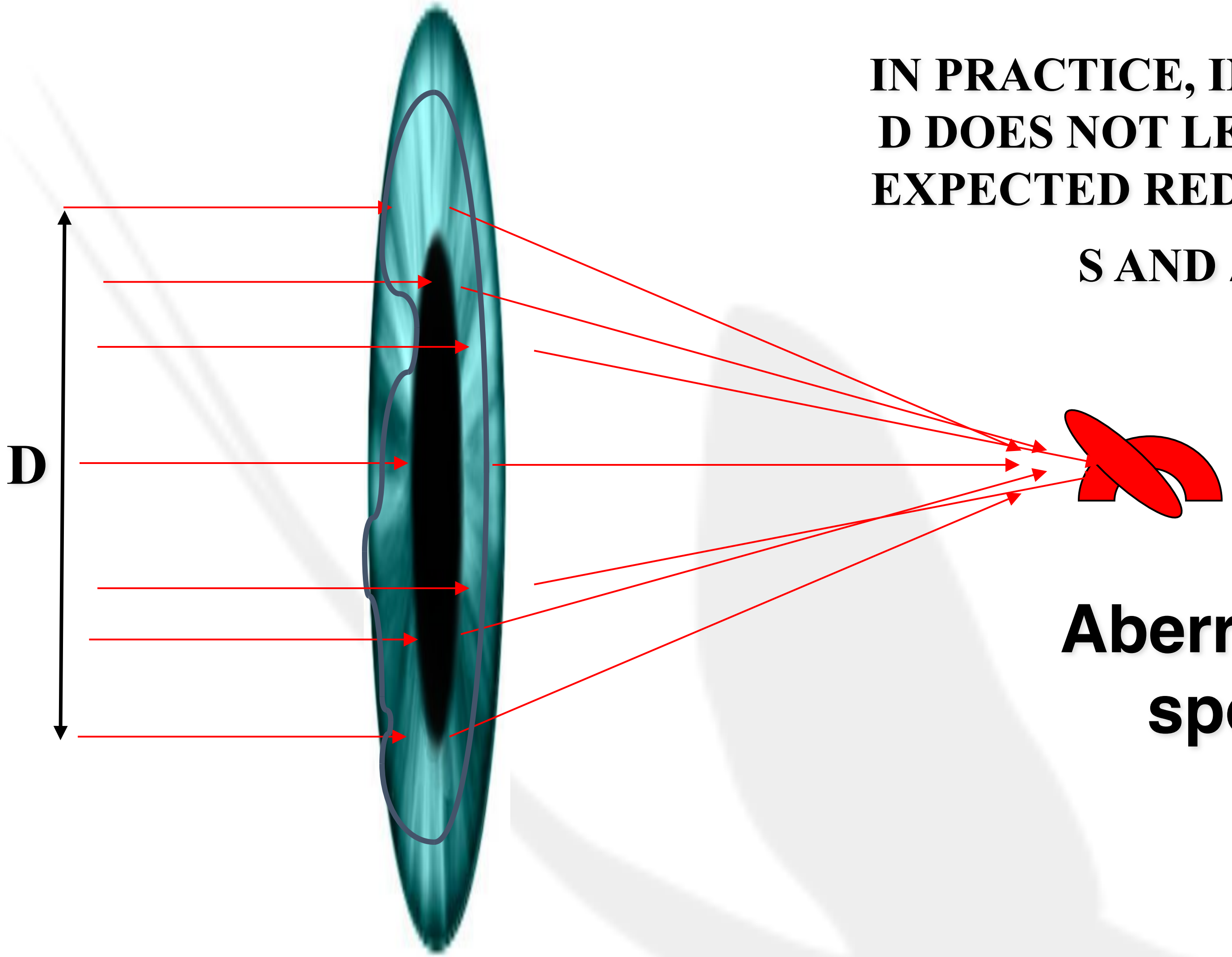


HOW SMALL THE DEPTH OF FOCUS COULD BE?

In the case of the eye, 3 mm pupil
200 microns axial



Increasing D to 7 mm, Δz could reach 0.05 mm



IN PRACTICE, INCREASING D DOES NOT LEAD TO THE EXPECTED REDUCTION OF S AND Δz

Aberrated spot

The curvature of the cornea is not following that of an ideal lens

Instead of improving the focus

Use as many colours as possible in an interferometer

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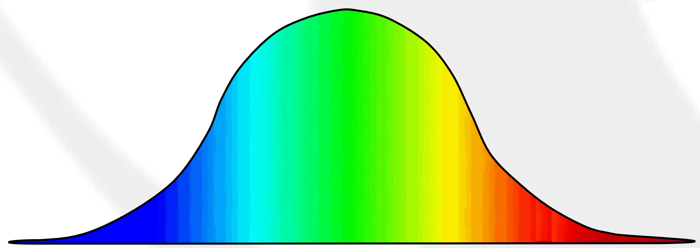
Even with aberrations present, such a method could determine a resolution depth ~ 1/(optical source bandwidth).



Sub-micron resolution is achievable

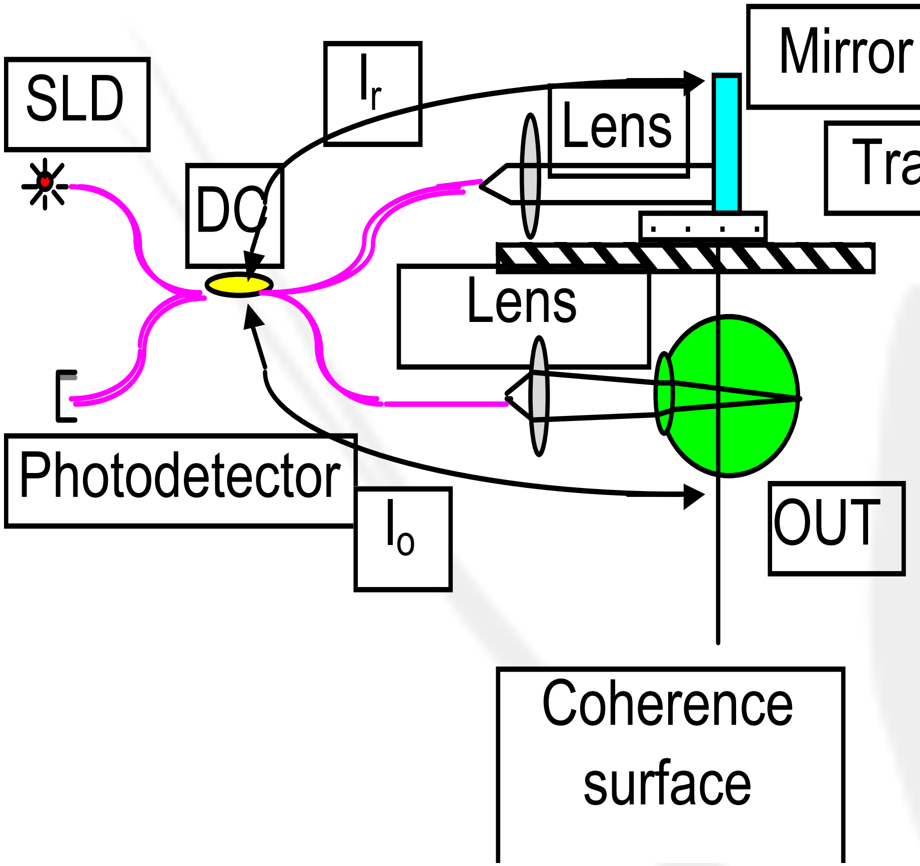
Optical Coherence Tomography (OCT)

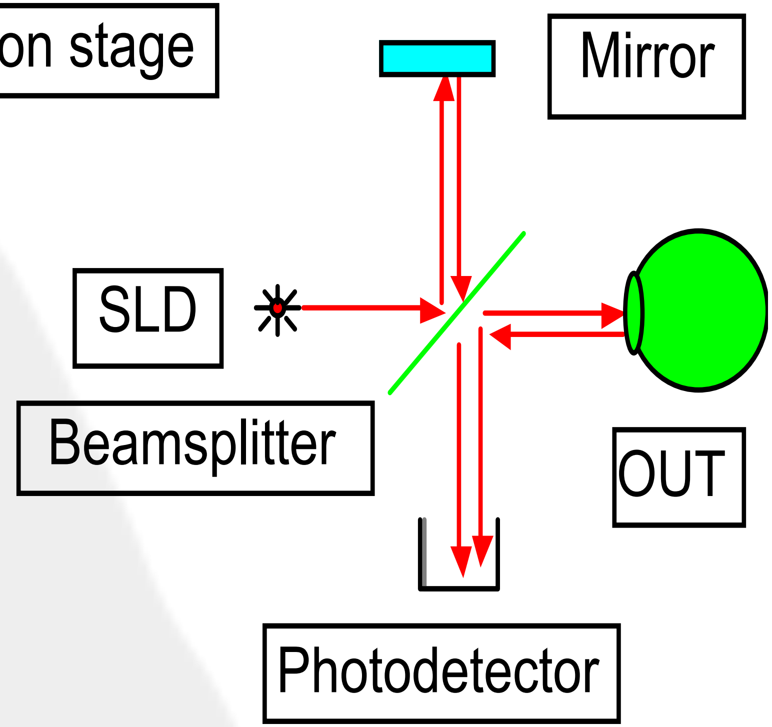
- Huang, Hee, Fujimoto, Puliafito 1991
- Optical B-scans (Cross-sections)
- Near histological resolution
- Excellent for macular diagnostics

Clutter of terminology

A, B, C, T scanning
Flying spot
Full field
Time domain
Spectral domain
Fourier domain
Swept source
Spectrometer
Mechanical scanning

Low coherence reflectometer (LCR)

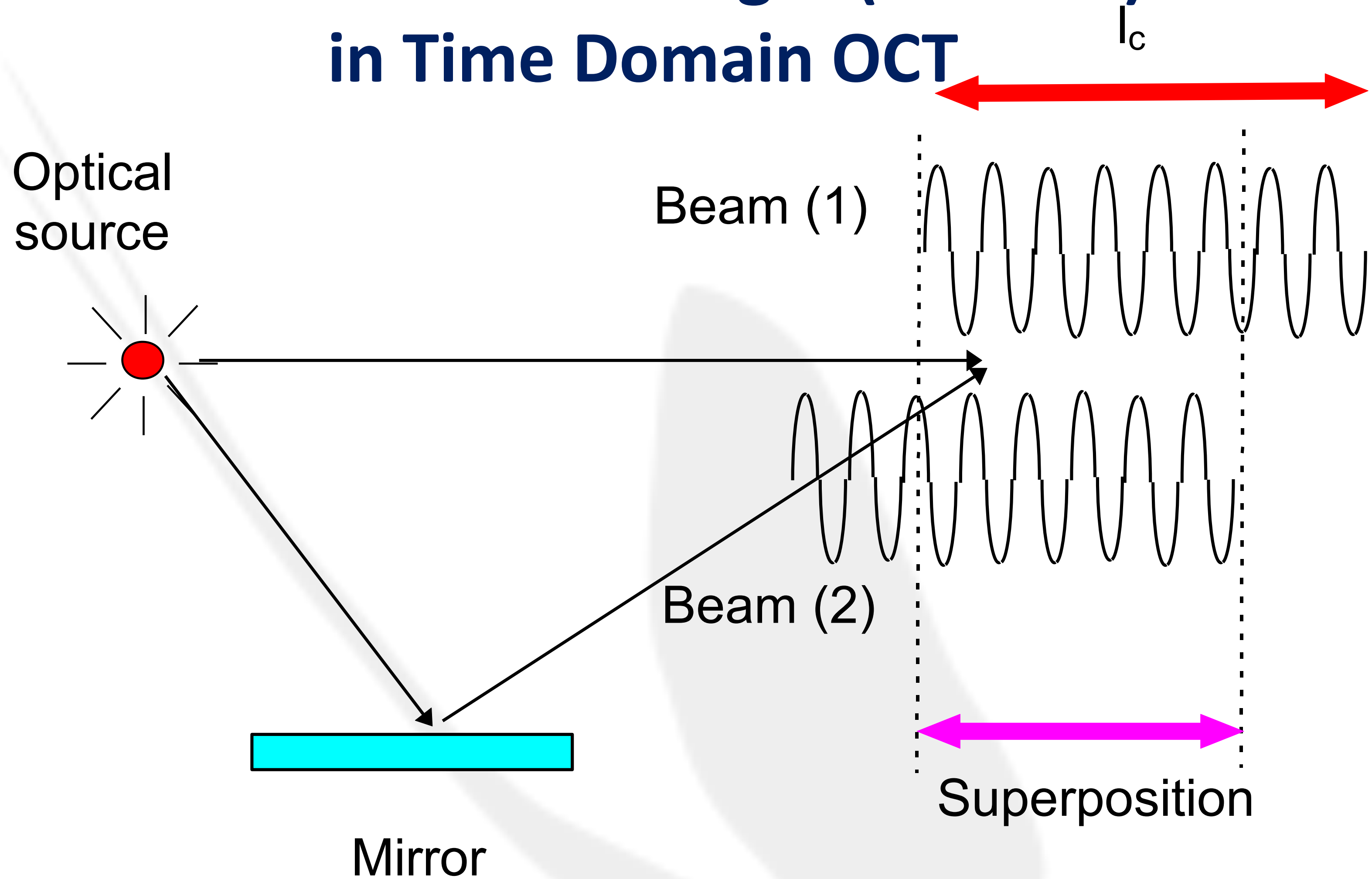




In-fibre LCR (OCT)

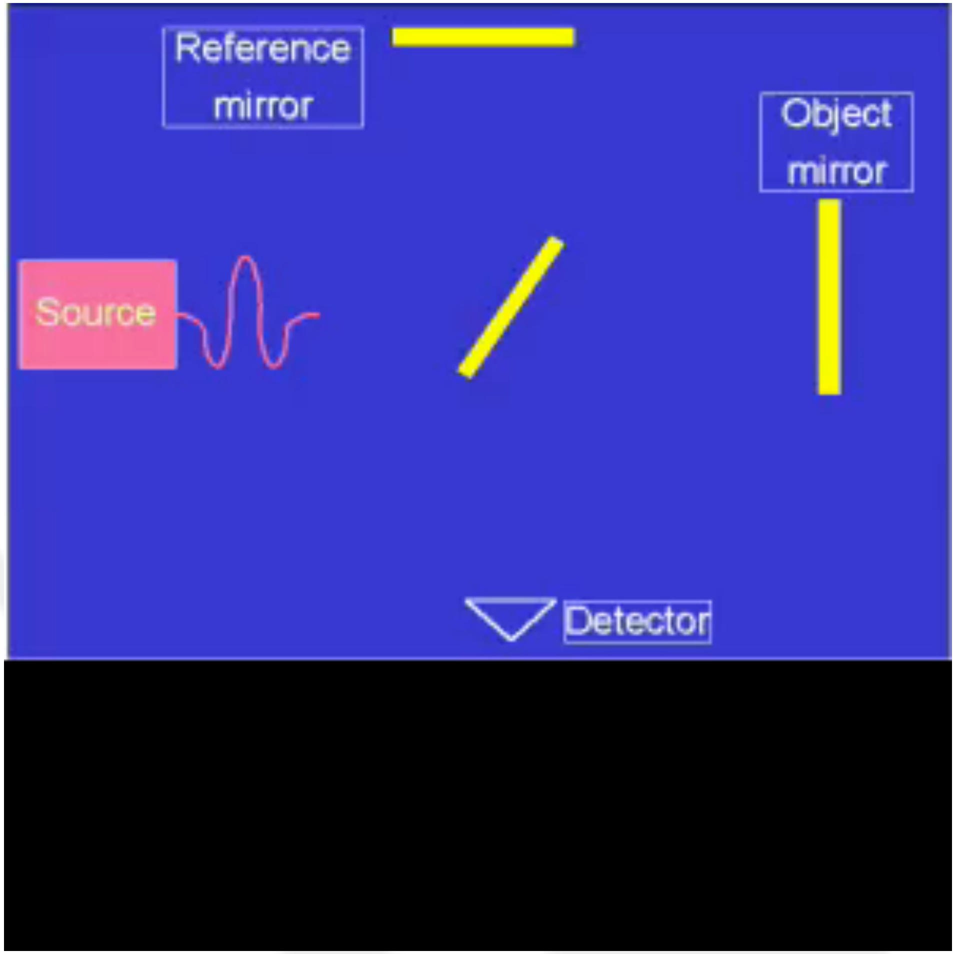
Bulk LCR (OCT)

OPD<Coherence length (microns) in Time Domain OCT



Superposition of two wavetrains (interference of two beams generated by a source with a large bandwidth).

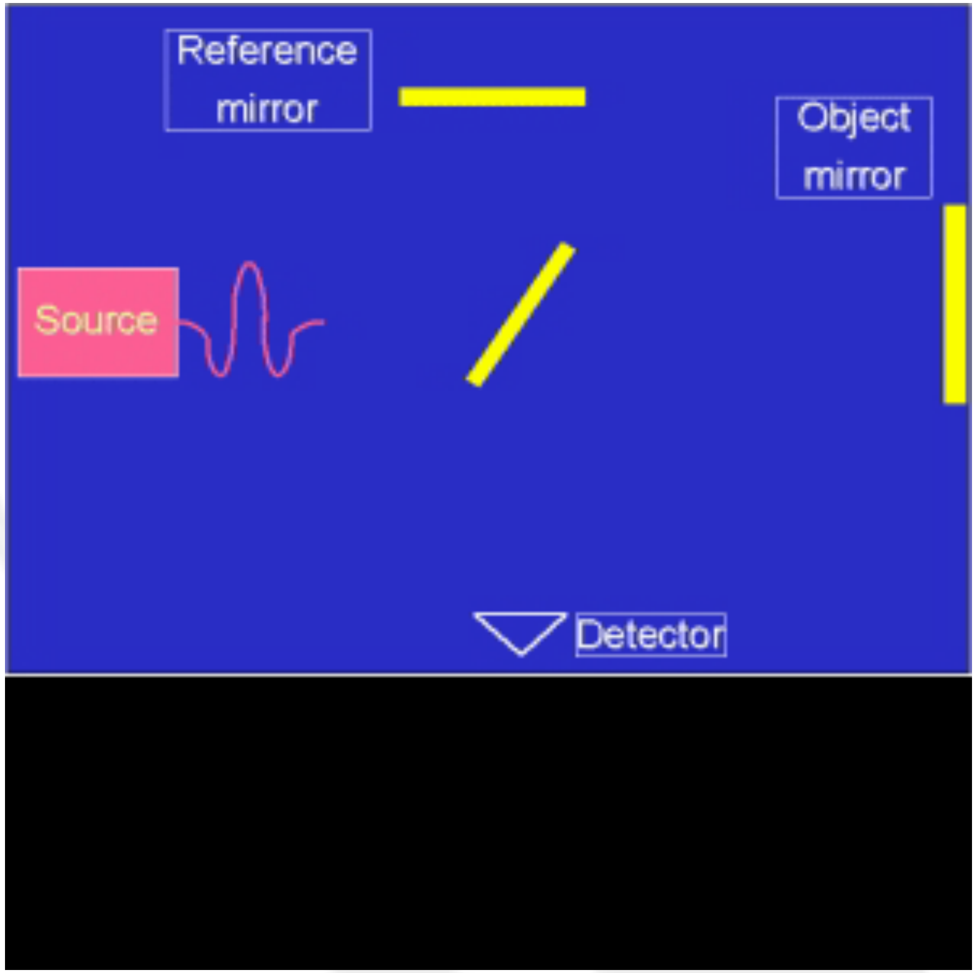
PRINCIPLE OF TIME DOMAIN INTERFEROMETRY



MATCHED INTERFEROMETER

(OPD = 0)

PRINCIPLE OF TIME DOMAIN INTERFEROMETRY

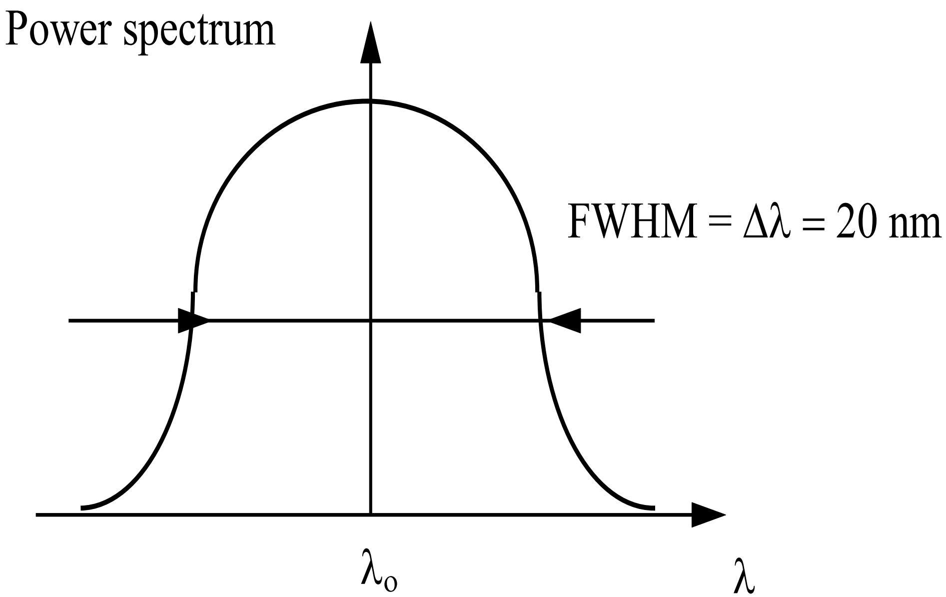


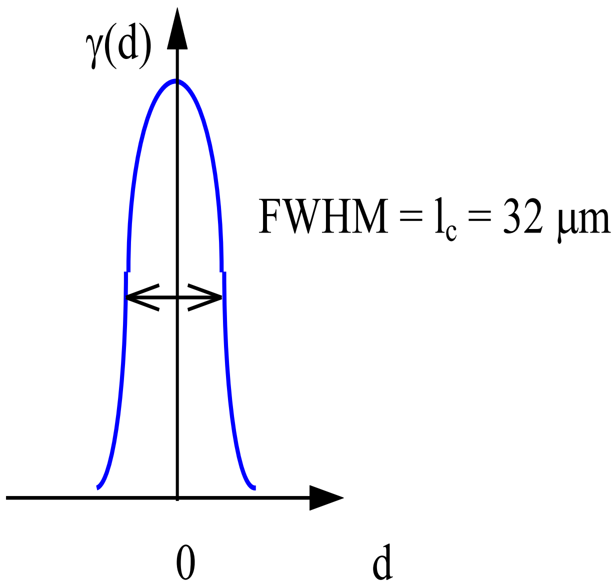
OBJECT PATH LONGER

$$i_{ph} = \alpha \frac{P_0}{2}\left[O + R + 2\sqrt{OR}\,\gamma(d)\,\Pi \cos\left(\frac{2\pi}{\lambda} d\right)\right]$$

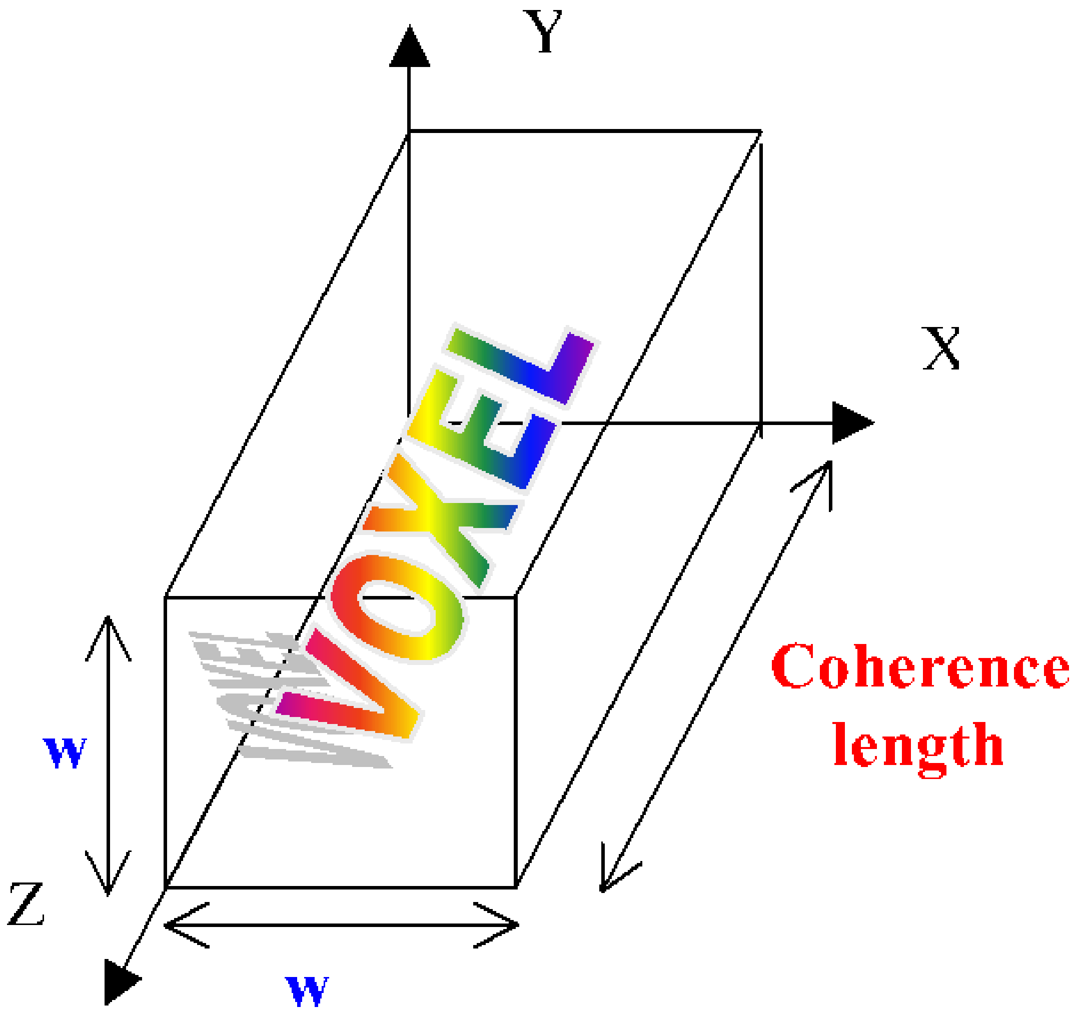
$$\gamma(d) = \exp\left[-\ln(2)\left(\frac{2d}{l_c}\right)^2\right]$$

$$l_c = \frac{4\ln 2}{\pi}\frac{\lambda^2}{\Delta\lambda}$$





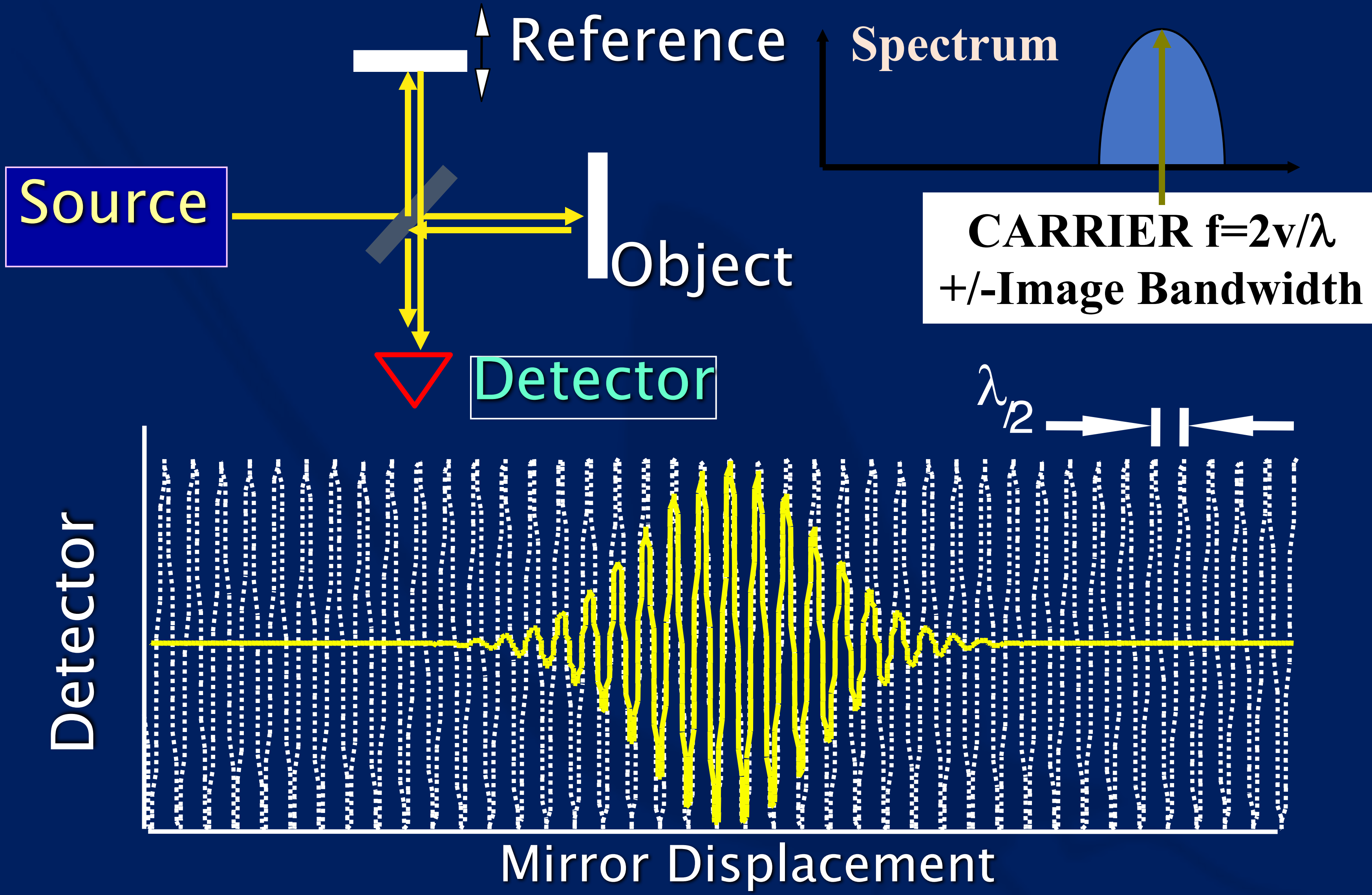
RESOLUTIONS



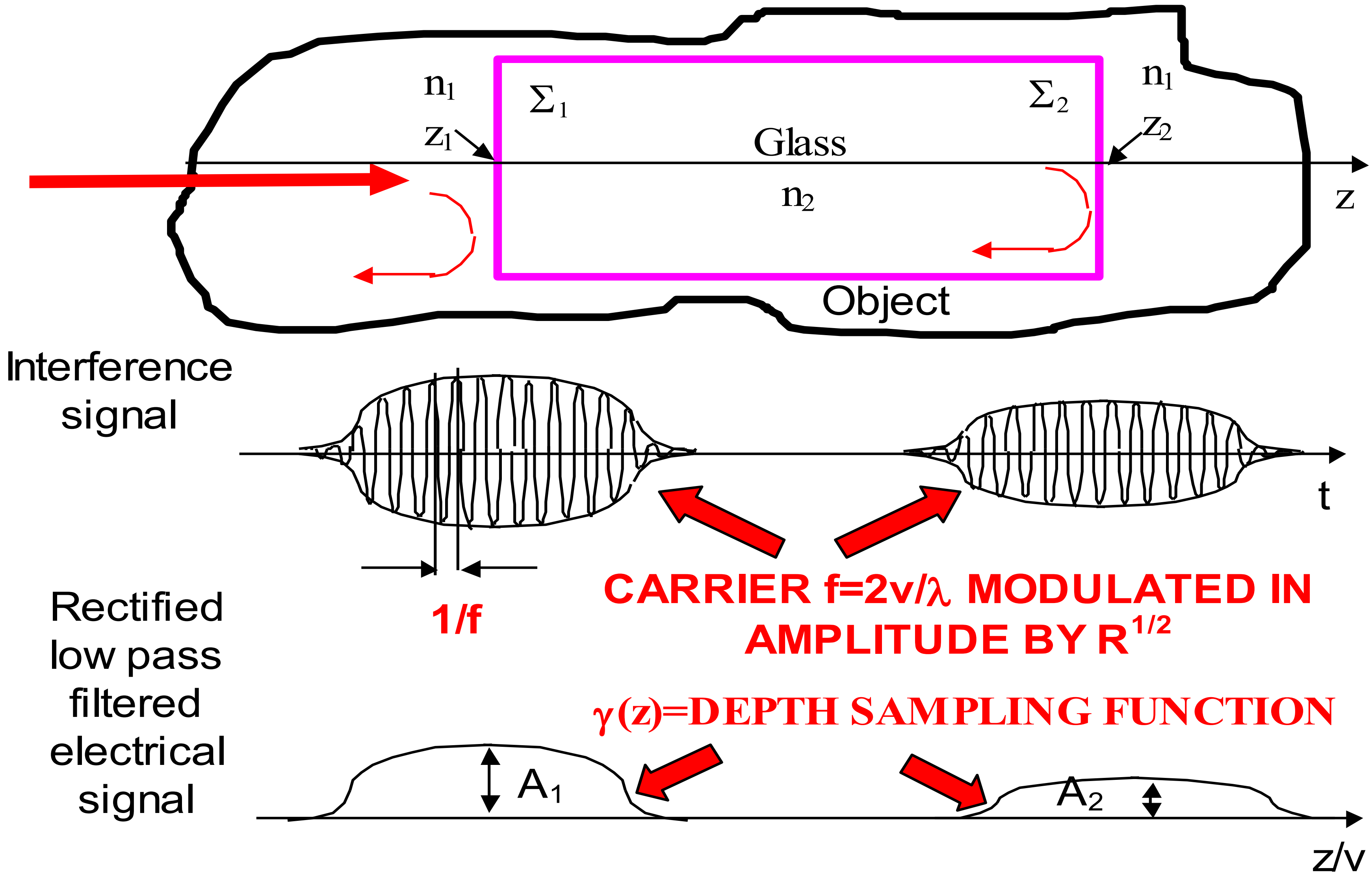
Coherence length: ***Optical spectrum***

w: ***Diffraction limit***

LONGITUDINAL OCT



CARRIER IN CONVENTIONAL OCT



OCT signal for two interfaces inside the object

OCT KEY PARAMETERS

INTERFEROMETRY

LINEWIDTH → DEPTH RESOLUTION

$$l_c = \frac{4\ln 2}{\pi}\frac{\lambda^2}{\Delta\lambda}$$

SINGLE SCATTERED PHOTONS → PENETRATION DEPTH

PHOTODETECTED SIGNAL ~

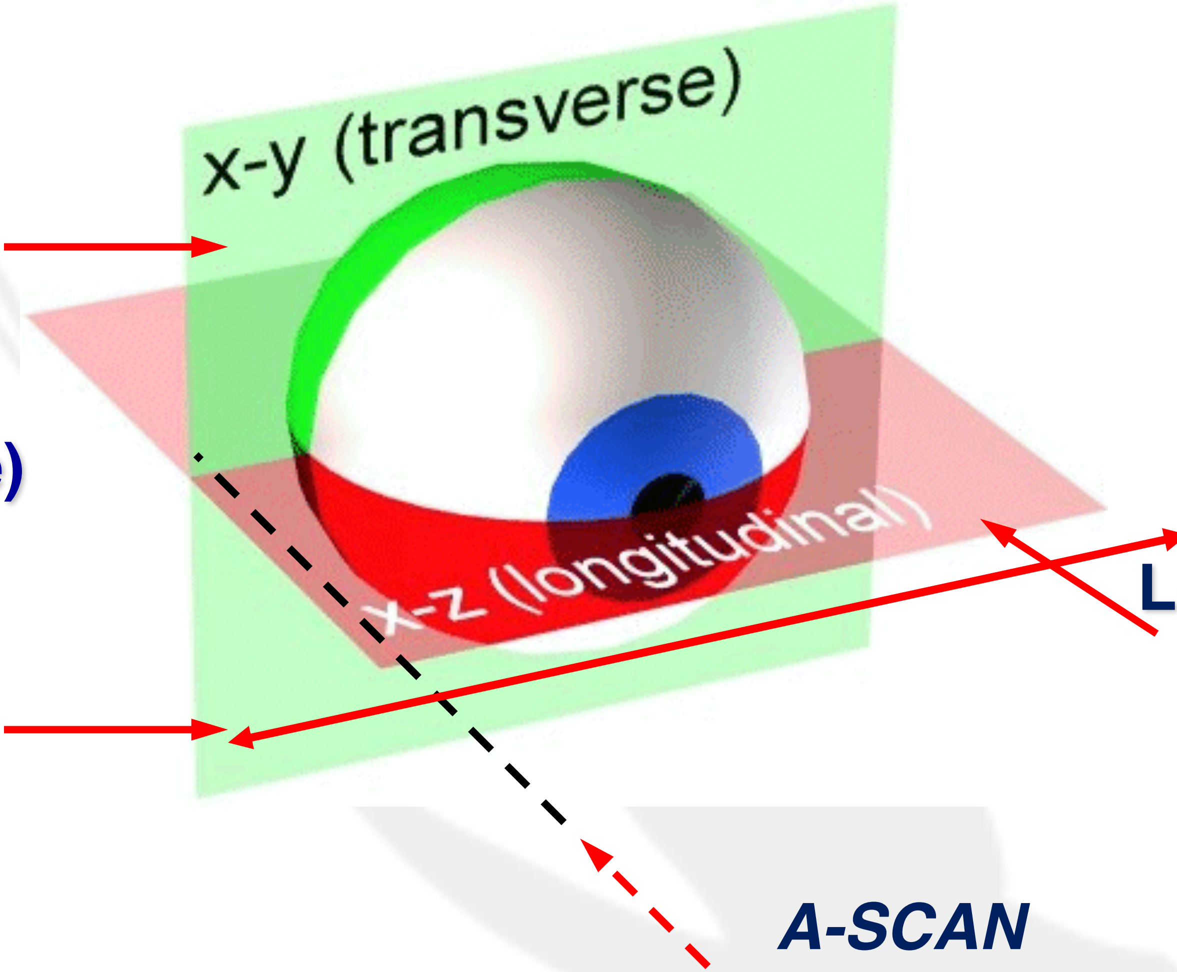
(WEAK BACKSCATTERED SIGNAL) X

(STRONG REFERENCE SIGNAL) $\approx \sqrt{P_{Object}} \bullet \sqrt{P_{Reference}}$

→ AMPLIFICATION EFFECT

Scanning Regimes

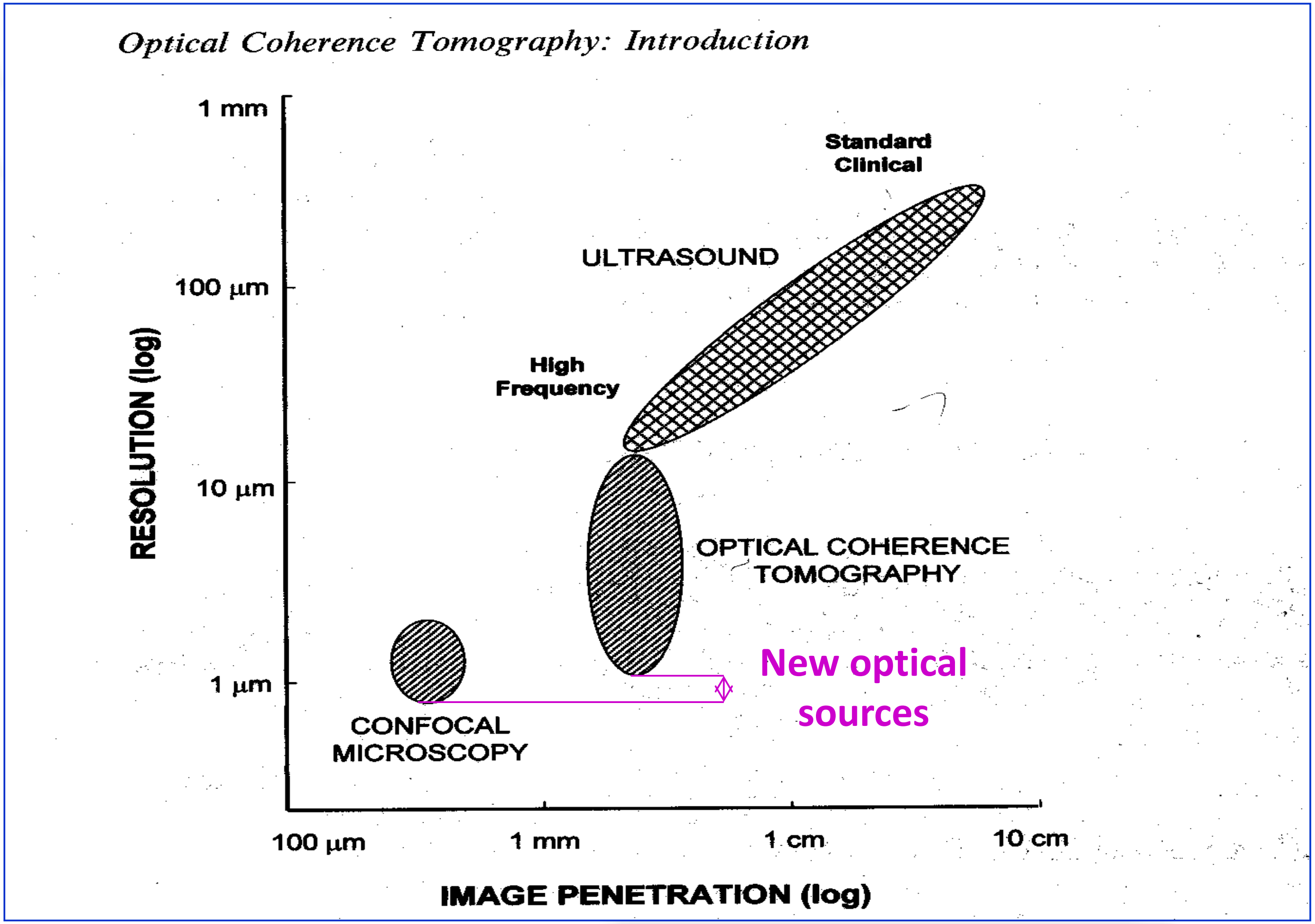
C-SCAN
Tranverse
En-Face
(x- y plane)



B-SCAN
Longitudinal
Cross-section
(x-z plane)

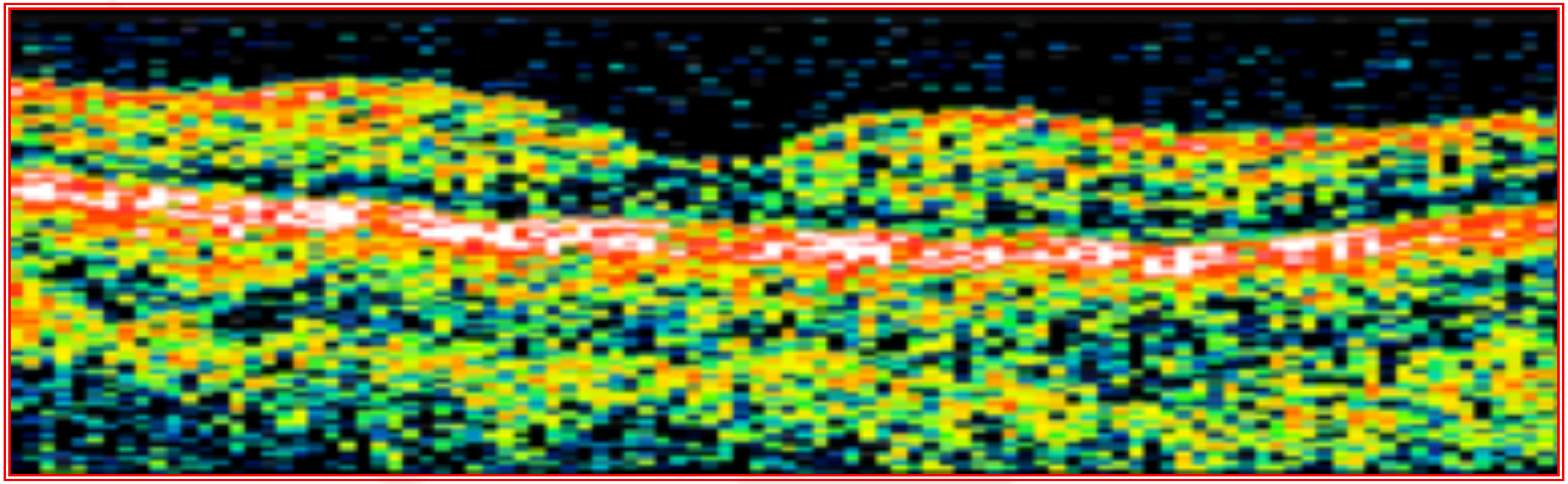
T-SCAN
Tranverse
En-Face

A-SCAN
Line scan



RESOLUTION AND PENETRATION DEPTH OF DIFFERENT IMAGING TECHNIQUES, Handbook of OCT, p. 17

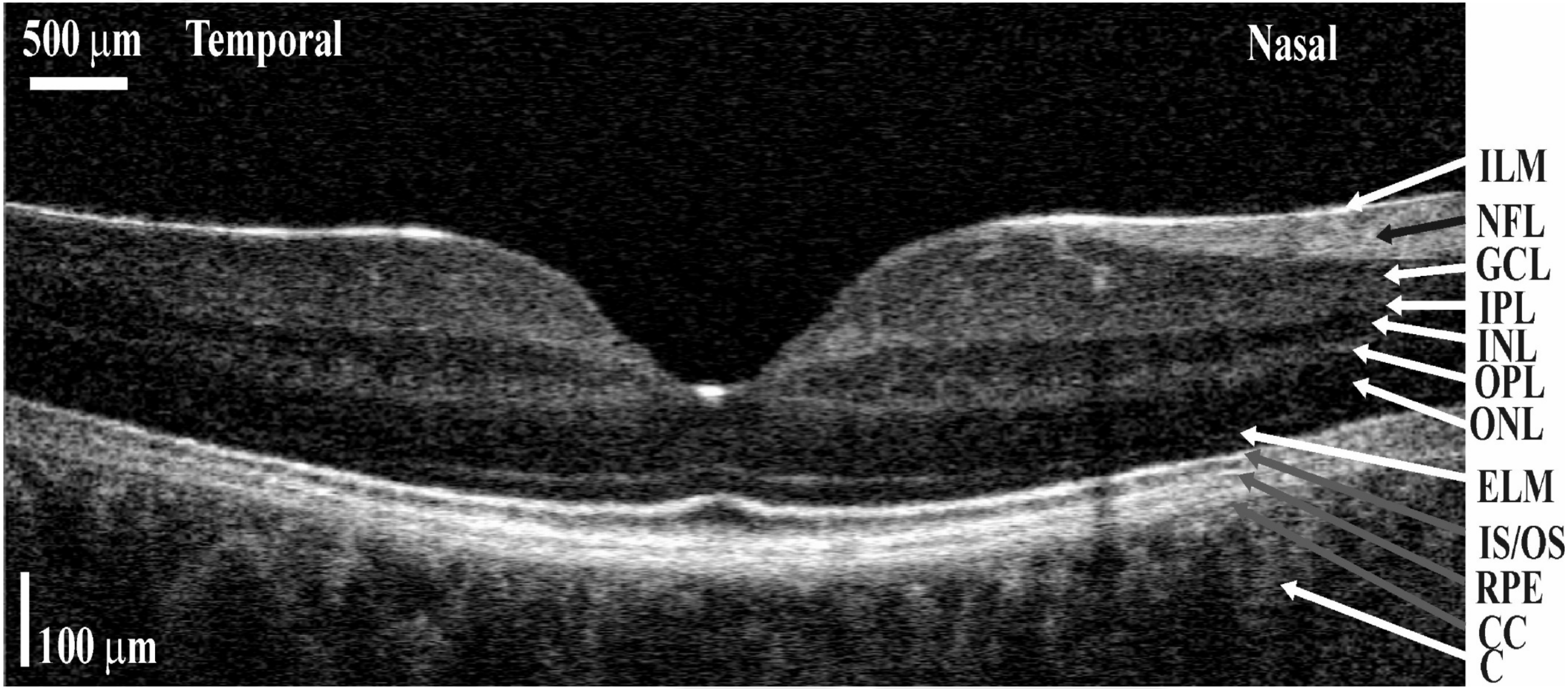
Optical Coherence Tomography (OCT)



- Huang, Hee, Fujimoto, Puliafito 1991
- B-scan (Cross-section)

ULTRA-HIGH RESOLUTION *EN-FACE* OCT

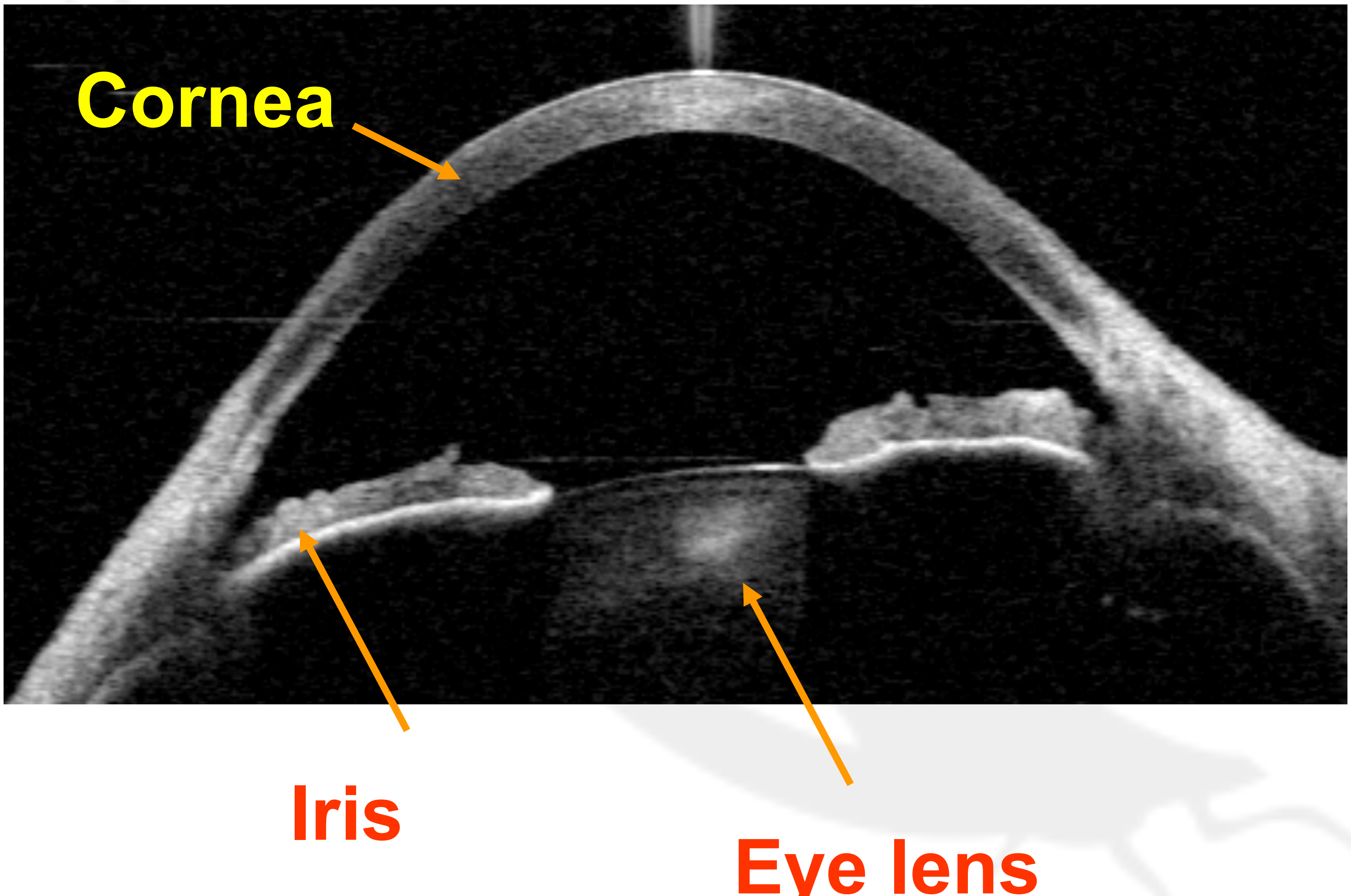
B-scan OCT with 3 μm depth resolution



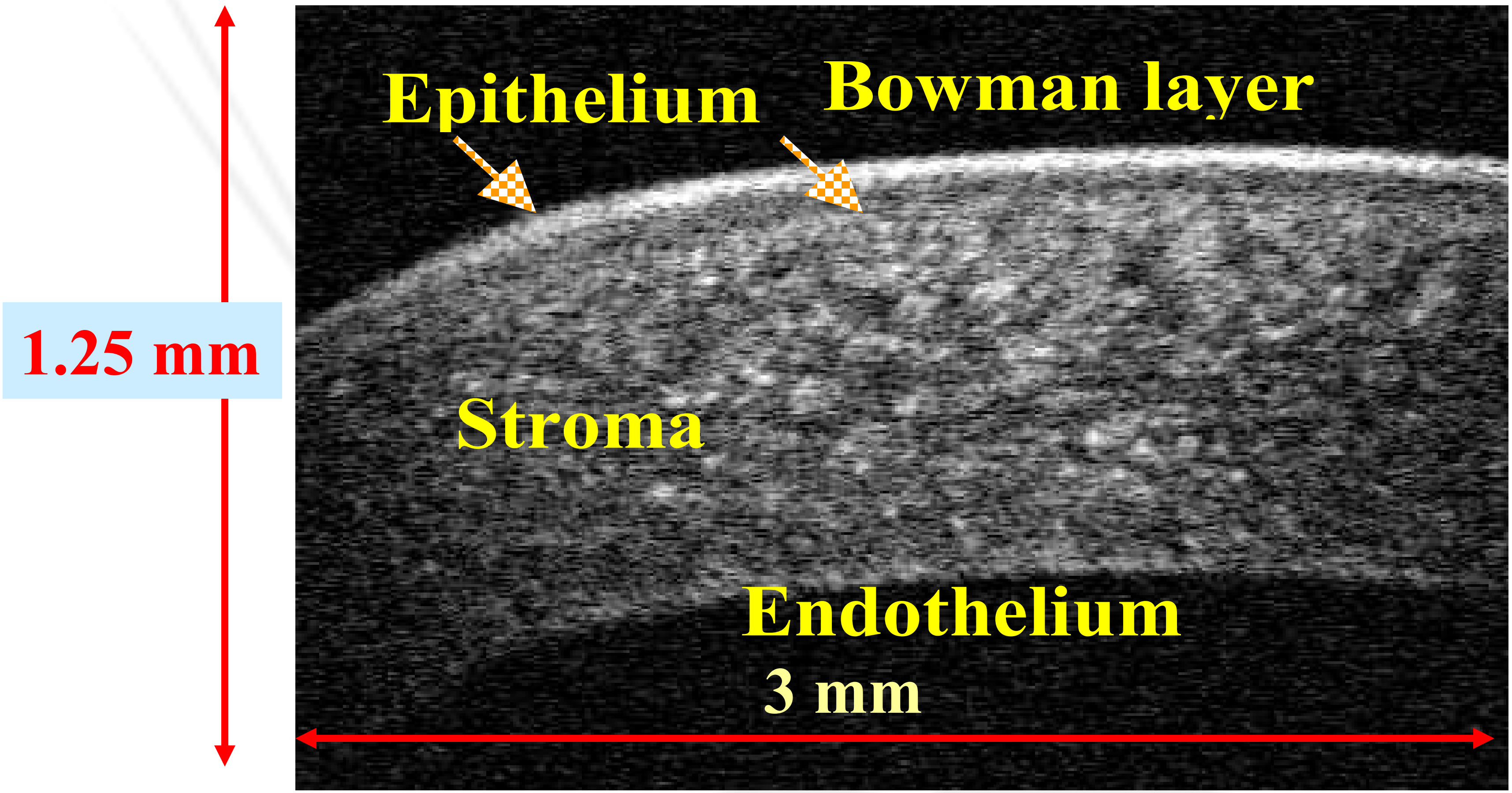
R. Cucu, Optics Letters, Vol. 31, No. 11, June 1, 2006, 1684-1687.

840 nm, 0.8 mW

ANTERIOR CHAMBER

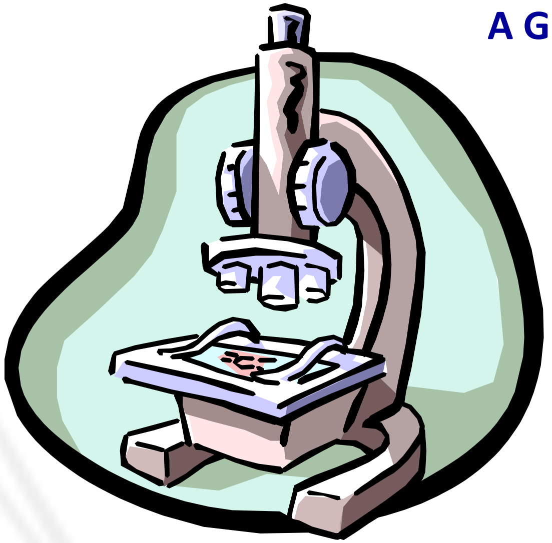


B-SCAN FROM CORNEA



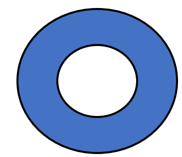
840 nm, 1050 nm or 1300 nm > 1 mW

A Gh. Podoleanu, Optical coherence tomography, Journal of Microscopy, 247(3) 209-219, 2012 (Review, OPEN ACCESS).

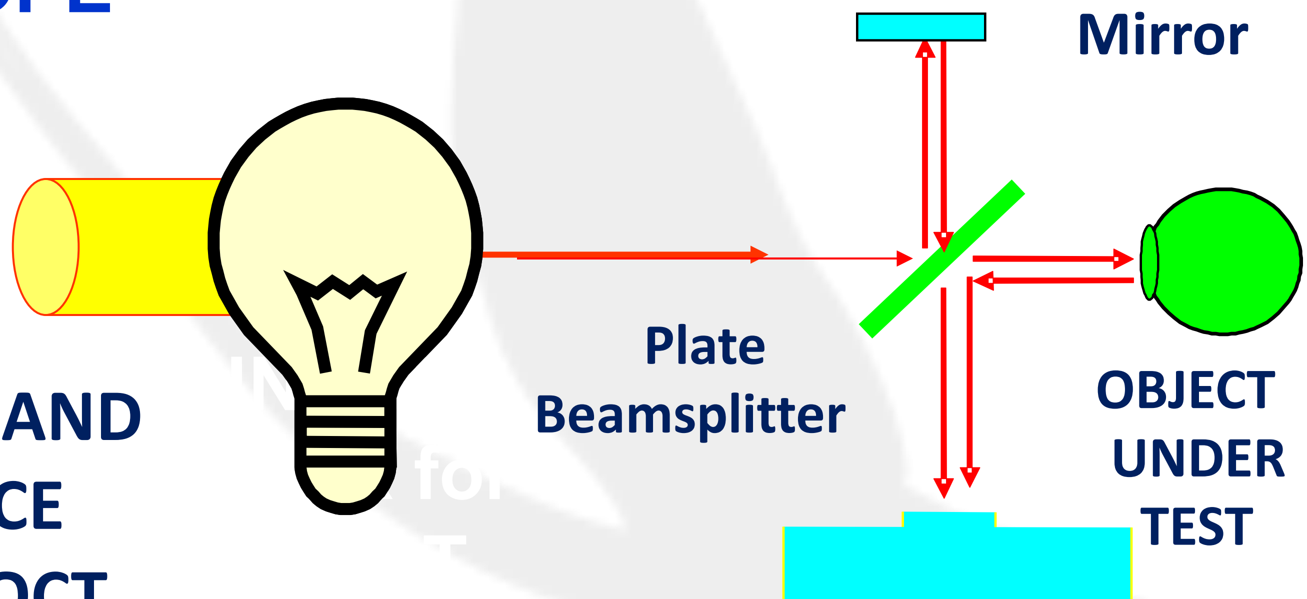


MICROSCOPE

PINHOLE



INTERFEROMETER

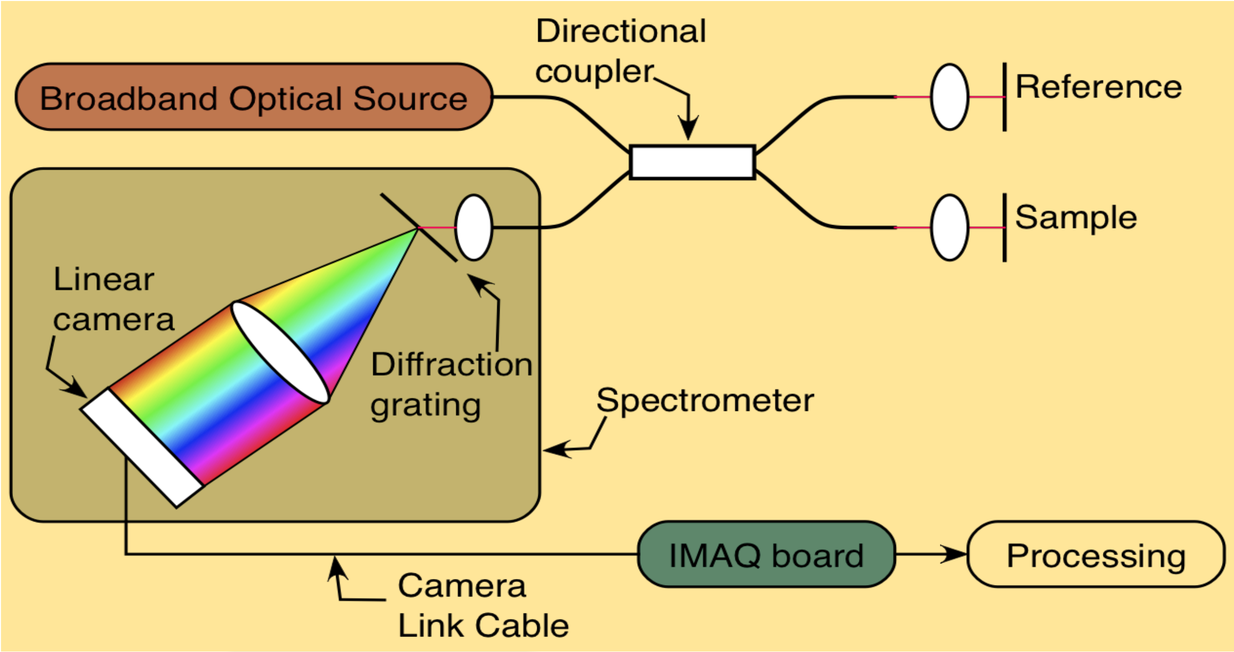


BROADBAND
SOURCE
for FD-OCT

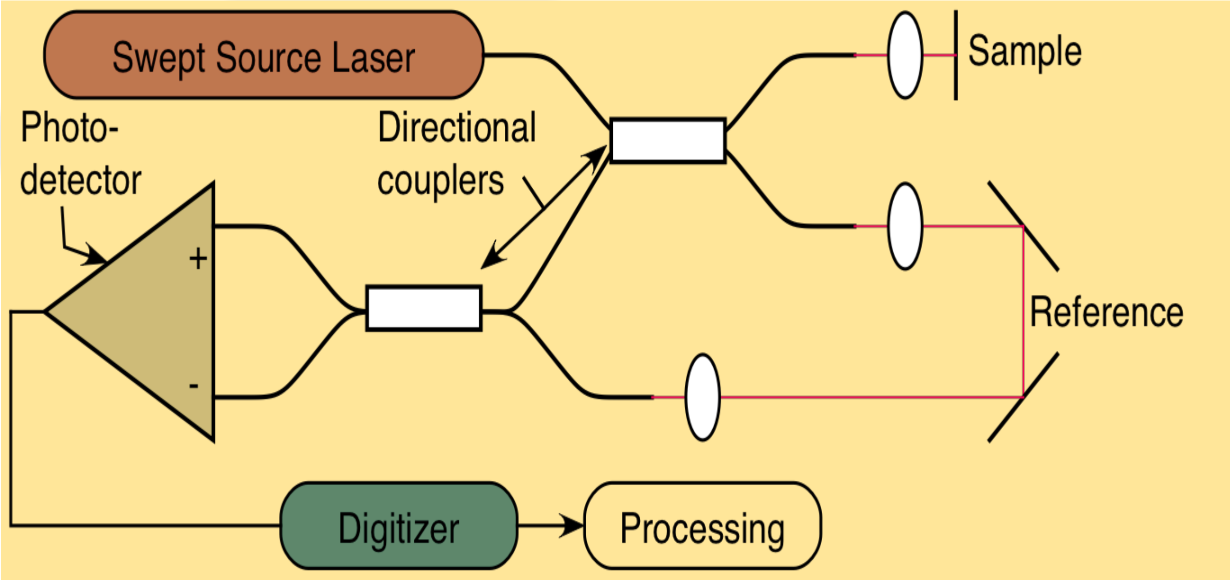
SPECTROMETER

Spectral Domain-OCT

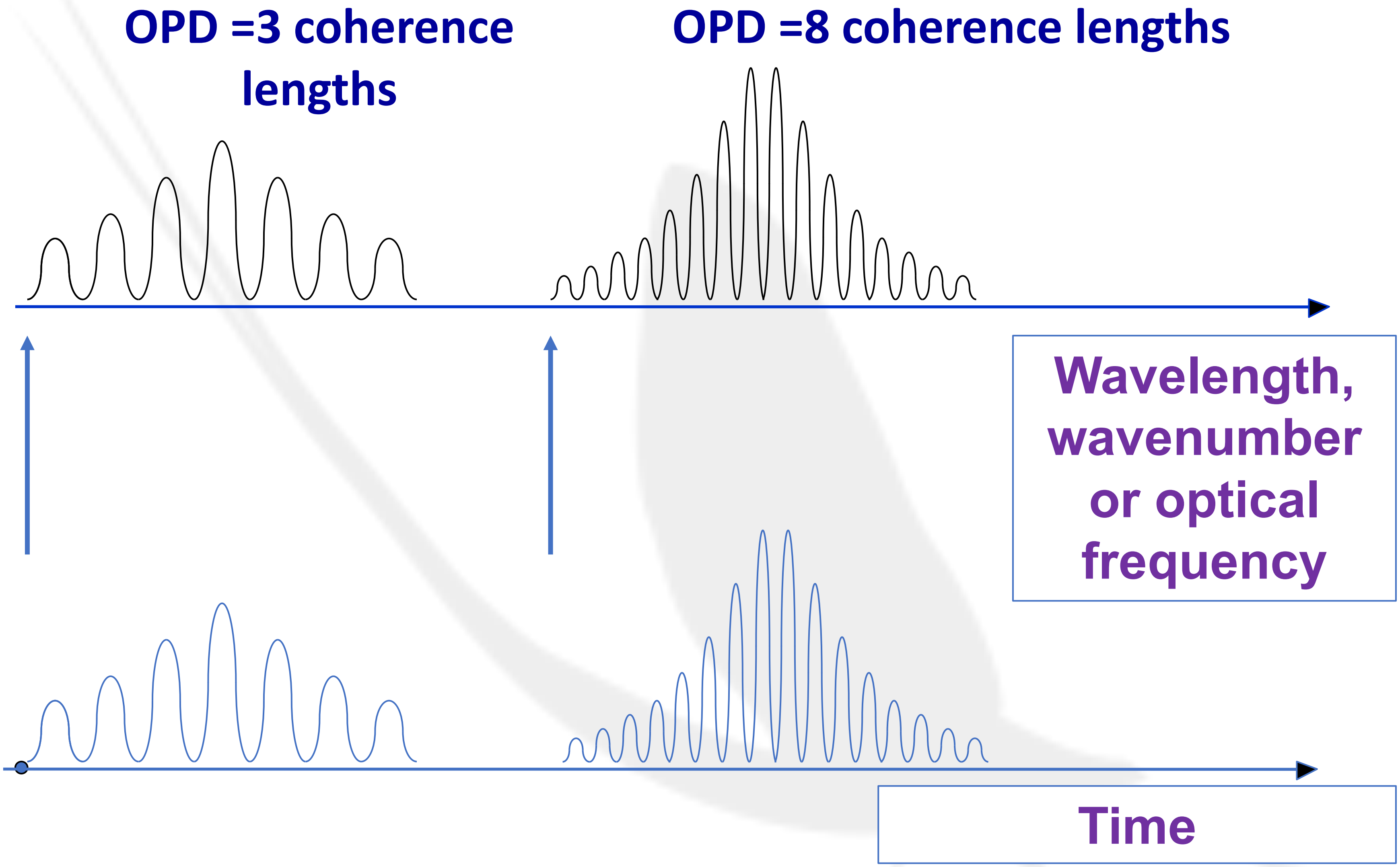
Generic Camera based OCT system

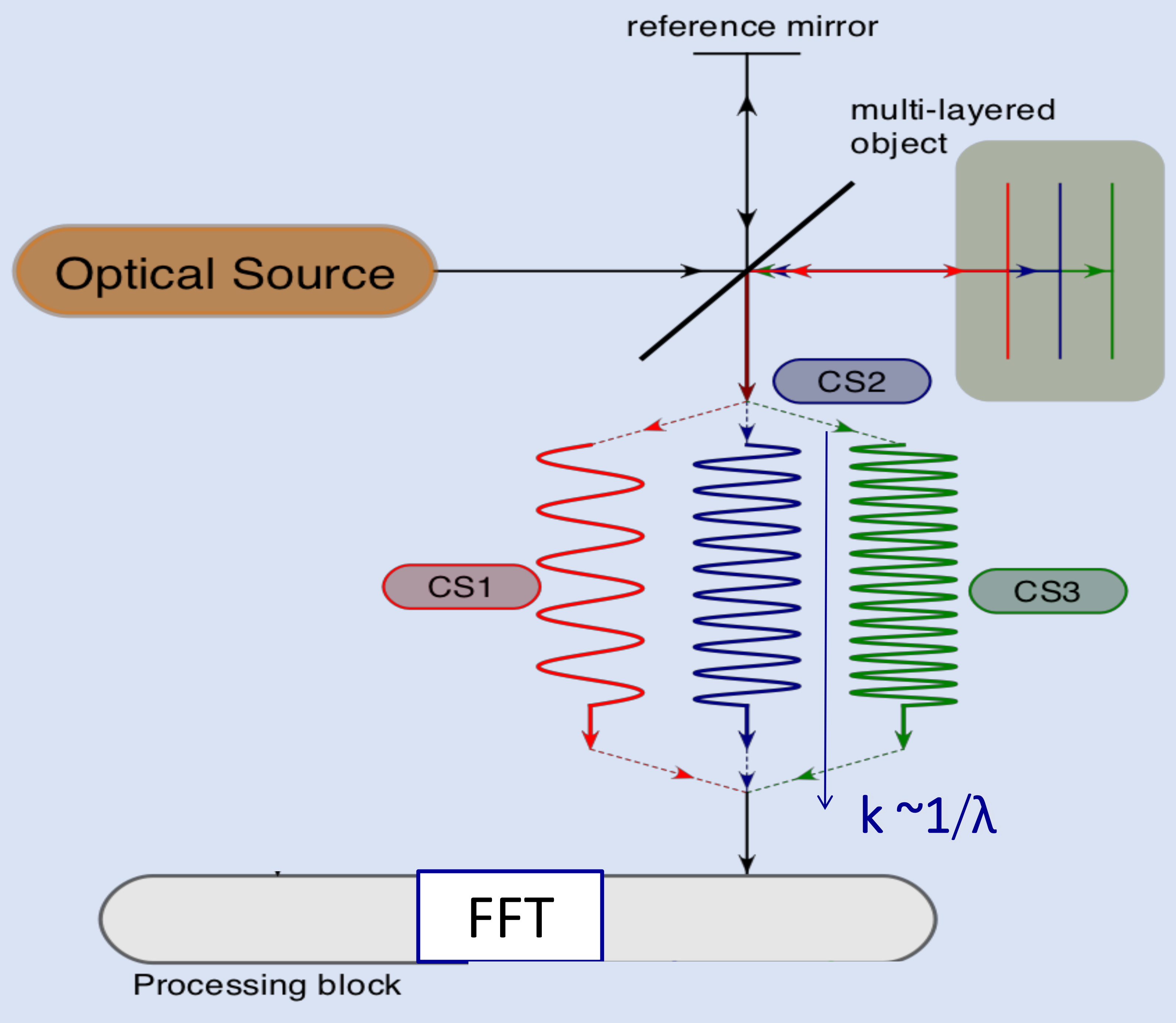


Generic Swept Source OCT system



SS-OCT


OPD =3 coherence lengths
OPD =8 coherence lengths
Wavelength, wavenumber or optical frequency
Time


reference mirror
multi-layered object
Optical Source
CS2
CS1
CS3
k ~1/λ
FFT
Processing block

Fundamental difference between time domain and spectral (Fourier) domain OCT

- TD-OCT works around OPD = 0

- In SD-OCT and FD-OCT all OPDs are interrogated at once

Journal of Microscopy, 247 (3) 209-219, 2012.

COMPARISON

Depth resolution

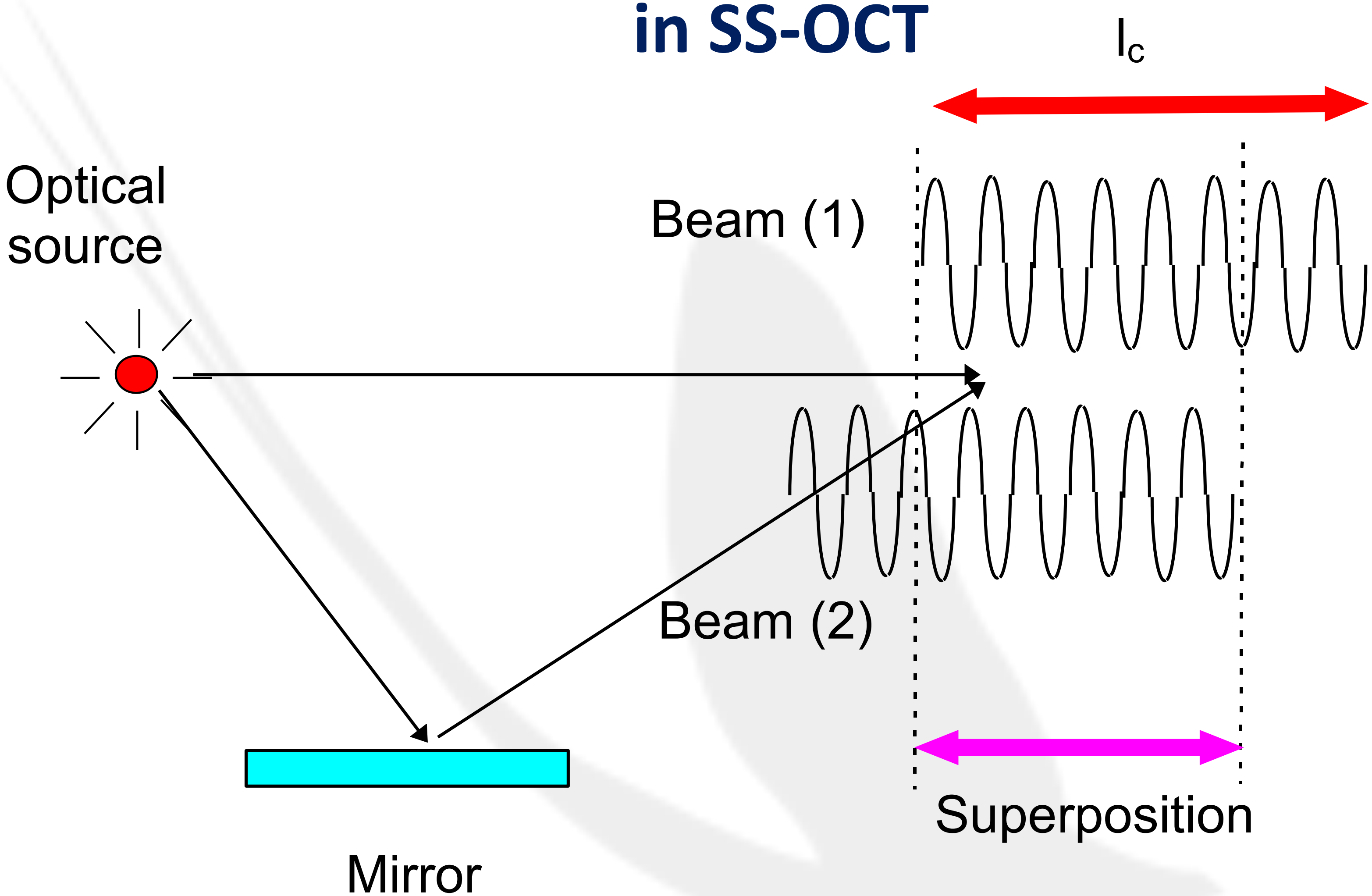
Spectrometer based	Swept source based
Bandwidth	Tuning bandwidth

Axial scan range

Spectrometer based	Swept source based
Spectrometer resolution	Linewidth

SENSING	TELECOM
(DISTANCE MEASUREMENTS) SIMILAR DEMANDS TO CURRENT OCT REPORTS	Tuning bandwidth: GHz Linewidth: <MHz

OPD<Coherence length (several mm) in SS-OCT



Superposition of two wavetrains (interference of two beams generated by a source with a narrow bandwidth).

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Optical sources for OCT

University of Szeged
Where knowledge and challenge meet

Laserlab Europe

eli attosecond

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Superluminiscent diode (Superlum Moscow Russia, Exalos Switzerland)

Groups of superluminiscent diodes (Superlum Moscow, Russia) or groups of fibre lasers (Multiwave Photonics, Porto, Portugal)

Titanium sapphire laser (Femto Lasers (Spectra Physics))

Supercontinuum (NKT Denmark, Fianium UK)

fiber-based SuperContinuum, 1999

Optical coherence tomography

Endoscopy

Instrumentation

OCT: 1991

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Lasers in Medicine and Life Sciences

EXAMPLES of Broadband sources

Groups of fibre lasers (Multiwave Photonics, Porto, Portugal)

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Where knowledge and challenge meet

Laserlab Europe

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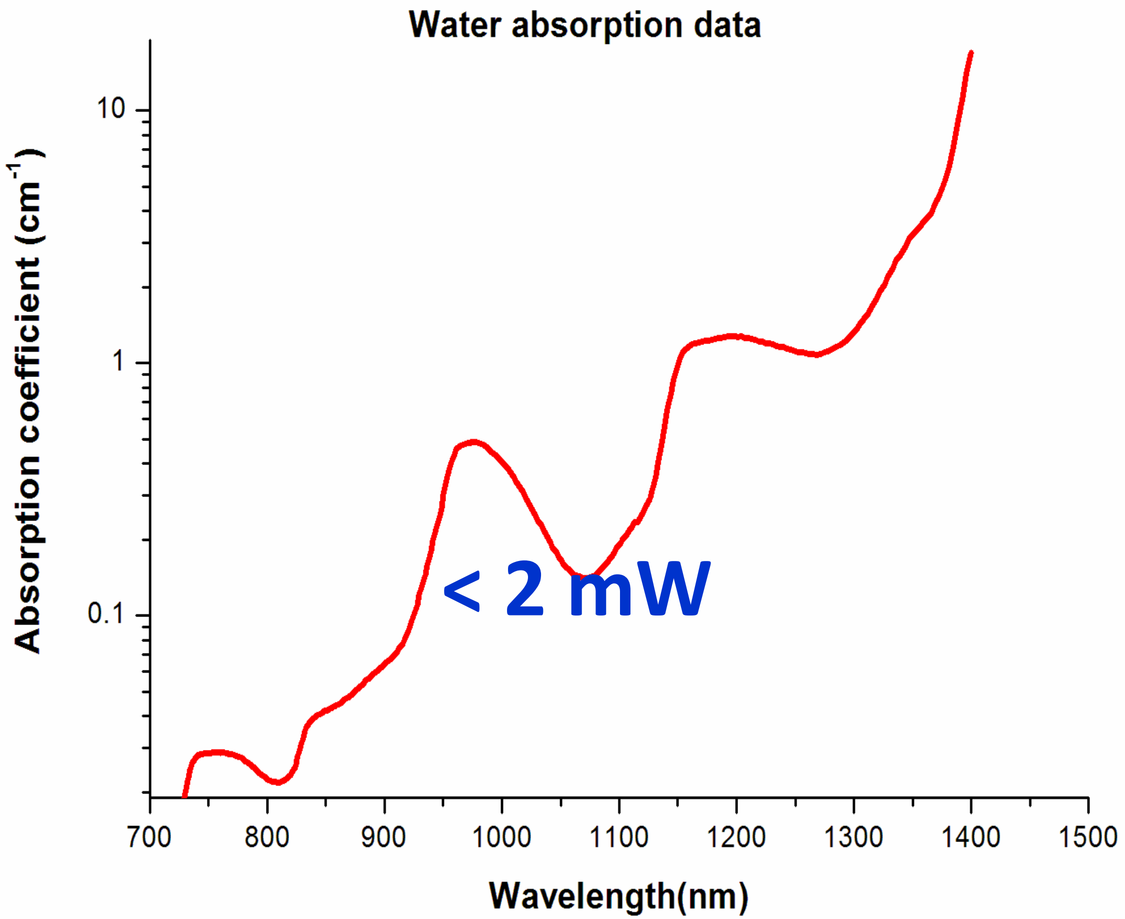
EÖTVÖS LORÁND FIZIKAI TÁRSULAT 1891

The 1050 nm window in imaging the eye fundus

- InGaAs cameras with 1024 pixels (Goodrich,
  46 kHz, 14 bits,
  100 kHz, 12 bits)

- 2006-2011, in collaboration with Multiwave, Porto, Novel large band source at 1050 nm for TD- OCT and Sp-OCT, Marie Curie Training Site, EC

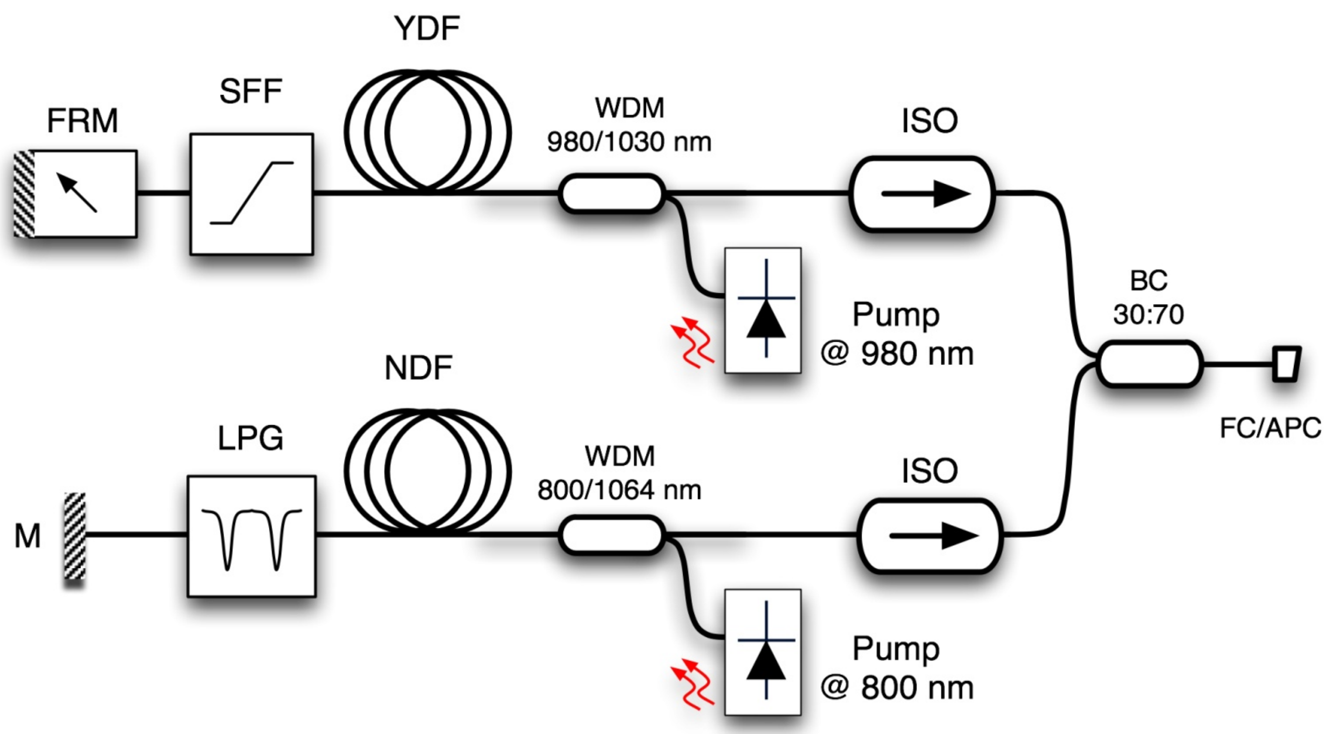
SNR and eye safety considerations



Total loss of signal of 3-4 dB when changing wavelength from 830 nm to 1050 nm.

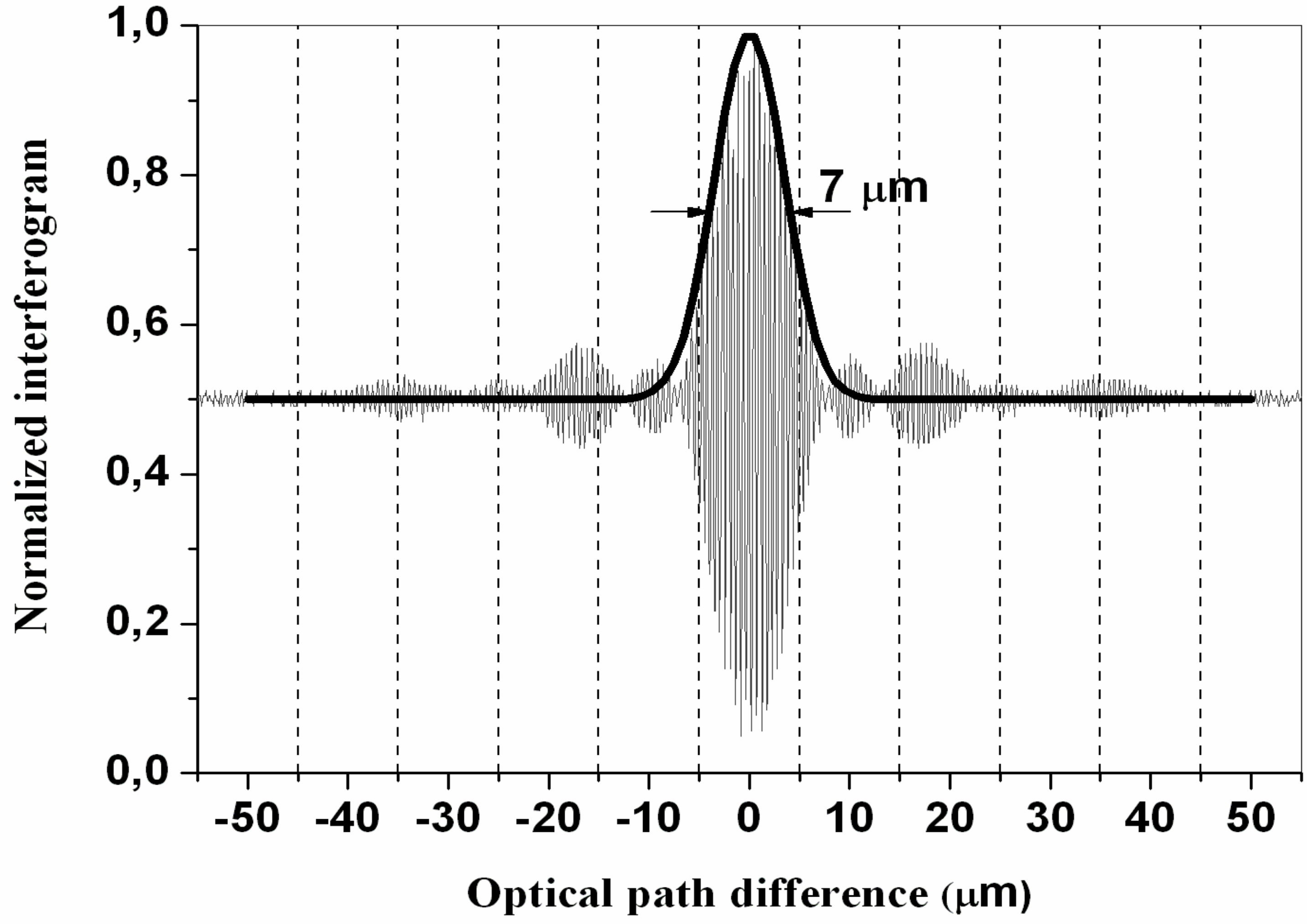
Large bandwidth source at 1050 nm

2006-2011, in collaboration with Multiwave, Porto



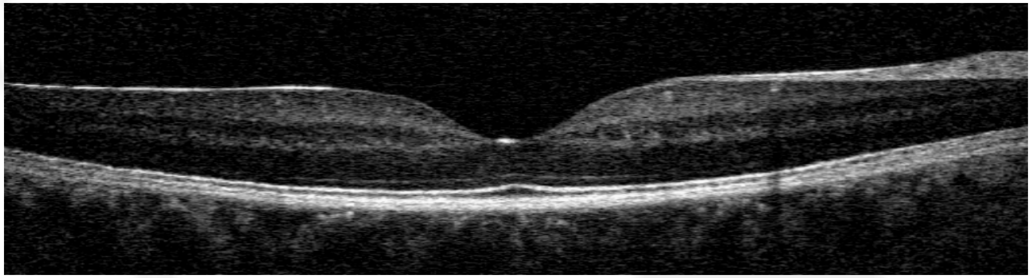
IEEE Photonics Technology Letters , Vol. 23, No. 1, January 1, 2011, 21 – 23.

Depth resolution



IEEE Photonics Technology Letters , Vol. 23, No. 1, January 1, 2011, 21 – 23.

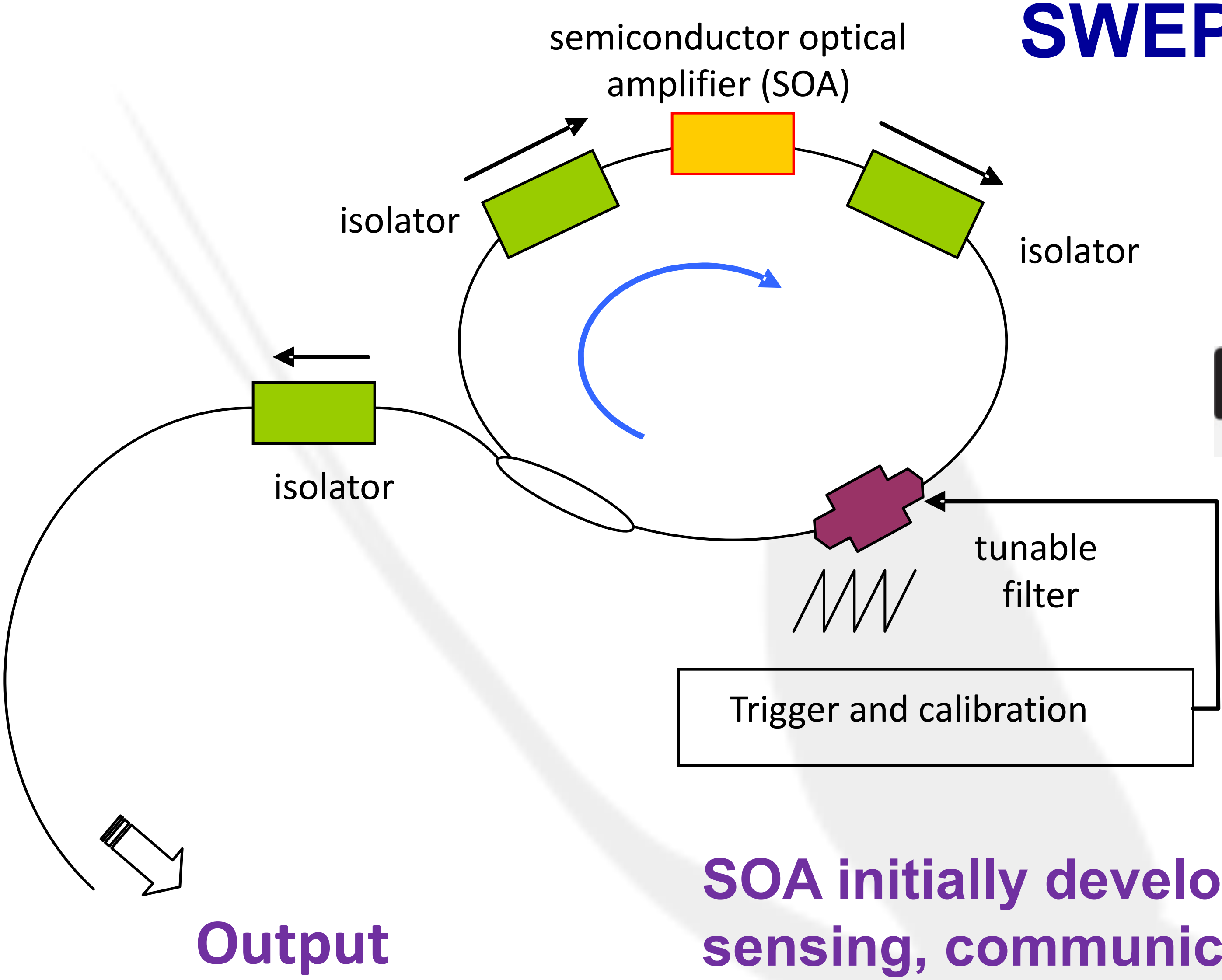
B-scans at 890 nm at 1050 nm



λ_0 = 890 nm
3 µm axial resolution

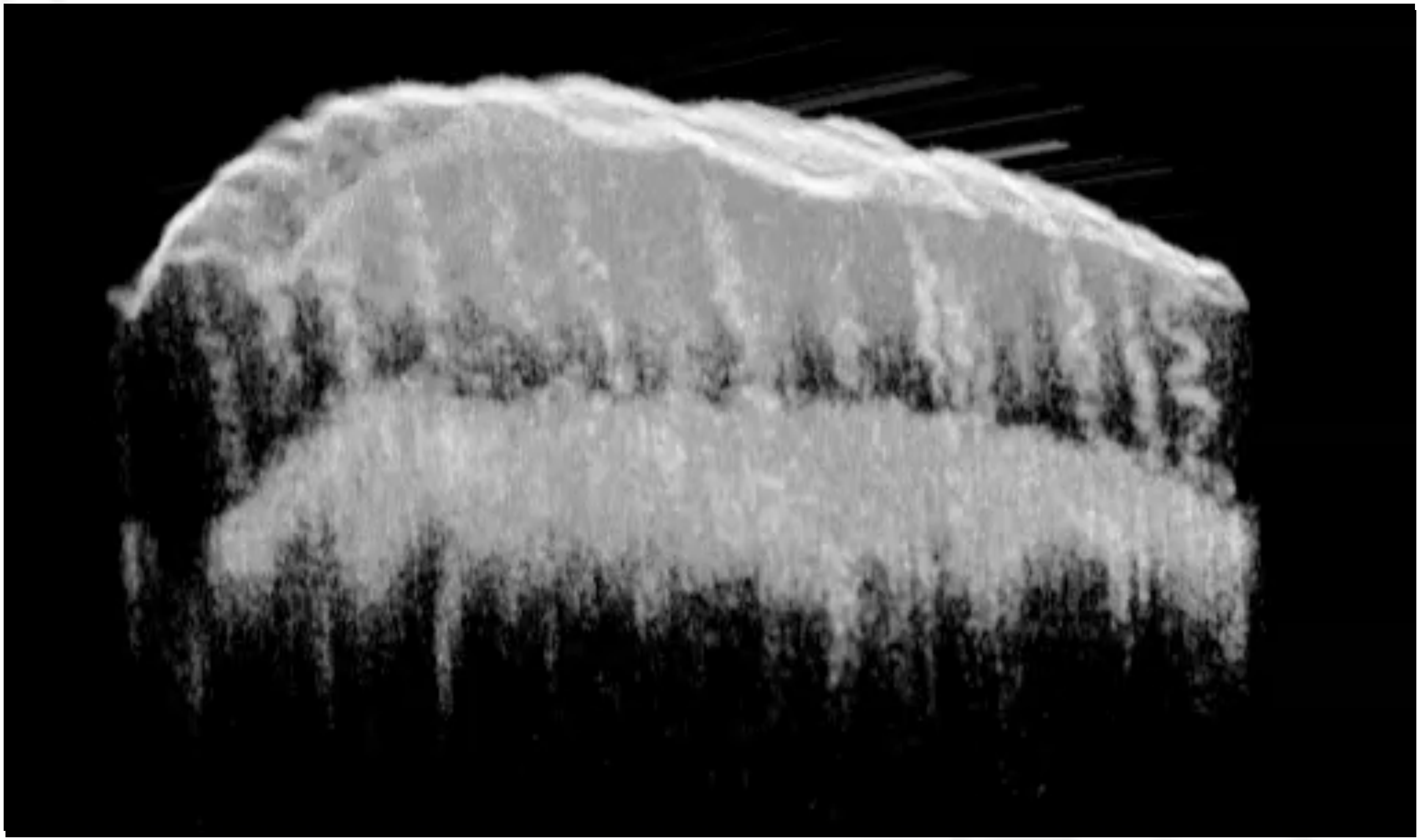
λ_0 = 1050 nm
12.31 µm axial resolution

SWEPT SOURCE



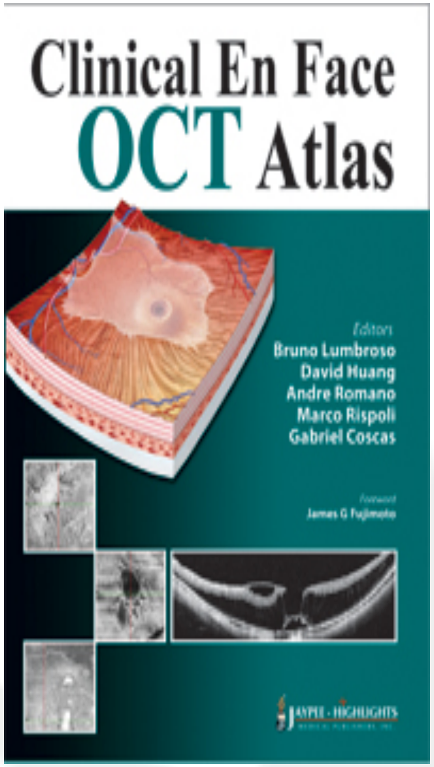
SOA initially developed for sensing, communications and amplification, now used in sources for SS-OCT

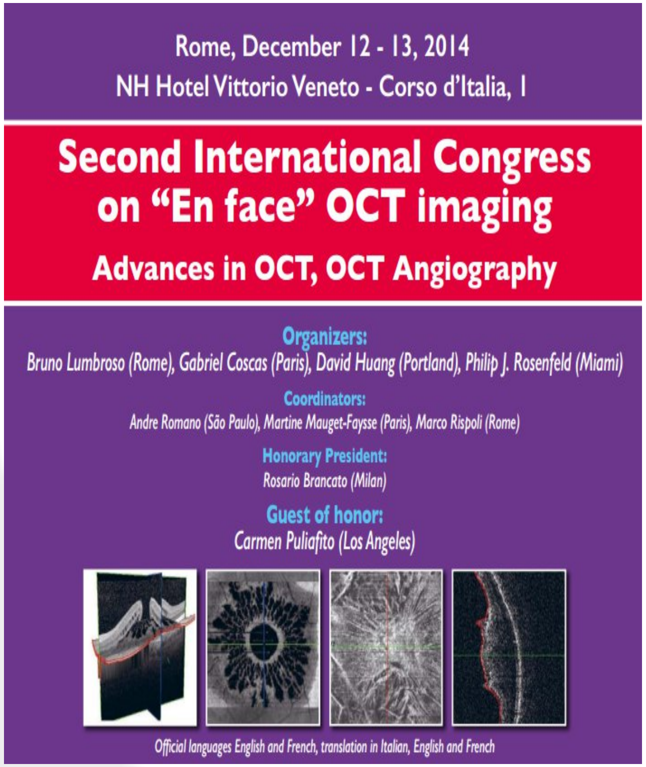
Assembled a volume of A-scans using FFT based Swept Source-OCT



TREND IN IMAGE PRESENTATION TOWARDS SHOWING THE *EN-FACE* ORIENTATION

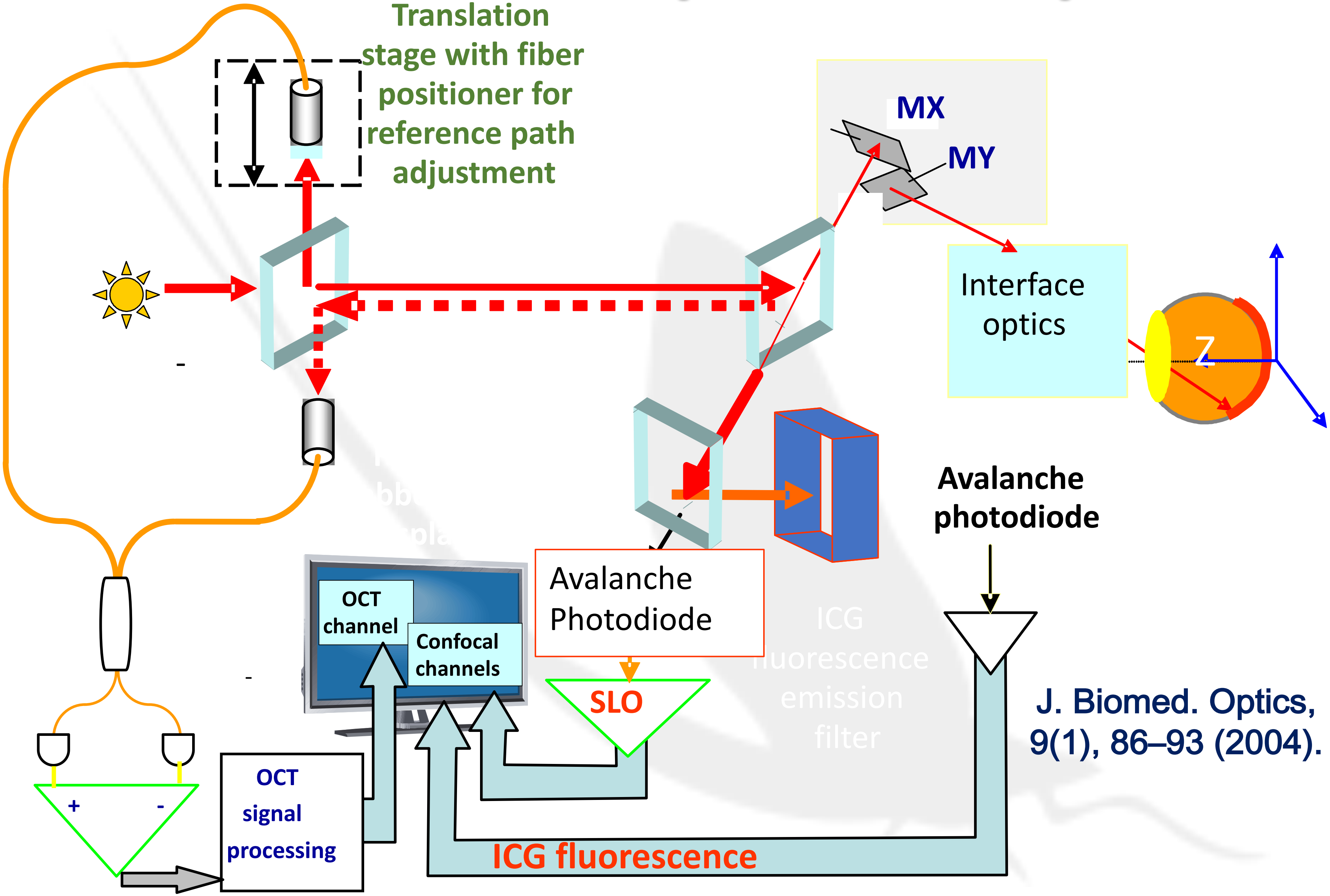
Interest for the *en-face* display:





Time domain OCT

OCT Confocal Ophthalmoscope



J. Biomed. Optics, 9(1), 86–93 (2004).

EN-FACE OCT

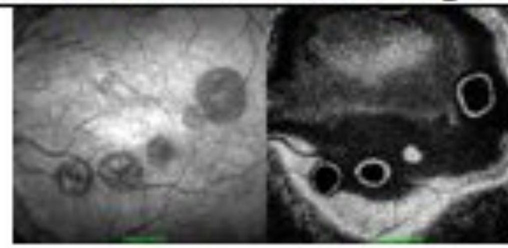
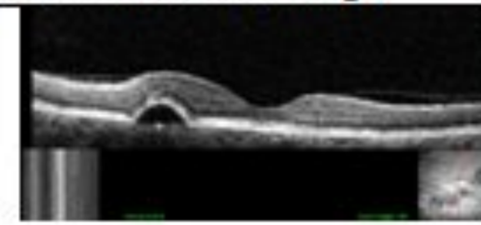
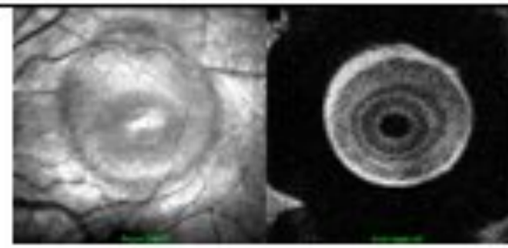
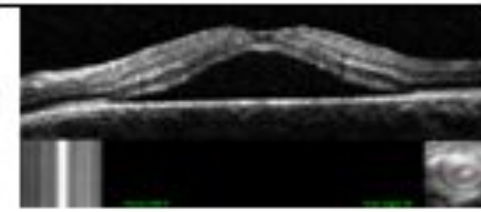
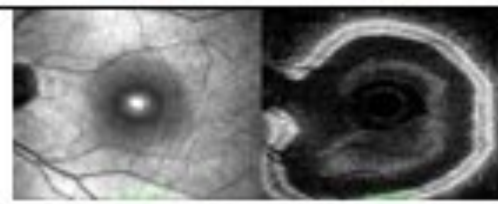
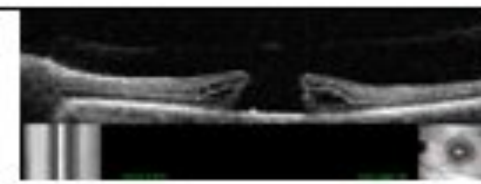
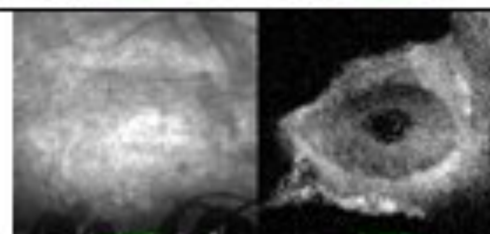
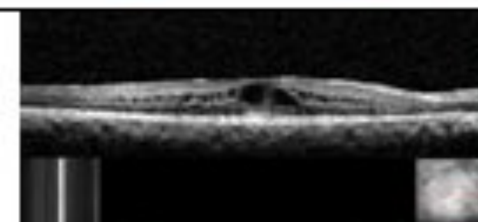
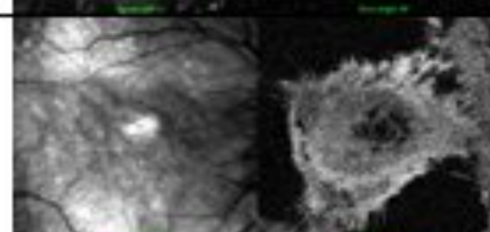
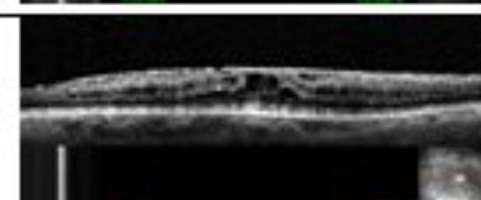
New York Eye & Ear Infirmary

Academisch Medisch Centrum, Amsterdam

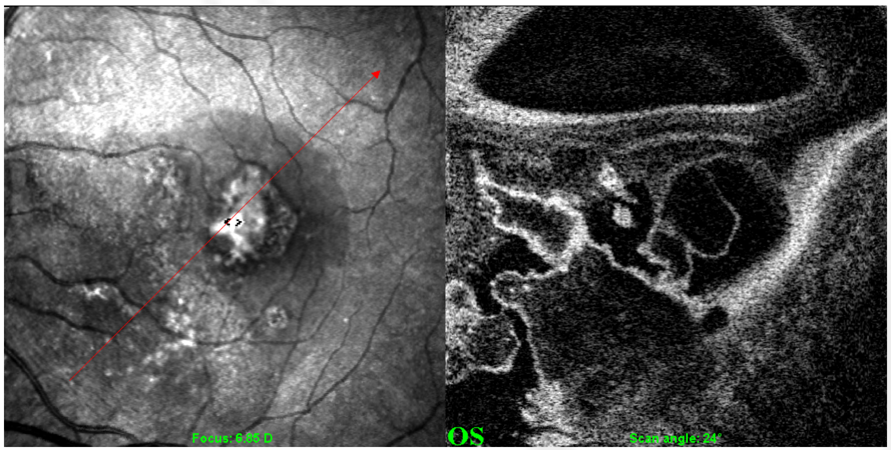
Asahikawa Medical College, Asahikawa, Japan

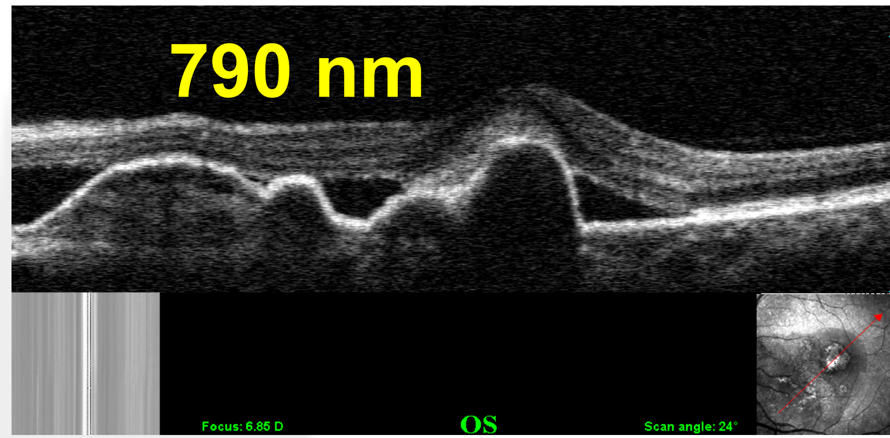
- Optics Express, 17/5, pp. 4112-4133 (2009)
- IOVS, 24, 50:851-860 (2008).
- Retina, 26:, pp. 129–136, (2006).
- J. Biomedical Optics, 9(1), 86–93 (January/February 2004)

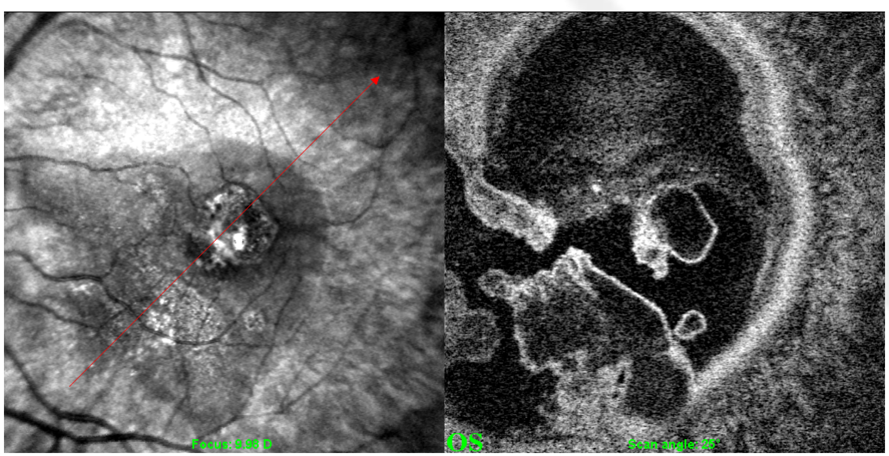
Richard Rosen, New York Eye and Ear Infirmary, Images produced by T-scan based OCT, (*en-face* OCT), PRER, No. 4, (2008): 464-499

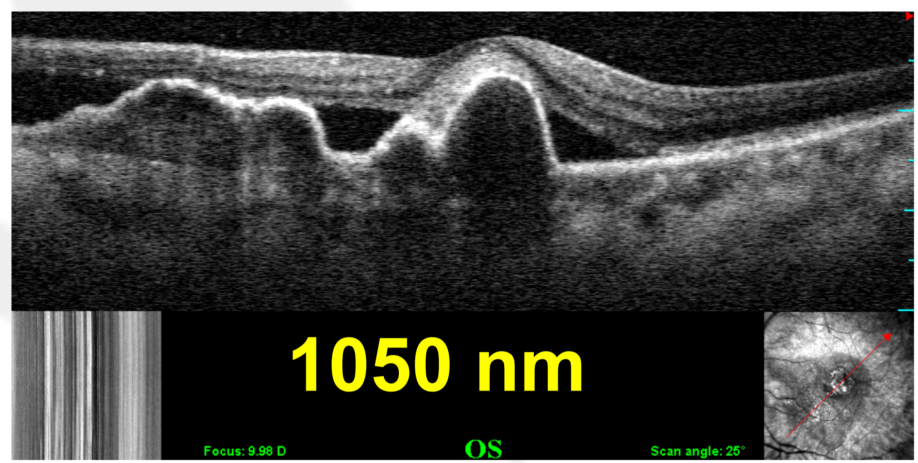
Disease	Pattern	C-scan OCT/SLO Image	B-scan OCT image
RPE detachment	Rings of light (isolated bright circles surrounding dark spaces)		
Central Serous Retinopathy	Bullseye target (concentric rings of alternating bright and dark lines)		
Macular hole	Petaloid wreath (ring of cysts around a central axis)		
Cystoid macular edema	Swiss Cheese Wheel (cluster of circular holes)		
Epiretinal membrane	Shining star (radiating lines)		

IPCV case - comparison with SLO/OCT imaging at shorter wavelengths



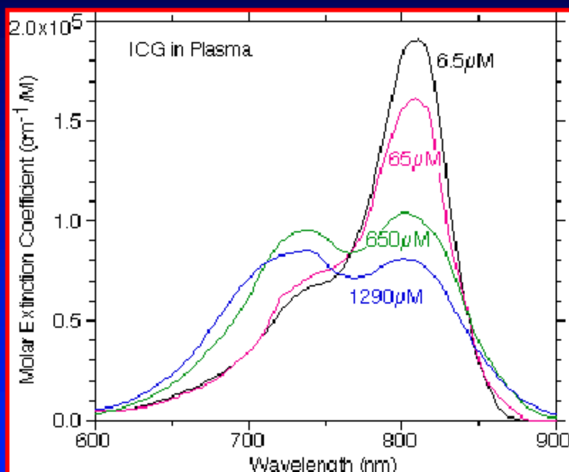






ICG and OCT - Common Operating Spectrum

ICG ABSORPTION SPECTUM

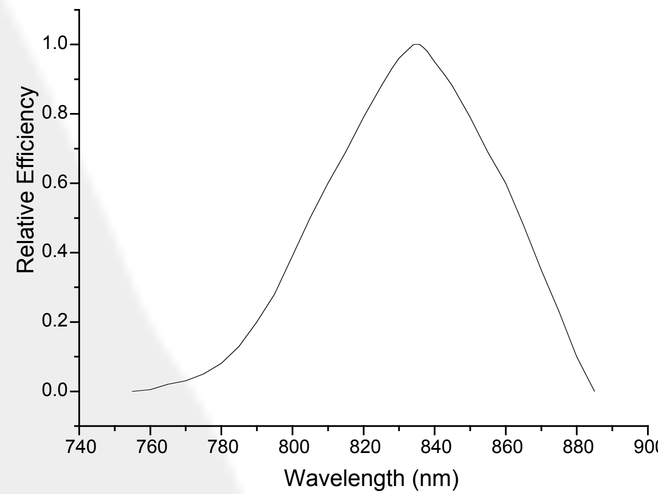


Peak = 805nm

Rochester, Oct. 14, 2004

Applied Optics Group, Canterbury

ICG FLUORESCENCE SPECTRUM

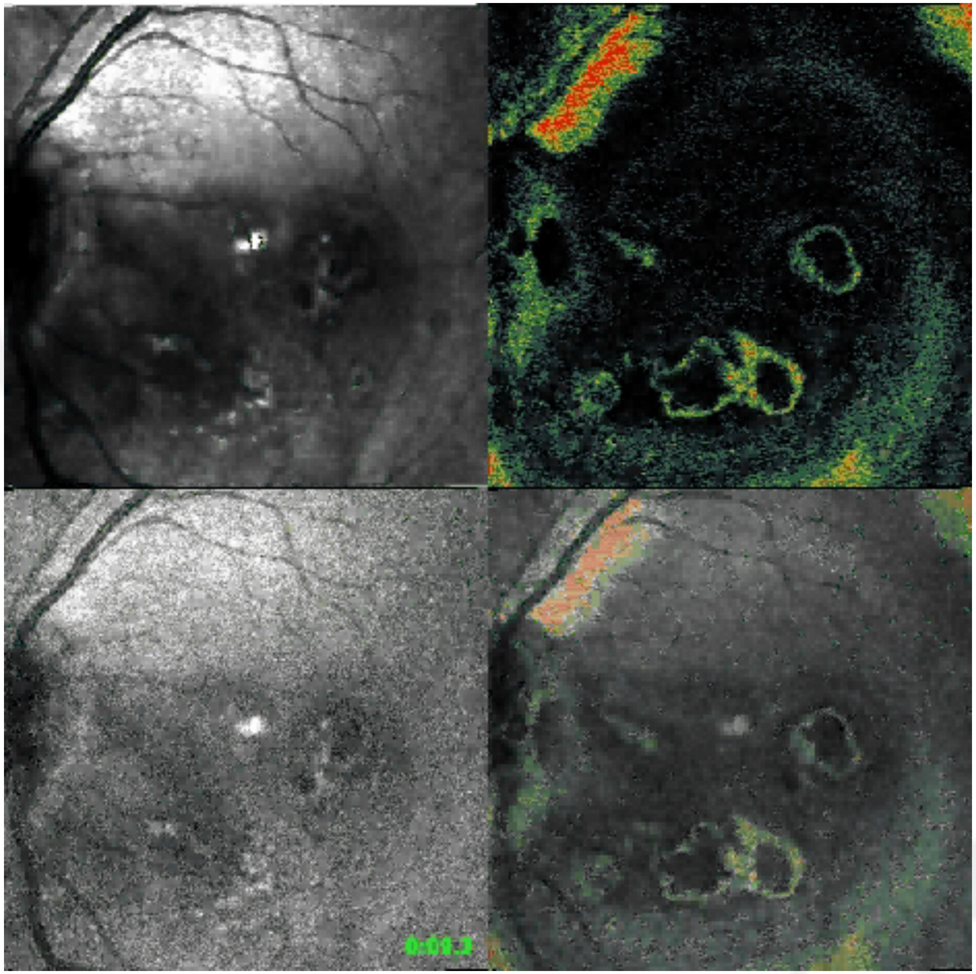


Peak at = 830 nm

Polypoidal Choroidal Vasculopathy
Complex Neovascularization

Confocal

C-scan
OCT



ICG

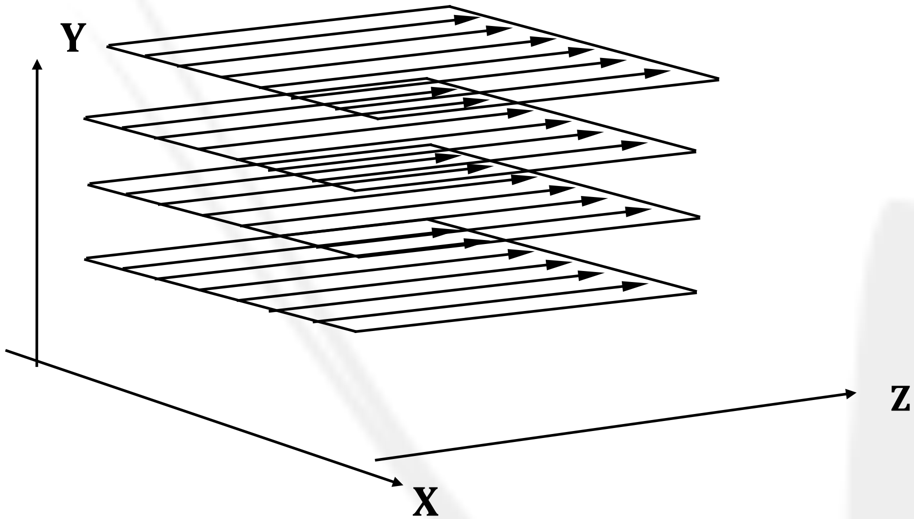
Overlay

4 screens
In 0.5 s

805 nm, 0.8 mW

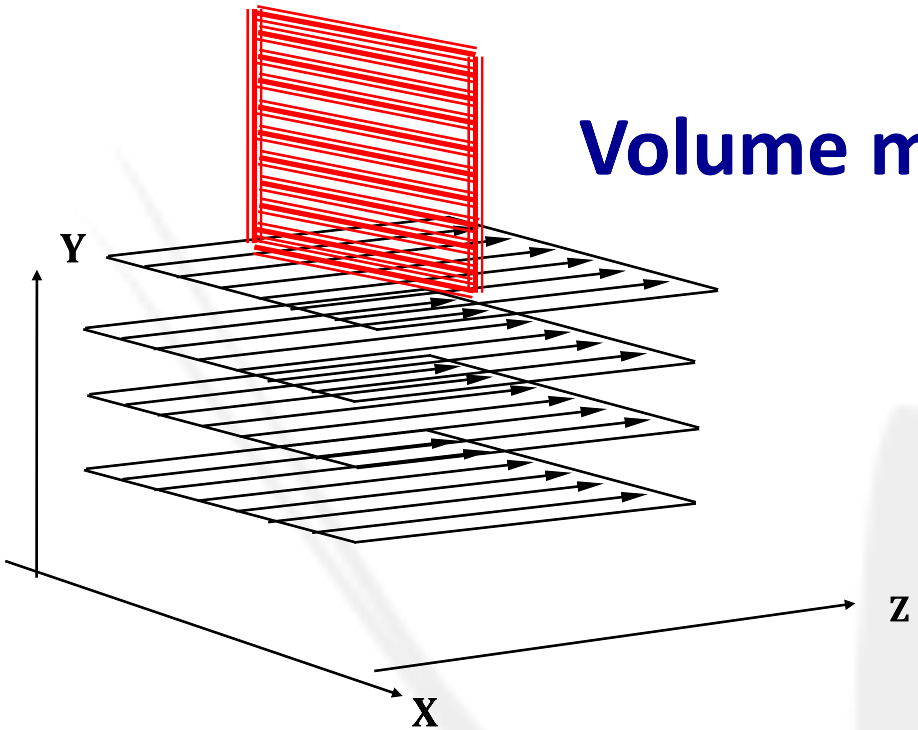
Spectral (Fourier) domain OCT

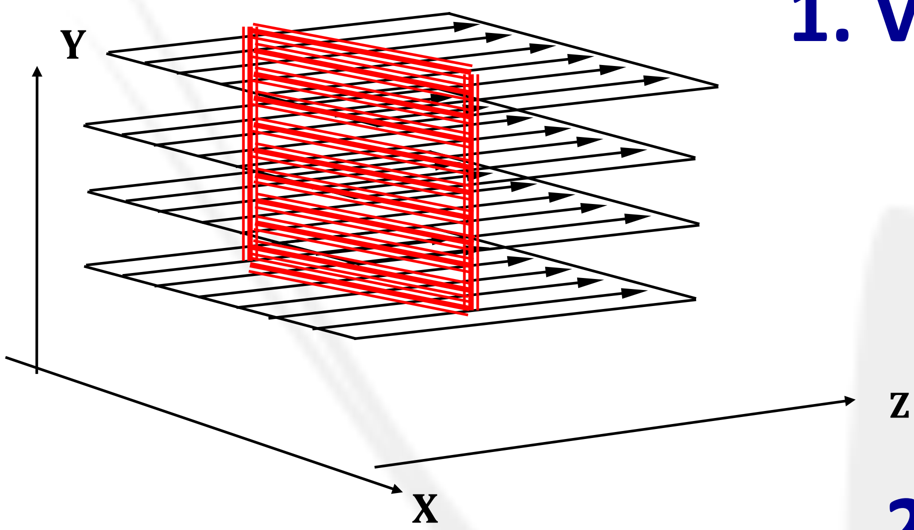
Volume made of A-scans



3D SCANNING BASED ON B-SCAN SLICES AT DIFFERENT POSITIONS Y
CURRENTLY USED BY SD-OCT SYSTEMS

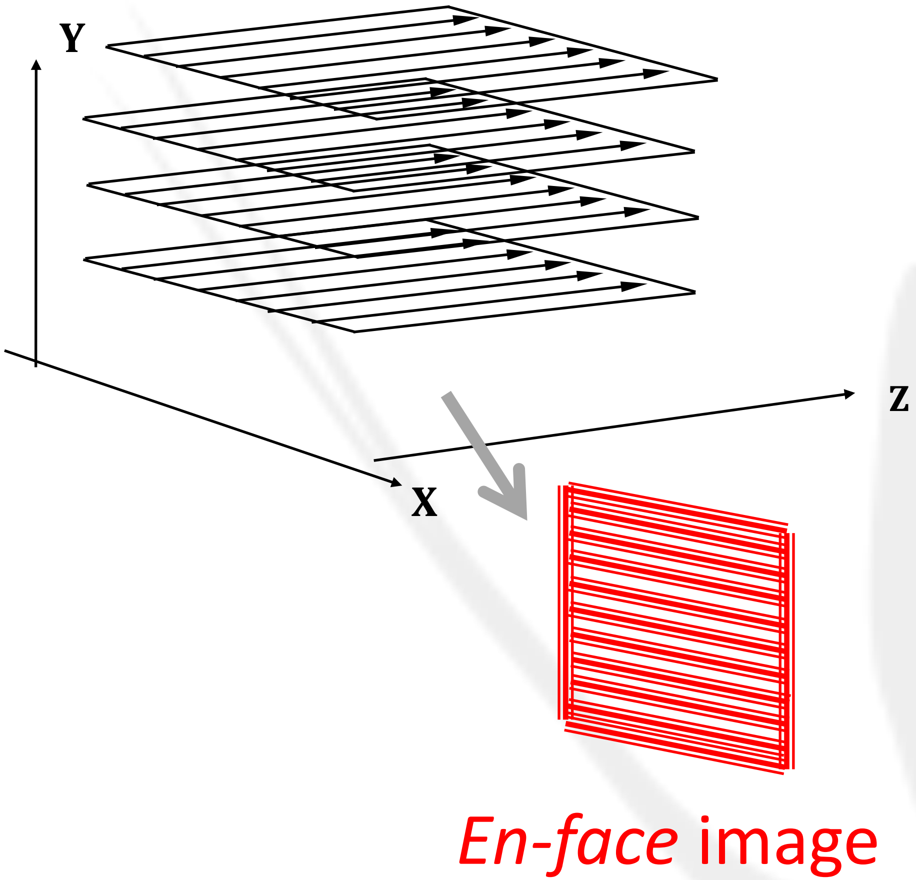
Volume made of A-scans





1. Volume made of A-scans

2. Slice of the volume calculated by software means to produce a C-scan (*en-face* OCT) image

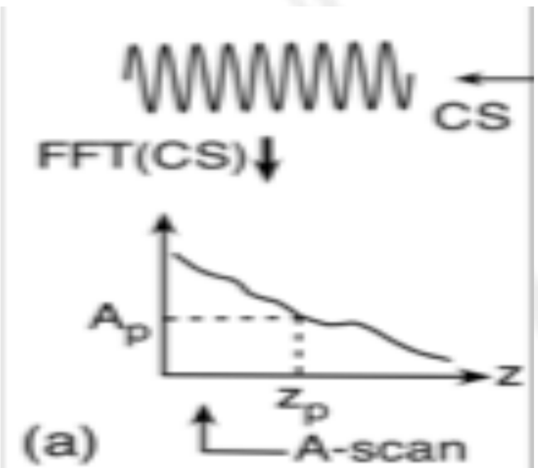


This takes time

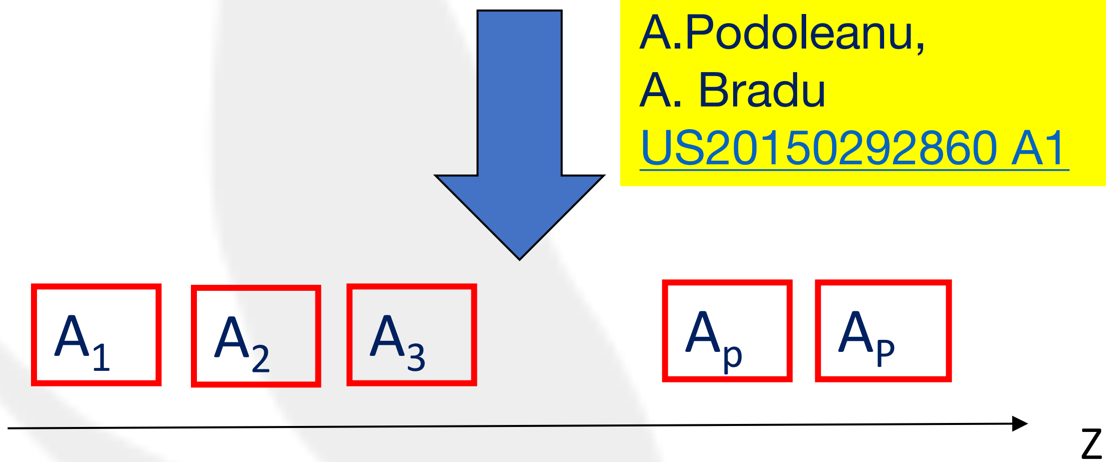
1st DISADVANTAGE: Based on A-scans, *en-face* images can only be obtained after reconstruction of data

Conventional OCT FFT of Channeled Spectra (CS)

Master/Slave OCT Uses a processor for each pixel in depth in the A-scan



A.Podoleanu,
A. Bradu
US20150292860 A1

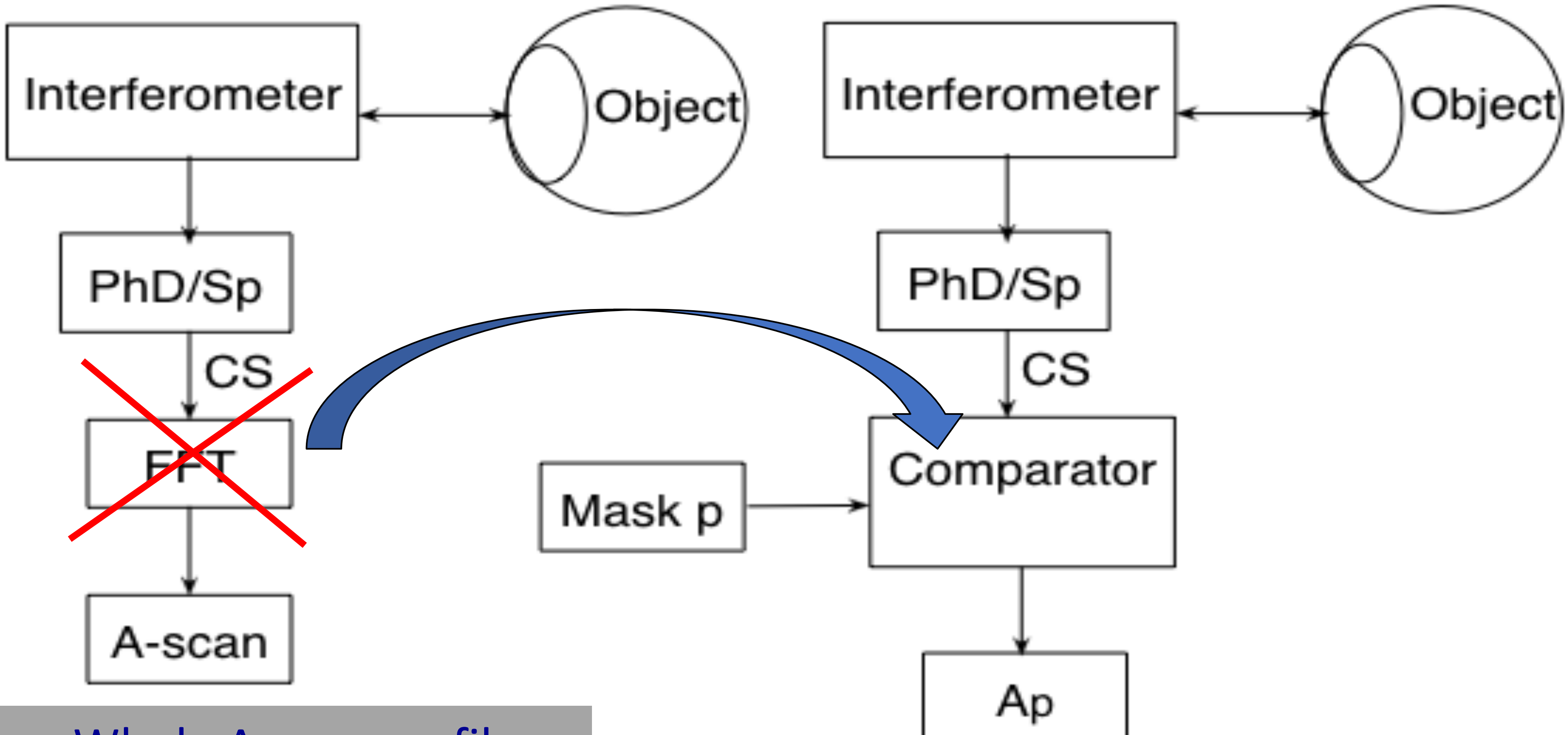


FFT delivers an A-scan, ie all Ap points are obtained in one go

A-scan made from P inferred results delivered by P processors implementing each a comparison (correlation) operation for each depth

Conventional FFT based interferometry (ALL)

Master Slave interferometry (Kent only)

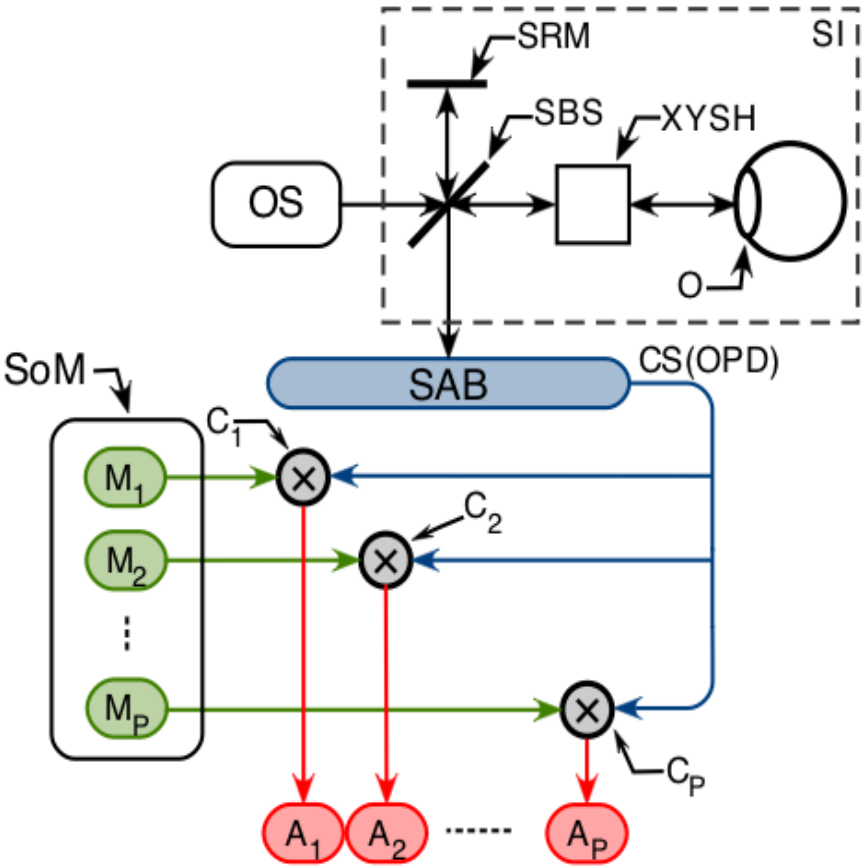


Whole A-scan profile

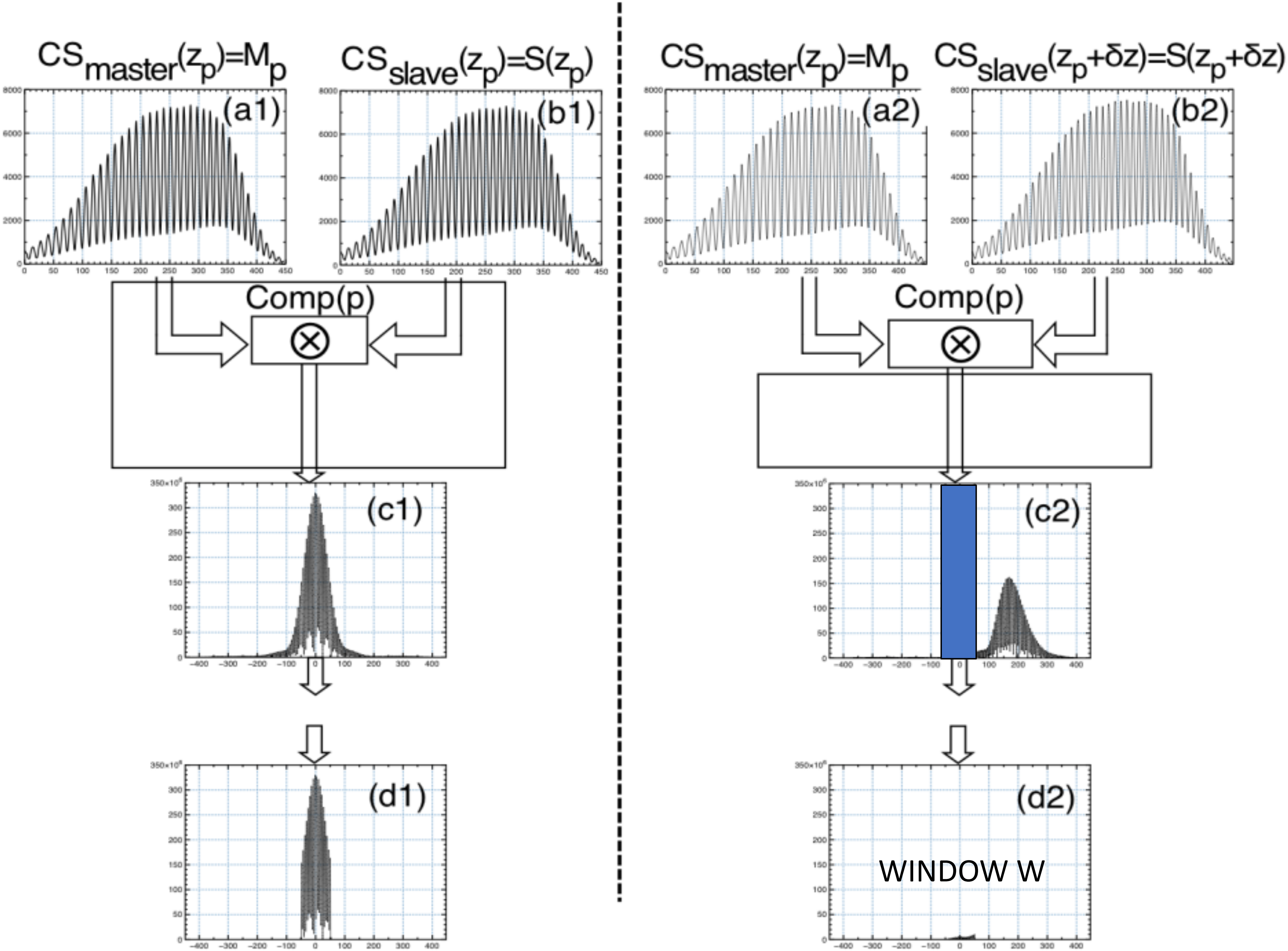
Single depth point in the A-scan

PARALLEL IMAGING AT SEVERAL DEPTHS SIMULTANEOUSLY

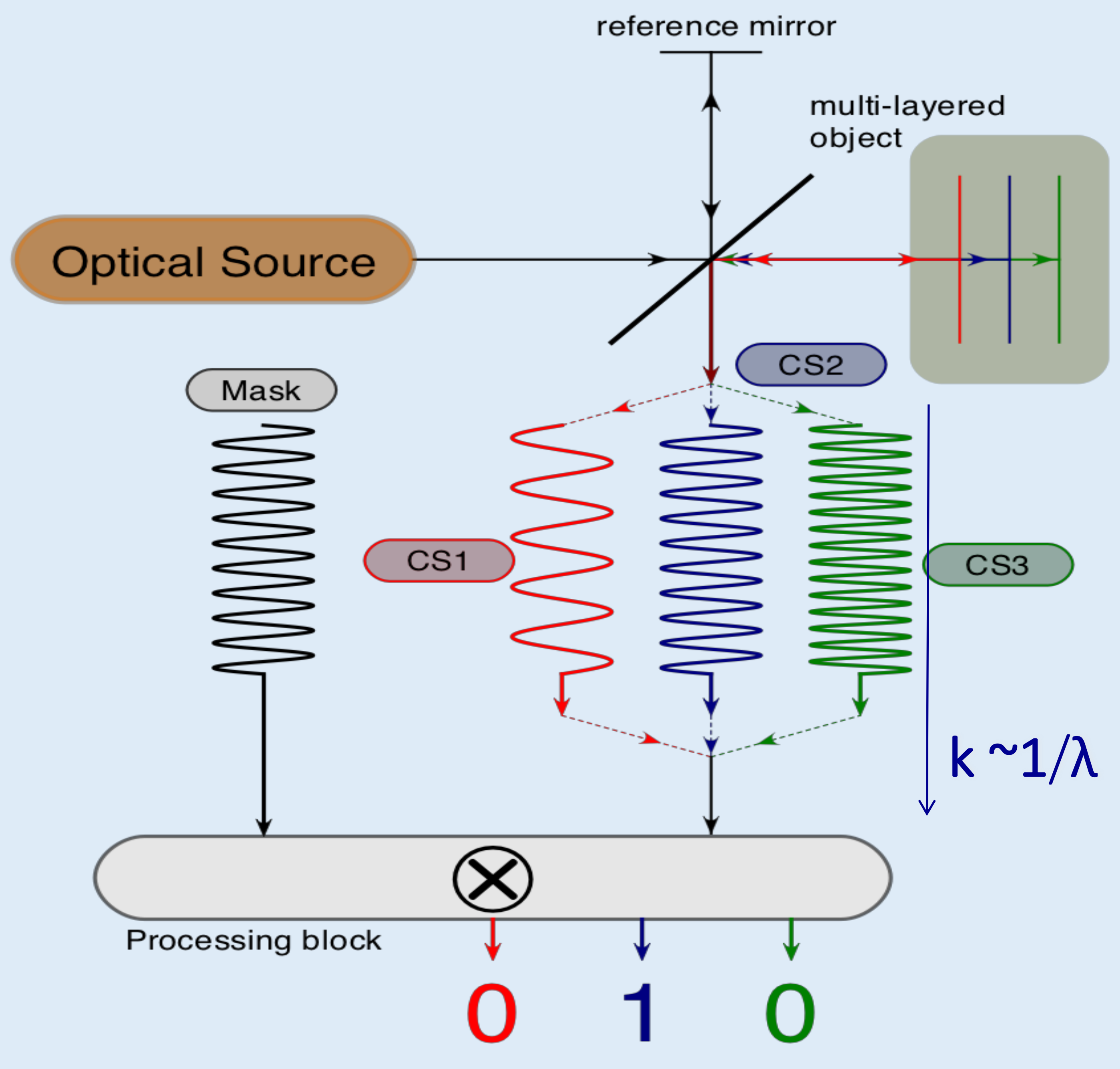
A. Podoleanu, A. Bradu, Master Slave OCT
Opt. Express 21, 19324-19338 (2013)



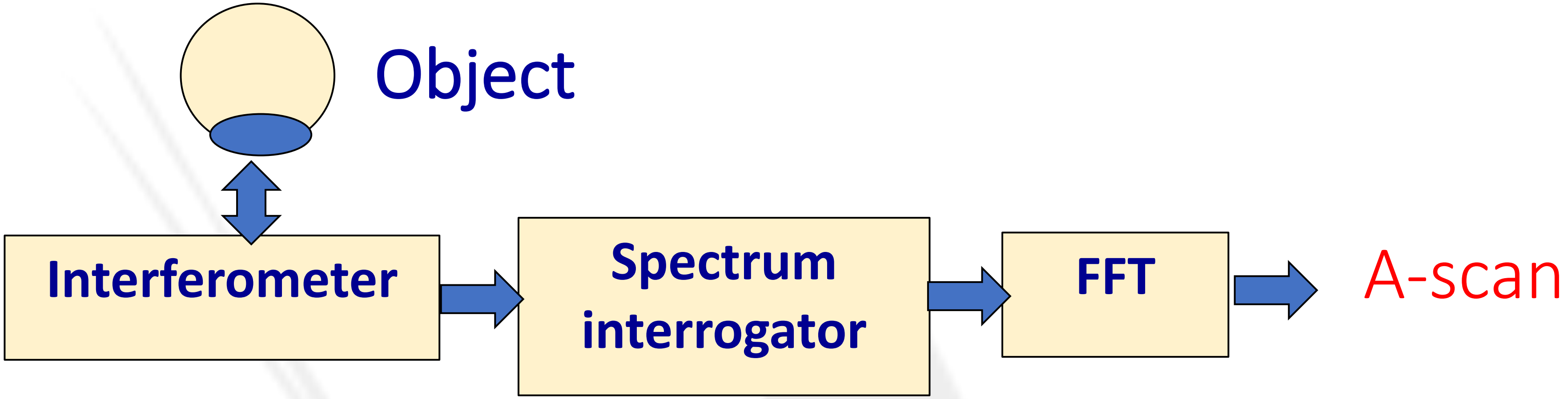
Comparison of channeled spectrum CS with M1, M2, …MP: MASKS



$CS_{master}(z_p)=M_p$
$CS_{slave}(z_p)=S(z_p)$
(a1)
(b1)
Comp(p)
(c1)
(d1)
$CS_{master}(z_p)=M_p$
$CS_{slave}(z_p+\delta z)=S(z_p+\delta z)$
(a2)
(b2)
Comp(p)
(c2)
(d2)
WINDOW W


reference mirror
multi-layered object
Optical Source
CS2
Mask
CS1
CS3
k ~1/λ
Processing block
0
1
0

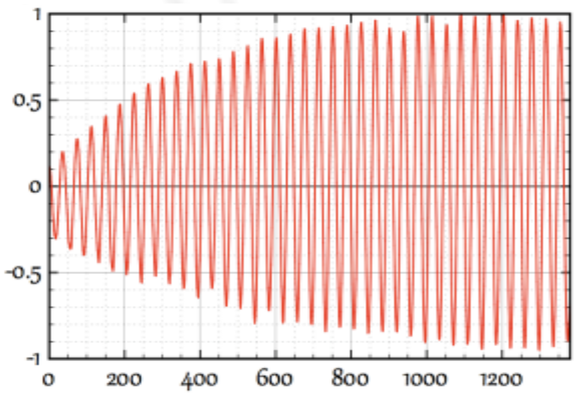
Conventional spectral domain OCT

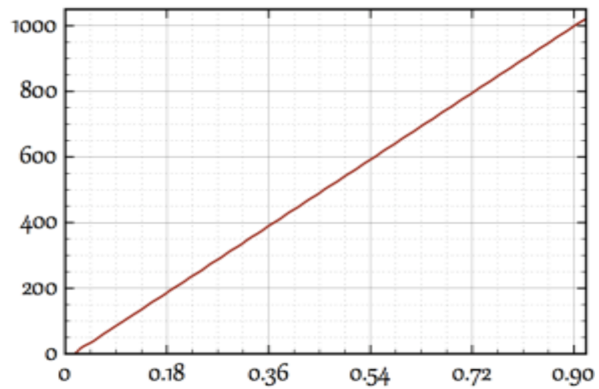


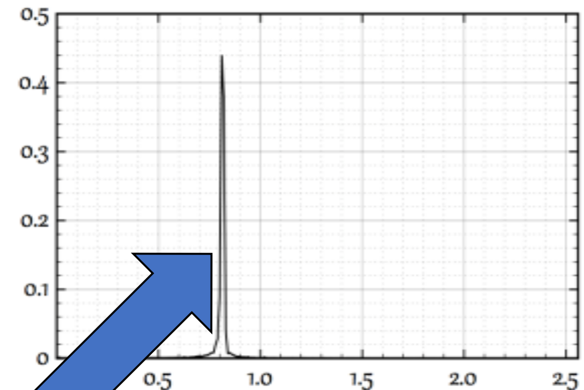
2nd DISADVANTAGE: Method requires resampling, linearisation that takes time

Need for resampling/linearisation

Effect of the spectrum chirp in the k-space







Channelled Spectrum

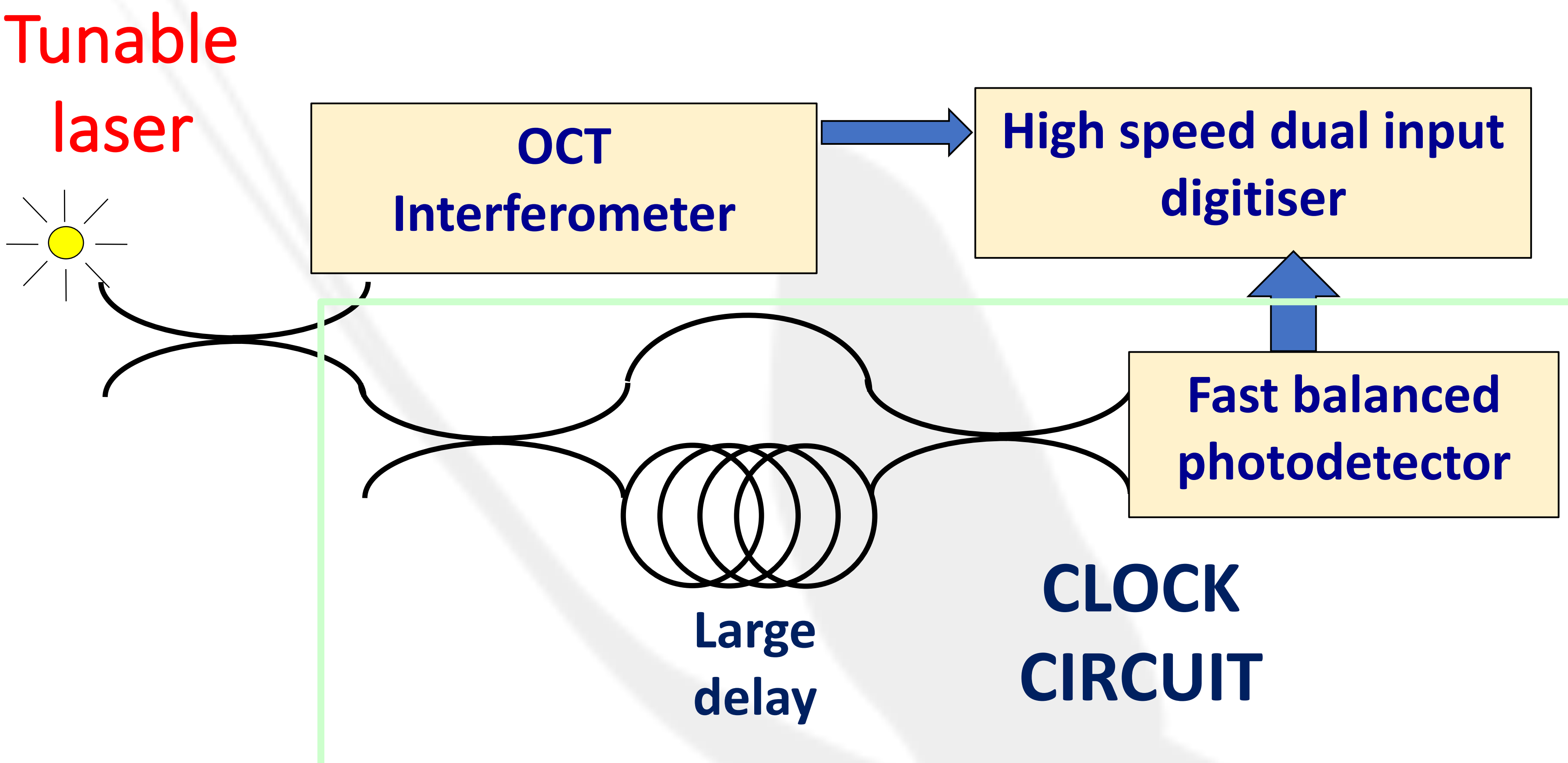
Phase

A-scan

For a different point in depth, peak is thicker and exhibits shoulders

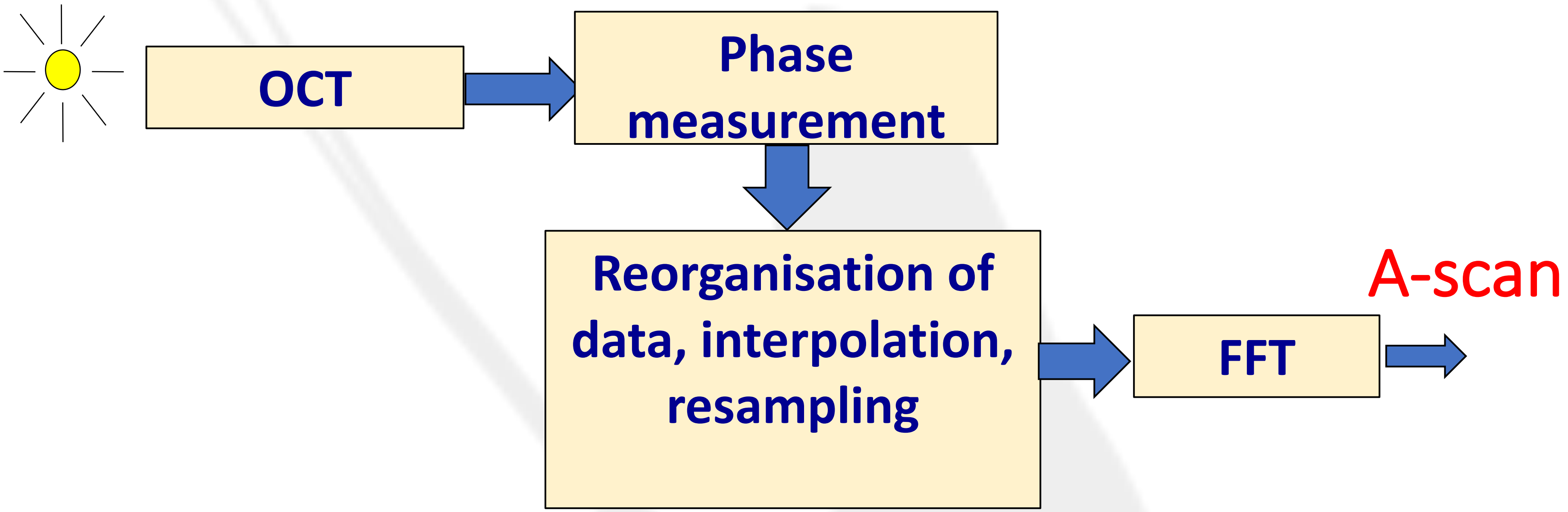
Procedure performed during acquisition, for each A-scan, delaying display

HARDWARE LINEARISATION OF CHANNELLED SPECTRUM



INCREASED COST OF SWEPT SOURCES LIMITS THE AXIAL RANGE

SOFTWARE LINEARISATION OF CHANNELLED SPECTRUM



IMPERFECT UNLESS MANY MULTIPLE PHASE POINTS ARE USED

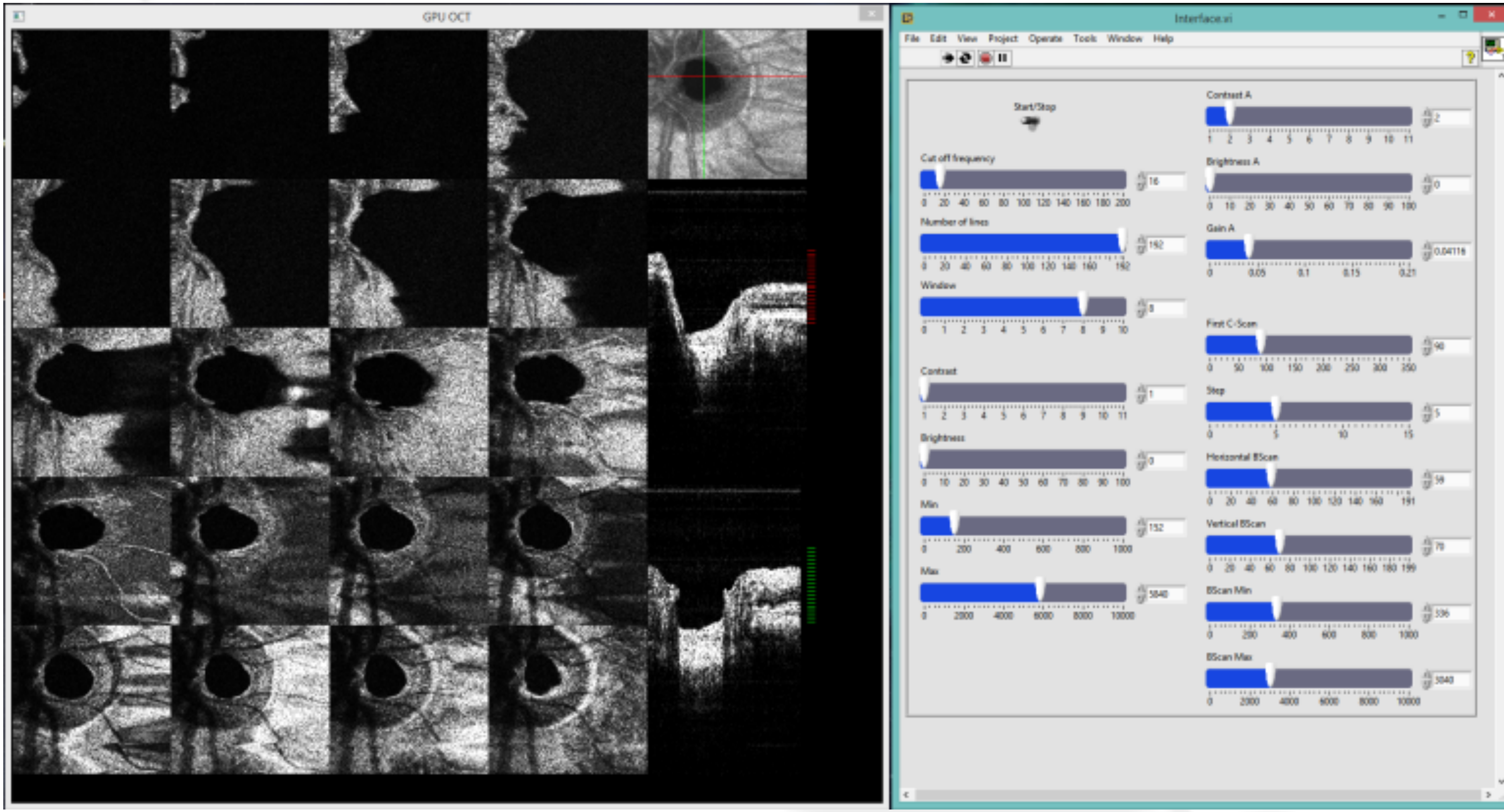
Developed a fast MS algorithm for evaluation of the correlation function

A. Bradu, K. Kapinchev, F. Barnes, A. Podoleanu,
J. Biomed. Opt., 20(7), 076008 (2015).

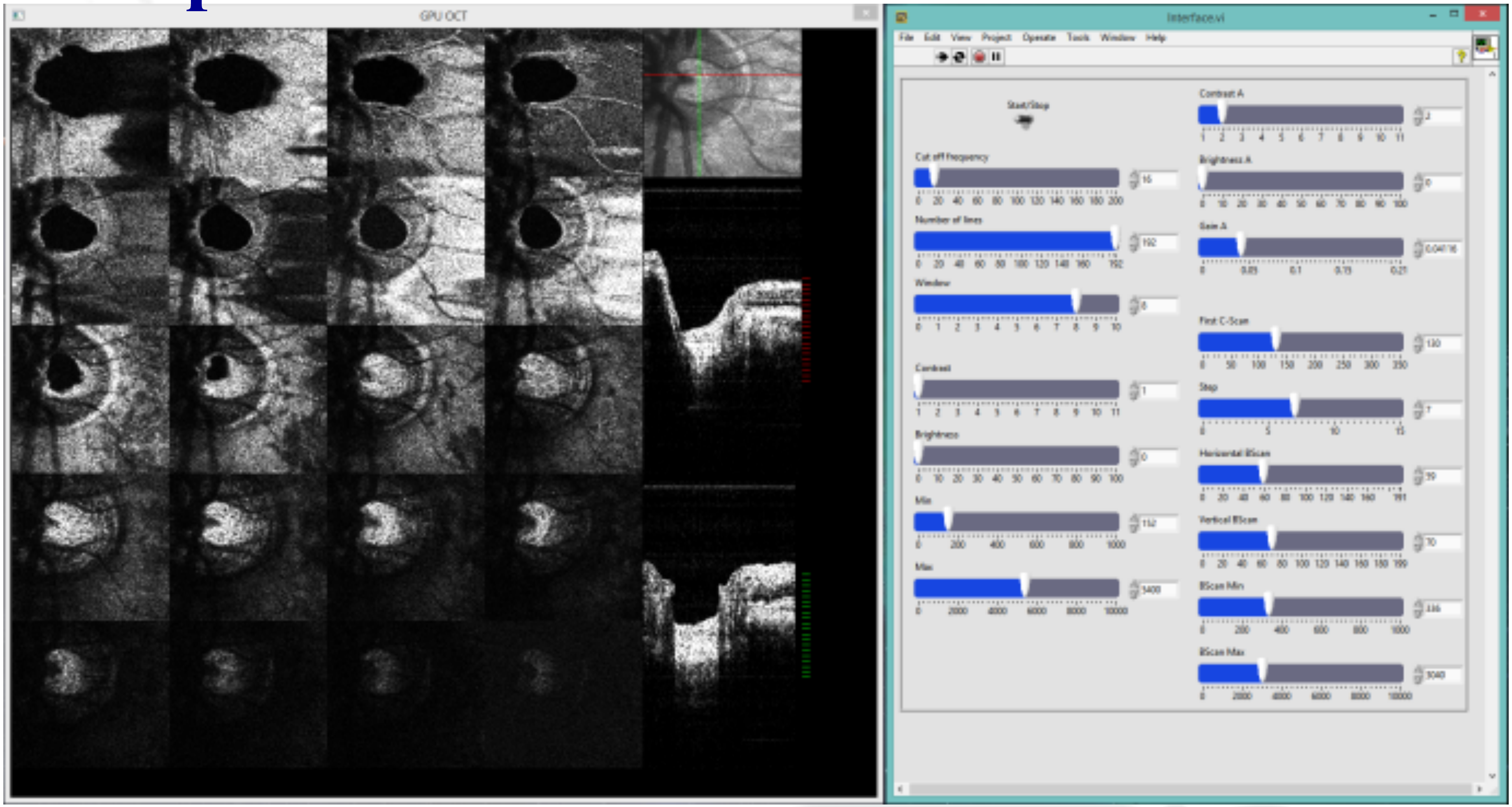
$$Corr_p = CS(k) \otimes CS_{(OPD=OPDp)}(k)$$

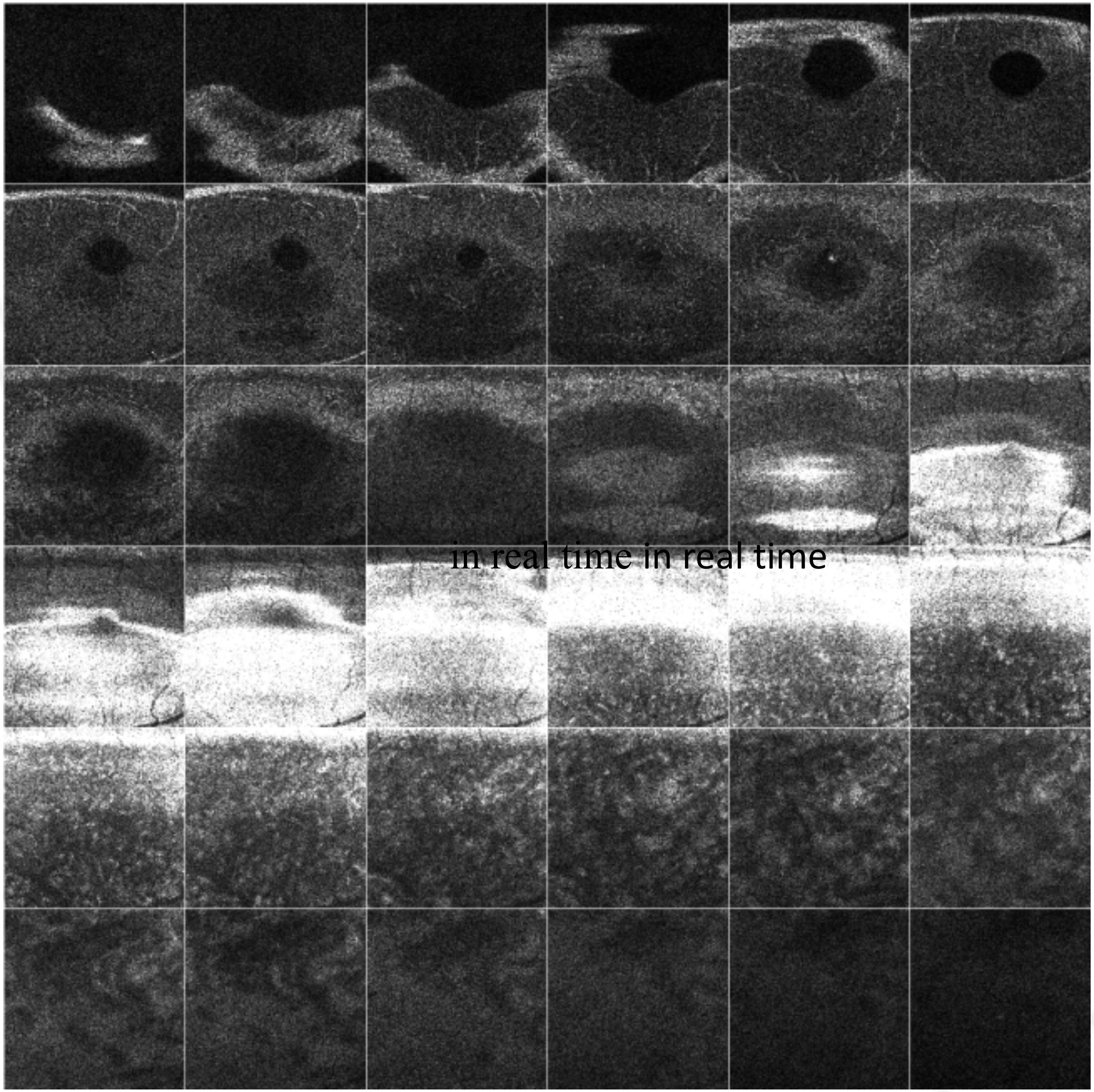
$$A_p = \sum_{k=-(w-1)}^{k=+(w-1)} \left| Corr_p(k) \right|$$

20 C-scans above the lamina



Deeper 20 C-scans inside the lamina




in real time in real time

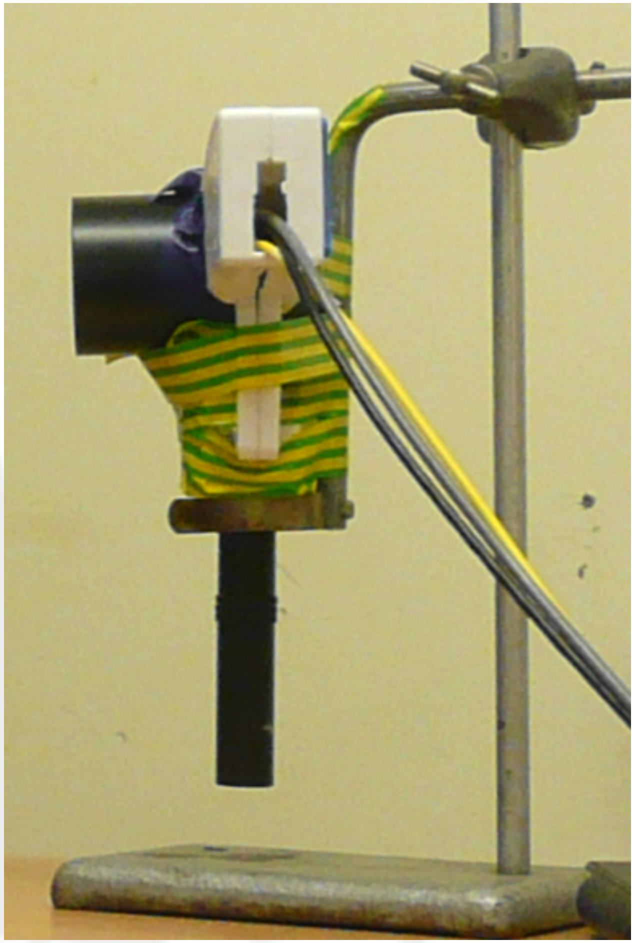
Hand-held devices

Trend in customising OCT systems for:

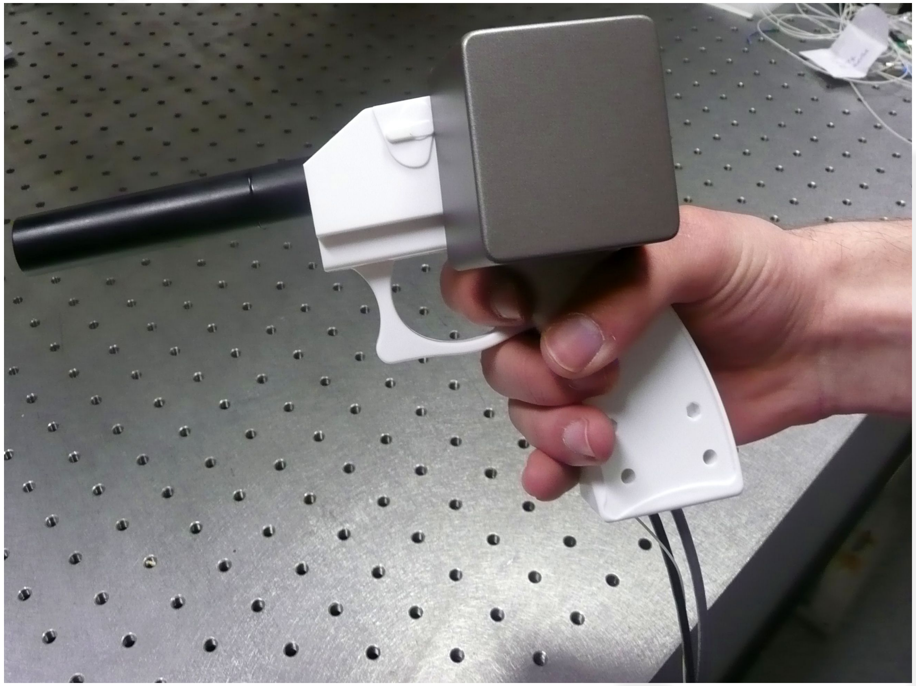
- Anterior chamber of the eye;
- Skin;
- Mouth

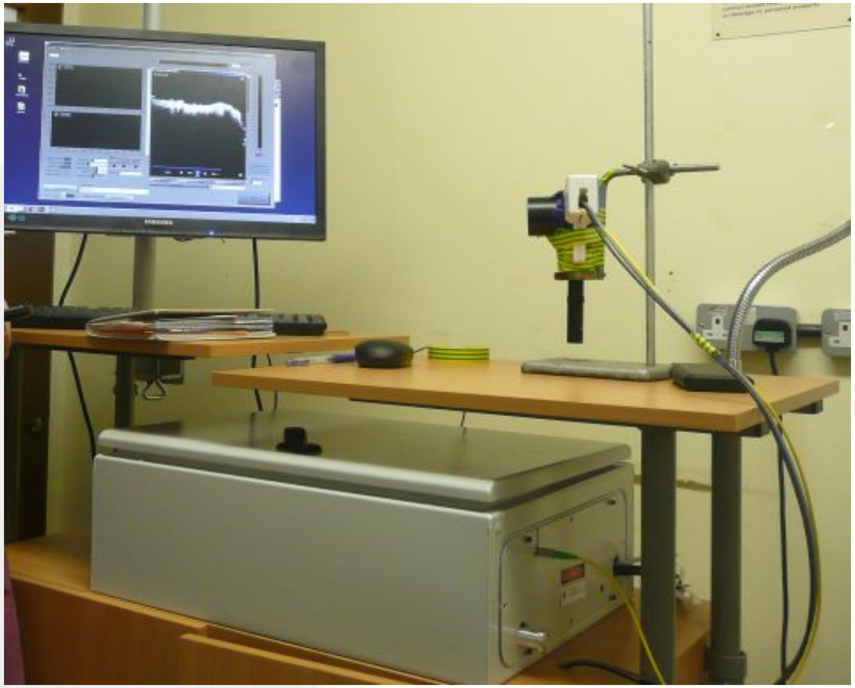
Oral cavity and skin surface of the head and neck: Hand held probe

Schematic diagram of the SS-OCT system where the hand-held OCT probe unit is used



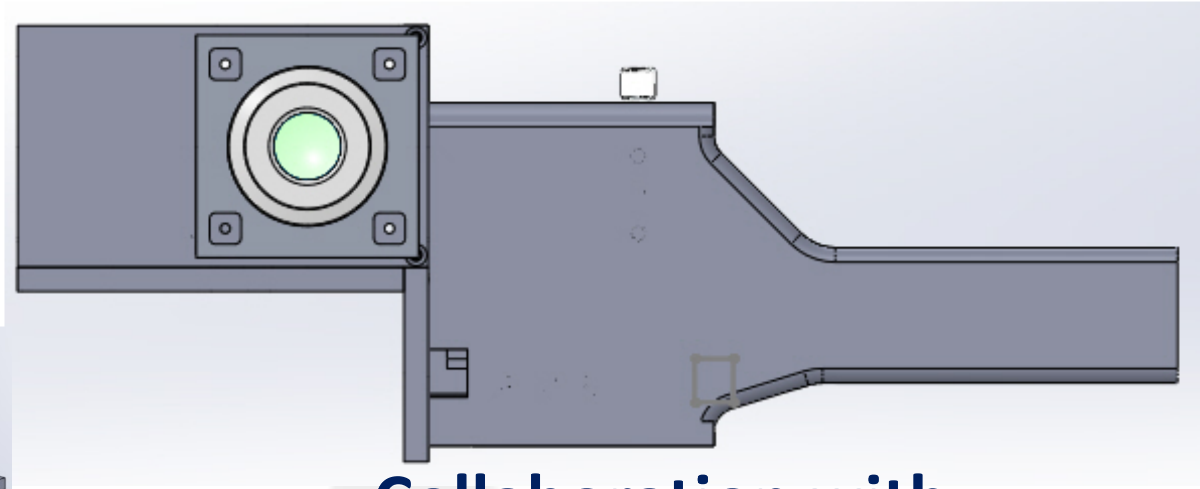
Currently at Northwick Park Hospital London

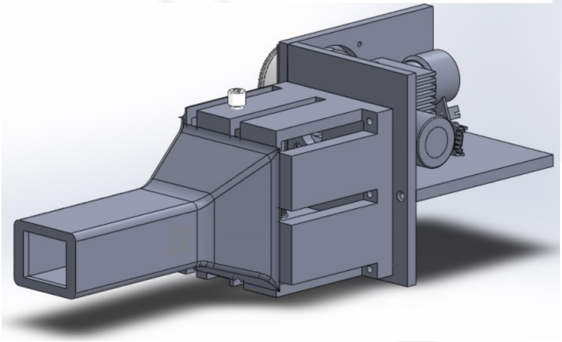




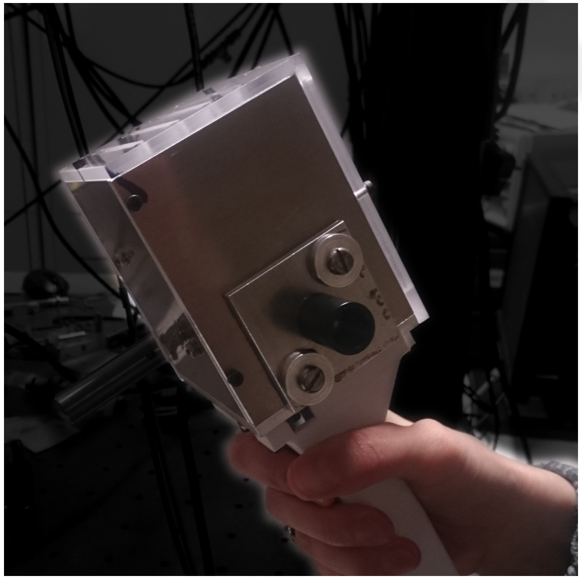
Hand held 1D lateral scanner with extended focus to access internal parts of the mouth

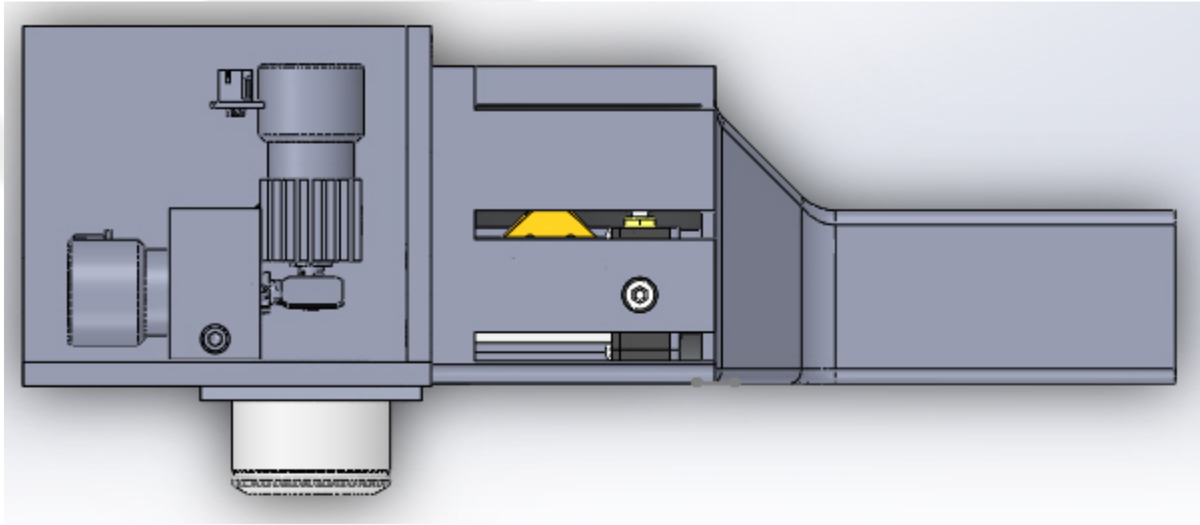
Hand held oriented vertically to inspect biopsied tissue





Collaboration with
Prof. Ole Bang, Dr. Niels Israelsen
Technical University of Denmark





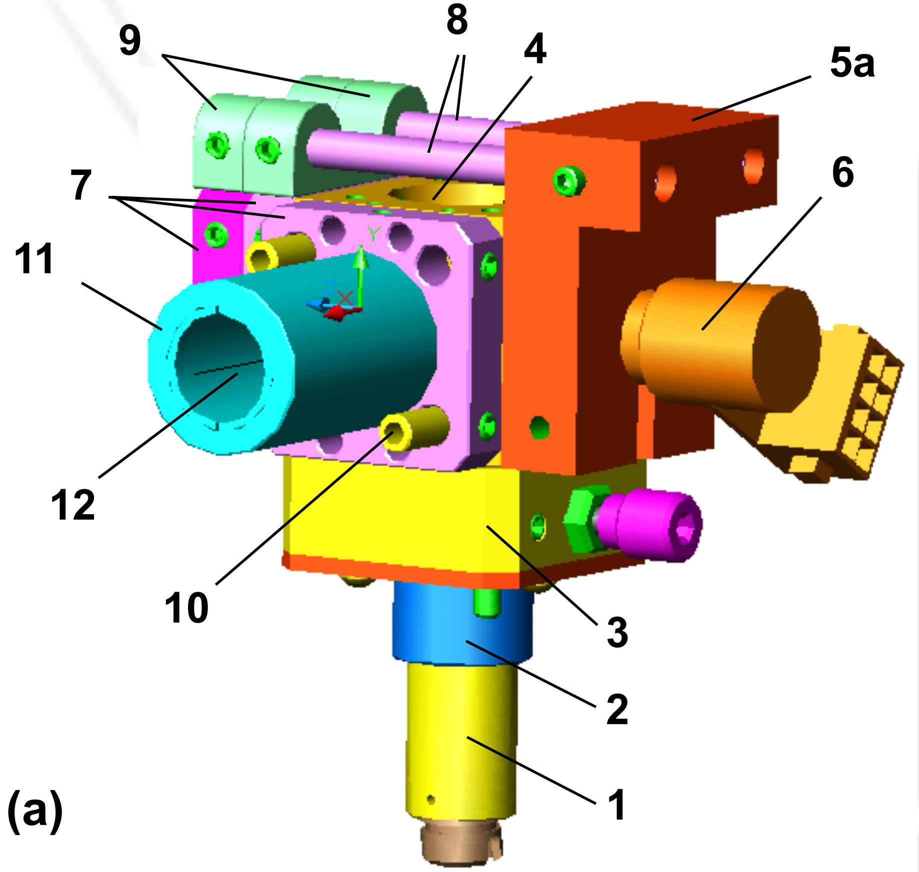
Hand-held devices

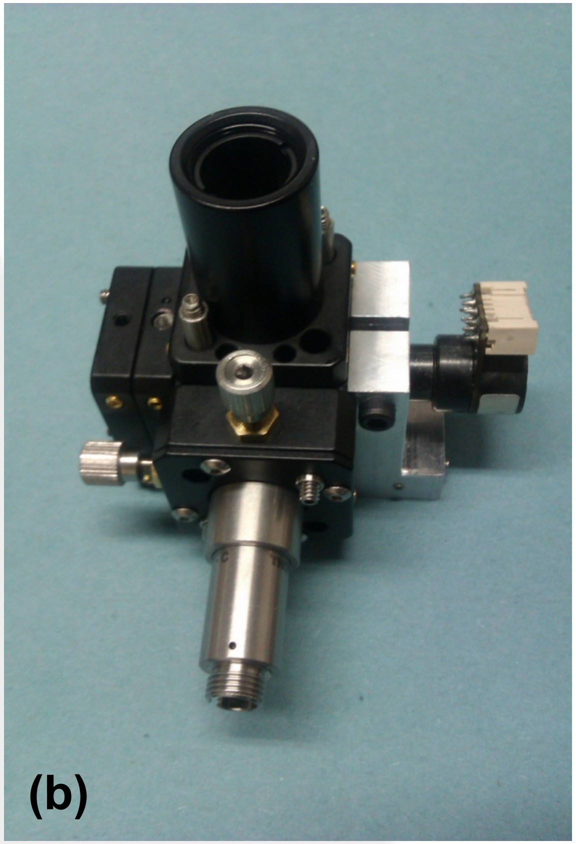
Collaboration with
Professor Virgil-Florin Duma
3OM Optomechatronics Group,
“Aurel Vlaicu” University of Arad

Handheld Scanning Probes for OCT

1st Design

- built almost entirely with off-the-shelf (Thorlabs) components





OCTNews Feature of the Week 10/5/14: Design and Testing of Handheld Scanning Probe Prototypes for Optical Coherence Tomography

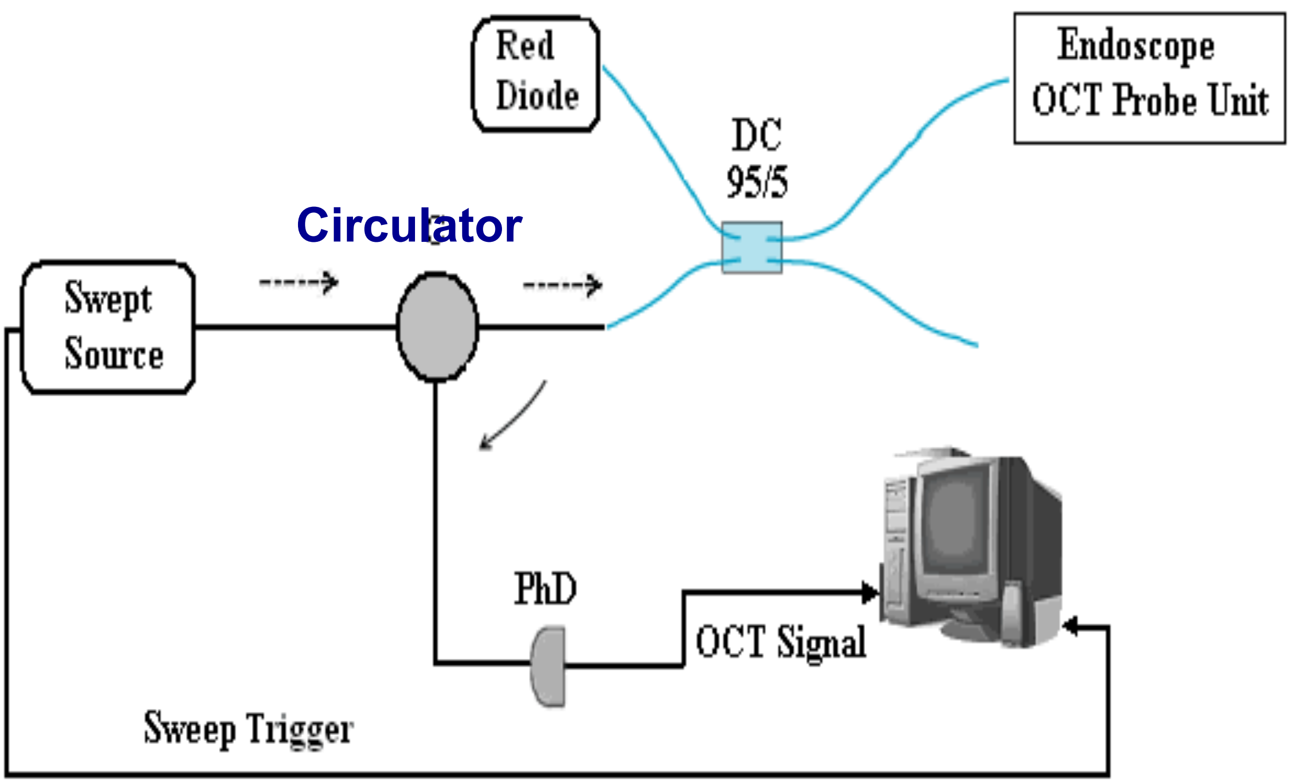
OCT ENDOSCOPY

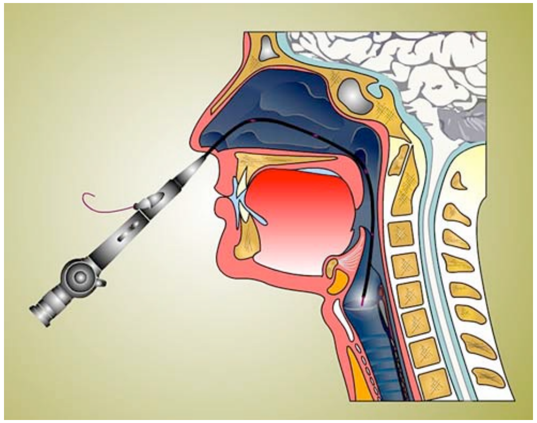
OCT endoscopy of the larynx

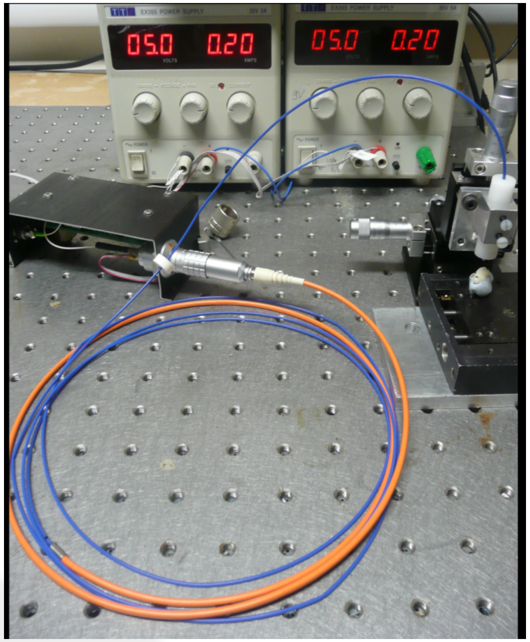
Laryngeal investigation via nasopharyngeal OCT endoscope

NIHR

NIHR i4i







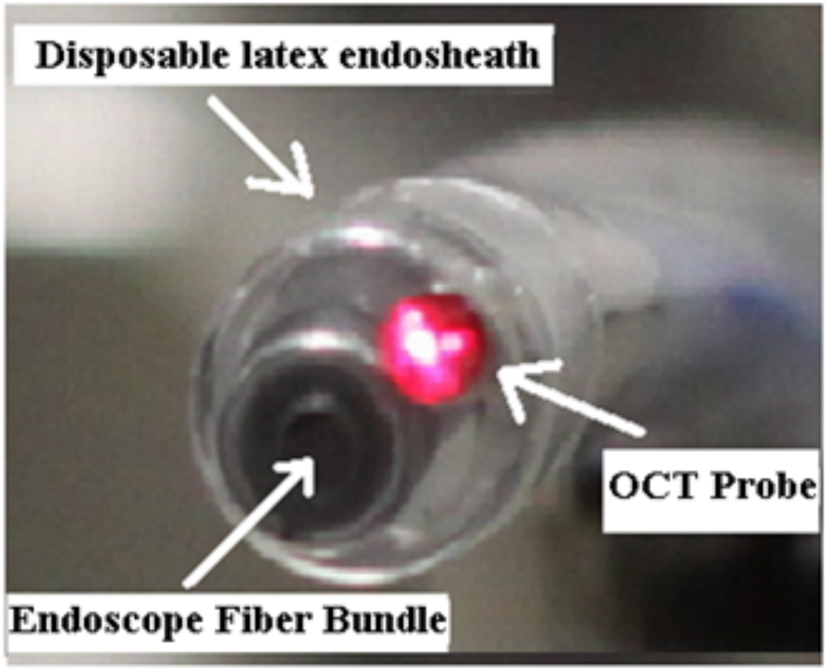
Endoscope OCT Probe

Combination of
1. *Cross section (B-scan)* SS-OCT and
2. Bundle Endoscopy)

Dual channel OCT/endoscope for larynx (NIHR support)

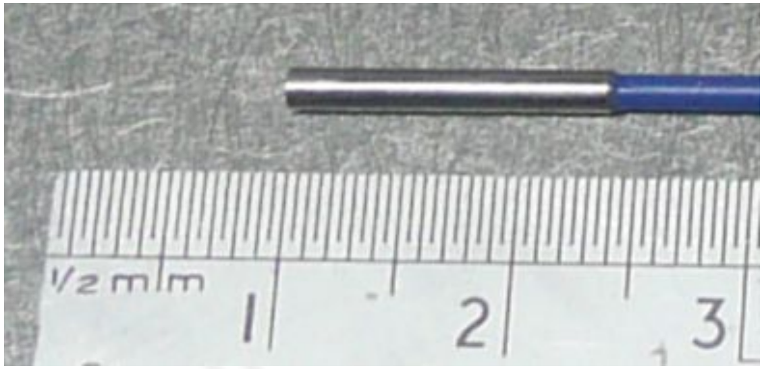
a)

b)



c)

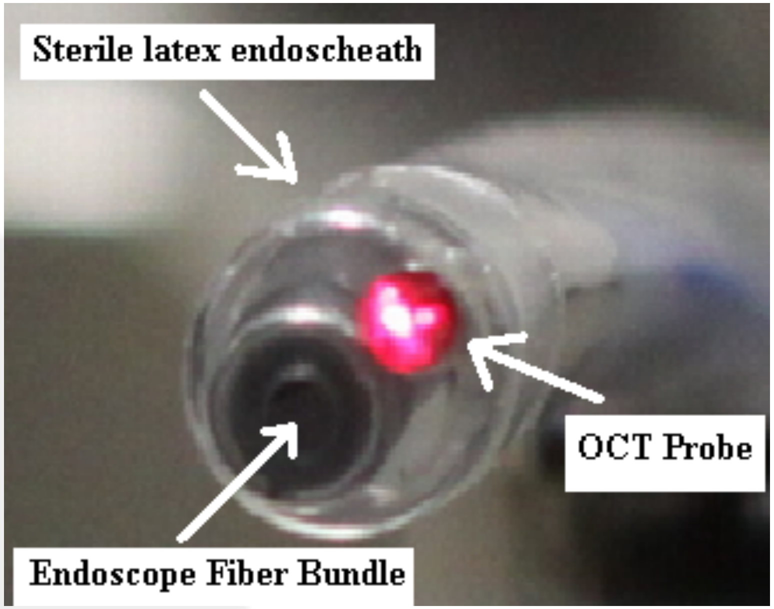
OCT Probe



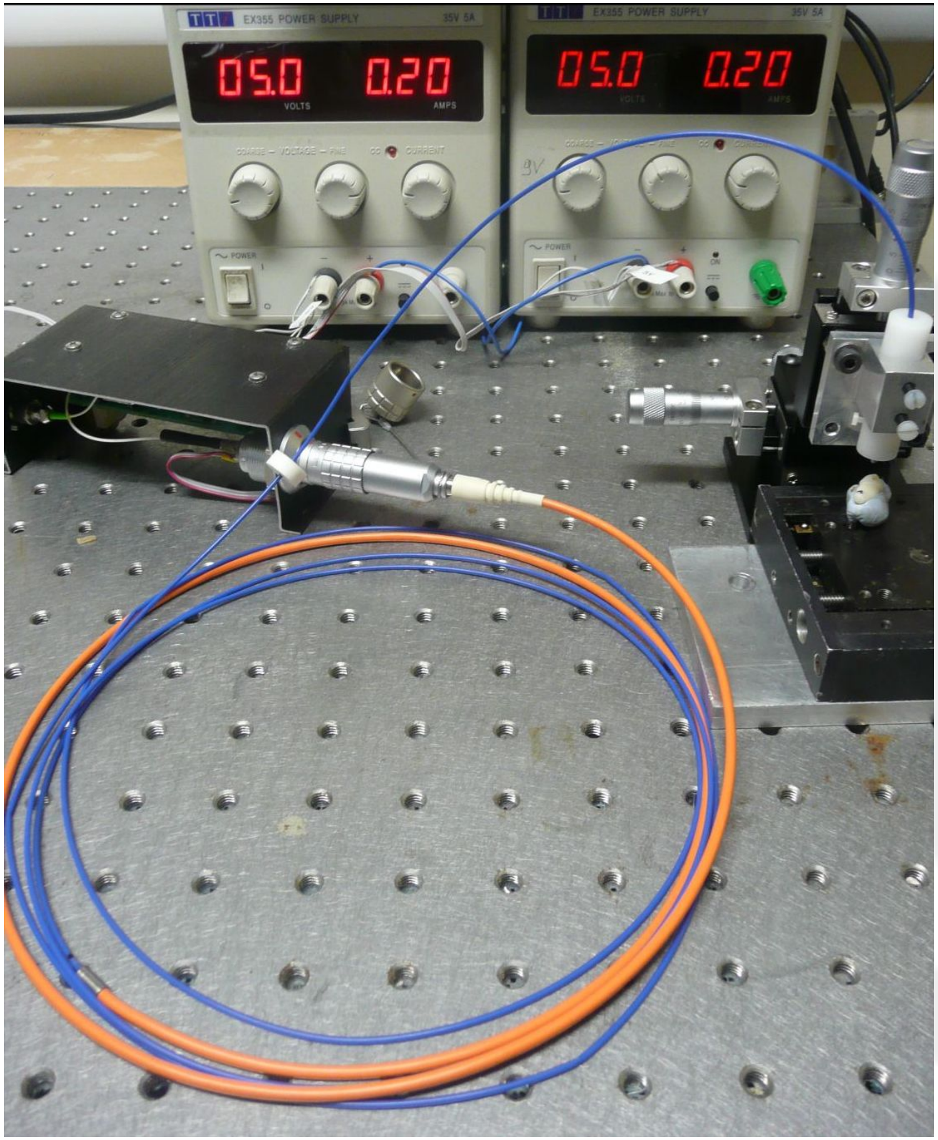
The OCT probe terminates with a stainless steel cylinder of 13 mm length and 1.9 mm diameter.

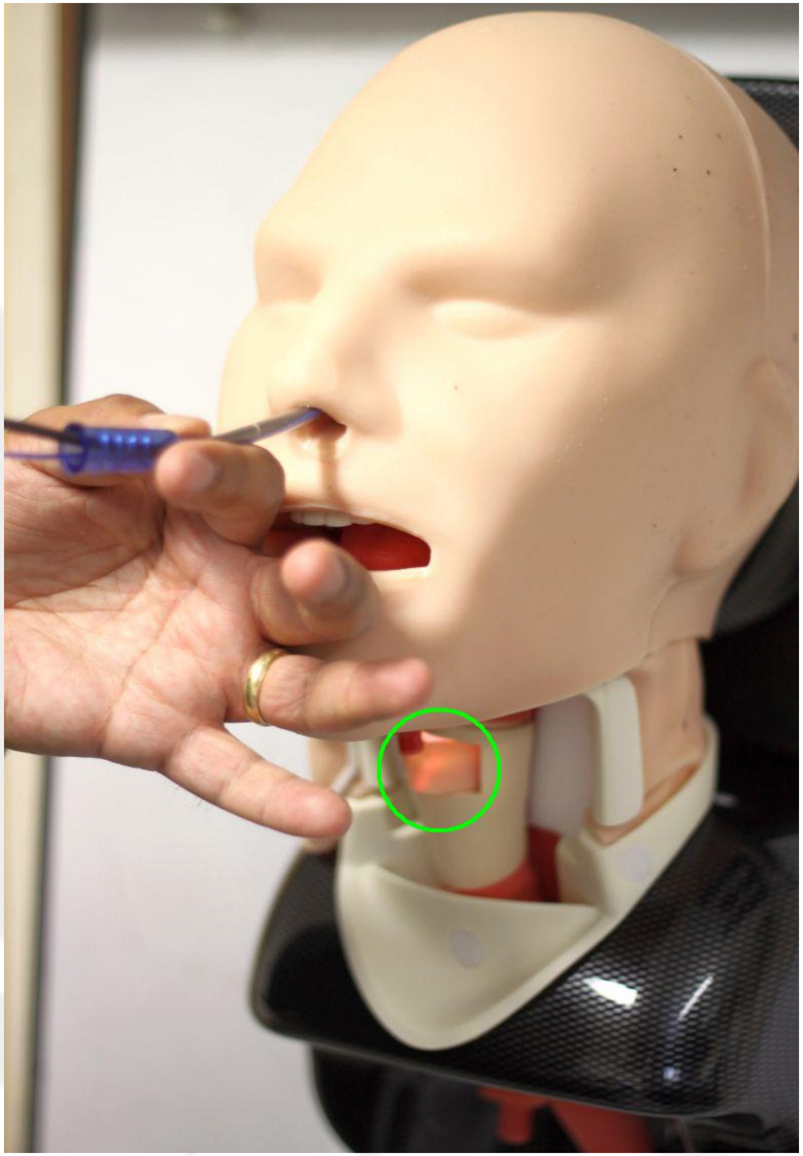
Disposable latex endosheath:
- length 22.5 cm
- shaft inner diameter 5.5 mm
- inner diameter 5.2 mm

Dual head



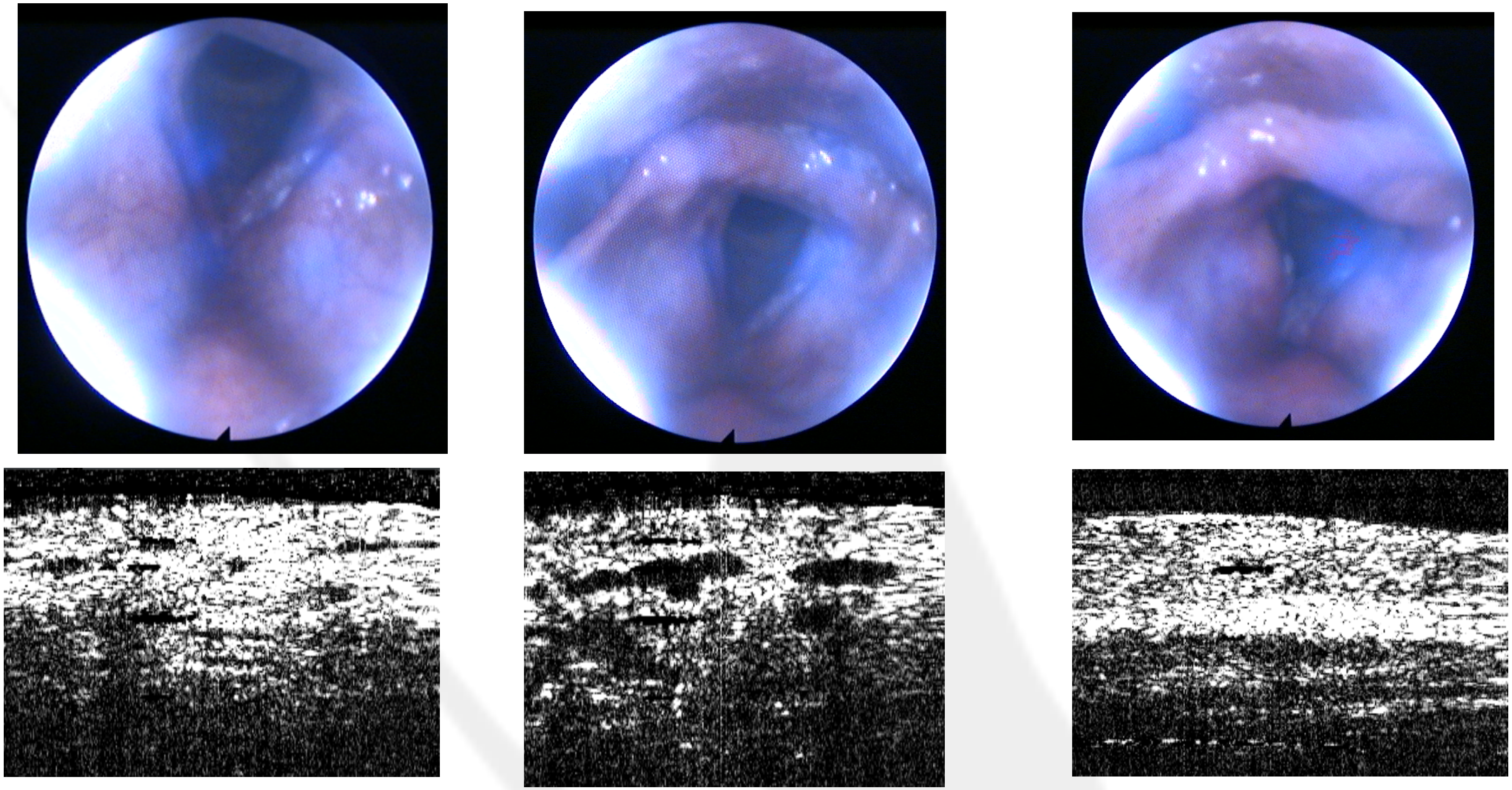
The internal dual probe head



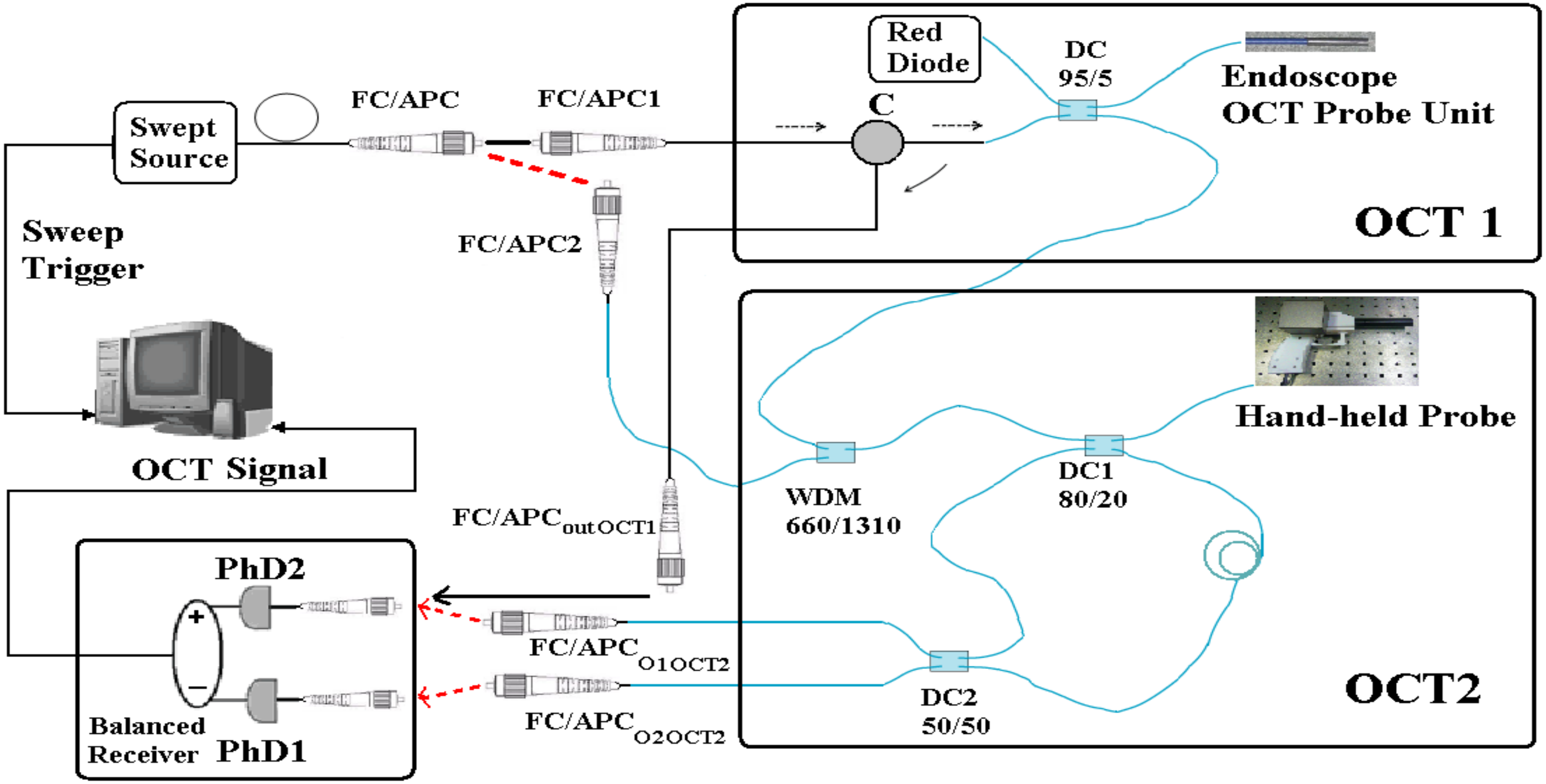


NIHR

In-vivo Investigations

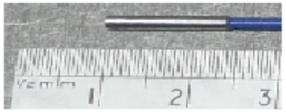


B-scan images of *in-vivo* laryngeal diseased tissue from suspect laryngeal lesions using the OCT probe unit simultanously with a commercial fiber bundle endoscope

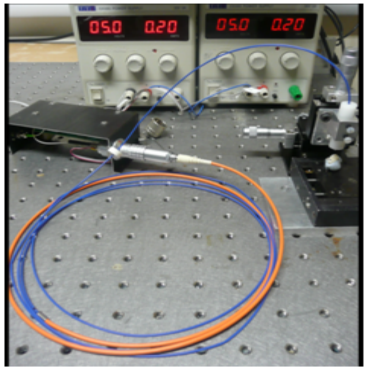


Biomed. Opt. Express 3, 3346-3356 (2012)

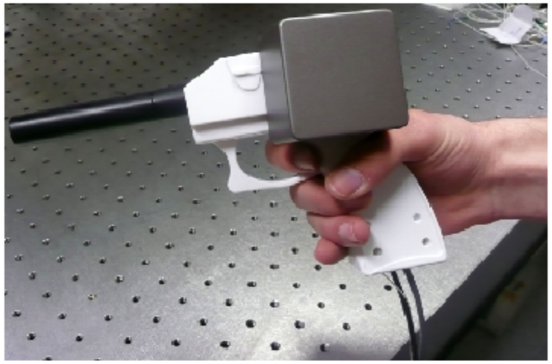
a)



b)

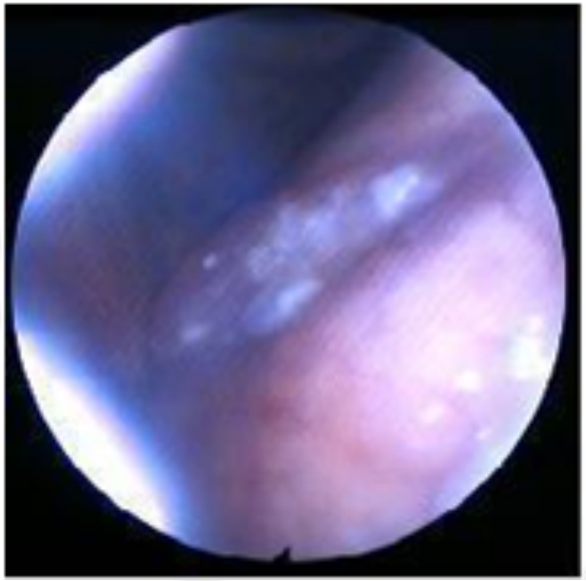
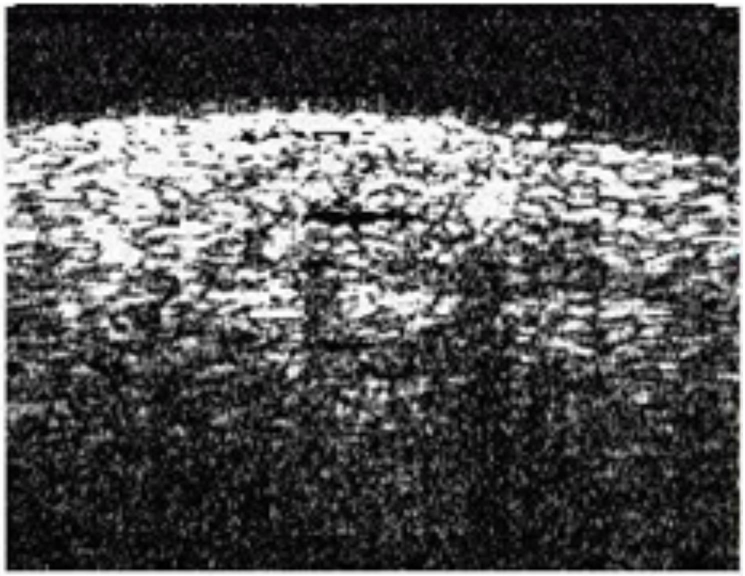
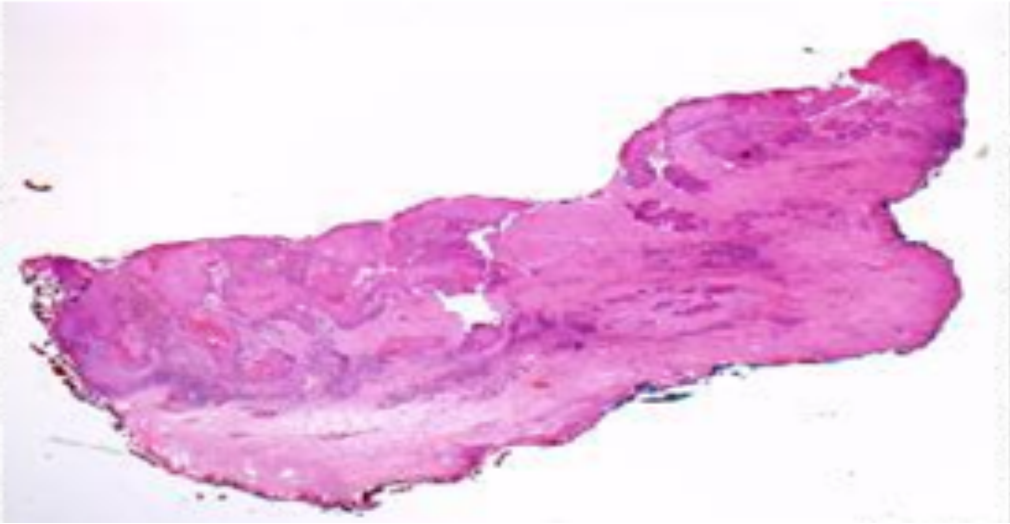
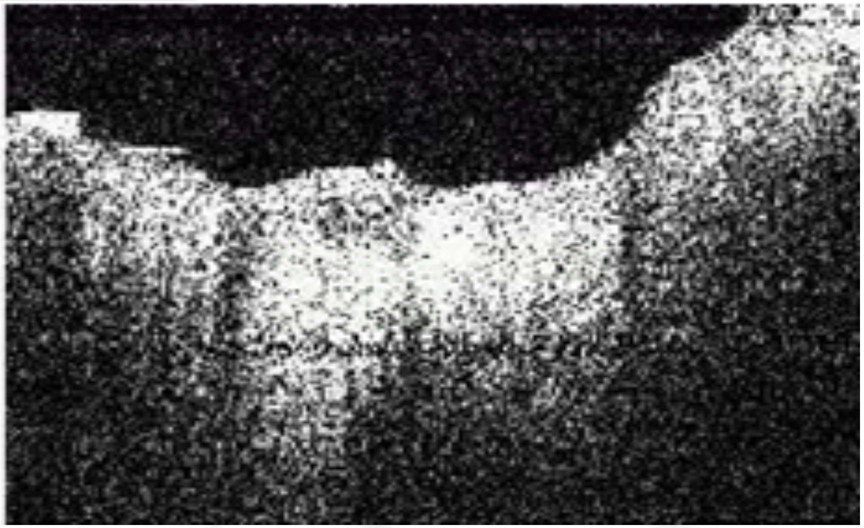


c)



d)

Invasive squamous cell carcinoma in a desmoplastic stroma

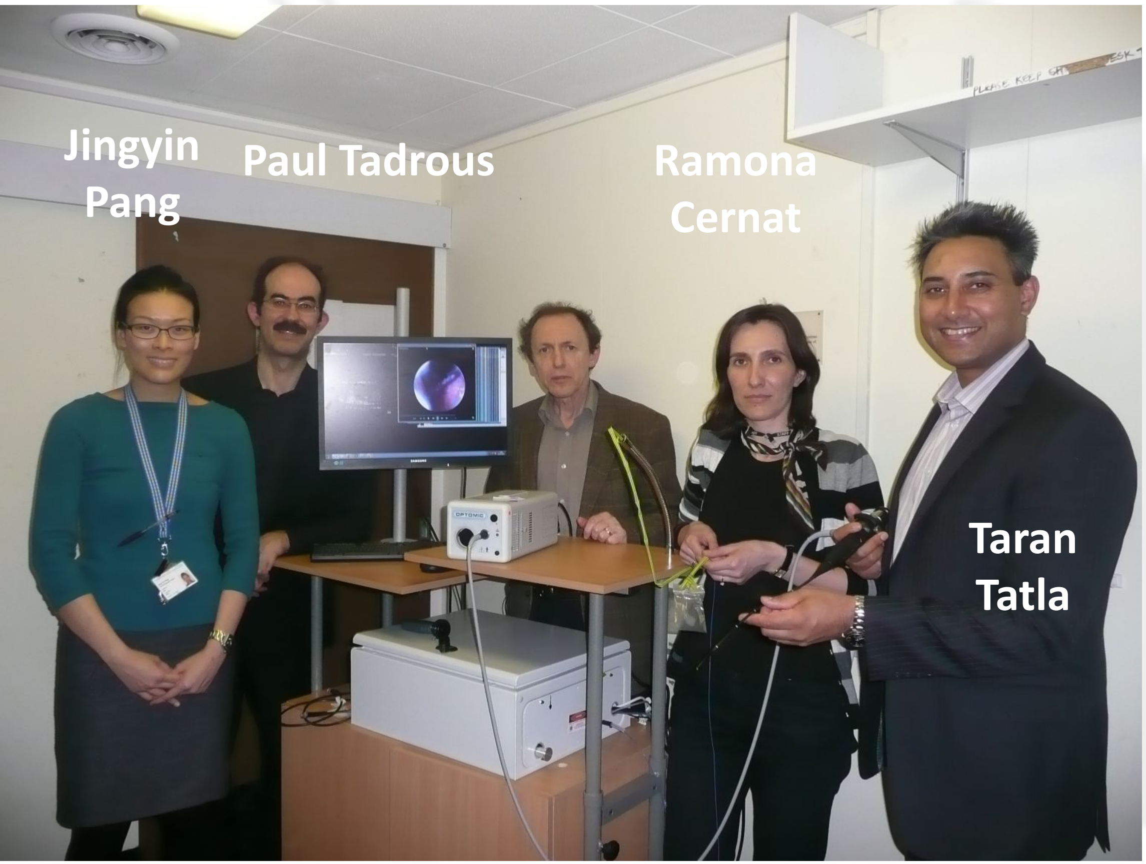





1300 nm, 2 mW

Northwick Park Hospital (NPH, London)

NIHR Support

The North West London Hospitals NHS
NHS Trust



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G. Gelikonov

V. Gelikonov

Biomed. Opt. Express 3, 3346-3356 (2012)

Top 100 fields

The first 100 Research Areas (by record count) are shown.

- OPHTHALMOLOGY
- RADIOLOGY NUCLEAR MEDICINE MEDICAL IMAGING
- CARDIOVASCULAR SYSTEM CARDIOLOGY
- OPTICS
- NEUROSCIENCES NEUROLOGY
- SURGERY
- GERIATRICS GERONTOLOGY
- PHARMACOLOGY PHARMACY
- SCIENCE TECHNOLOGY OTHER TOPICS
- BIOCHEMISTRY MOLECULAR BIOLOGY
- ENGINEERING
- MATHEMATICS
- PHYSICS
- IMAGING SCIENCE PHOTOGRAPHIC TECHNOLOGY
- PEDIATRICS
- PATHOLOGY
- IMMUNOLOGY
- GENETICS HEREDITY
- MEDICAL LABORATORY TECHNOLOGY
- ONCOLOGY

- MATERIALS SCIENCE
- DENTISTRY ORAL SURGERY MEDICINE
- RESPIRATORY SYSTEM
- UROLOGY NEPHROLOGY
- TOXICOLOGY
- MATHEMATICAL COMPUTATIONAL BIOLOGY
- RESEARCH EXPERIMENTAL MEDICINE
- PUBLIC ENVIRONMENTAL OCCUPATIONAL HEALTH
- LIFE SCIENCES BIOMEDICINE OTHER TOPICS
- DEMOGRAPHY
- PSYCHOLOGY
- OTORHINOLARYNGOLOGY
- DEVELOPMENTAL BIOLOGY
- INFECTIOUS DISEASES
- ZOOLOGY
- ANTHROPOLOGY
- SPECTROSCOPY
- REPRODUCTIVE BIOLOGY
- TRANSPLANTATION
- RHEUMATOLOGY

- AUTOMATION CONTROL SYSTEMS
- ETHNIC STUDIES
- SOCIAL ISSUES
- NUTRITION DIETETICS
- PLANT SCIENCES
- MECHANICS
- NUCLEAR SCIENCE TECHNOLOGY
- MICROBIOLOGY
- METEOROLOGY ATMOSPHERIC SCIENCES
- VIROLOGY
- SPORT SCIENCES
- ANESTHESIOLOGY
- OPERATIONS RESEARCH MANAGEMENT SCIENCE
- EDUCATION EDUCATIONAL RESEARCH
- ELECTROCHEMISTRY
- BUSINESS ECONOMICS
- ROBOTICS
- REHABILITATION
- SOCIOLOGY
- ART

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Optical Coherence Tomography News

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Feature of the Week 05/08/2016: Complex Master Slave Interferometry

Optical Coherence Tomography News *(May 8 2016)*

A general theoretical model is developed to improve the novel Spectral Domain Interferometry method denoted as Master/Slave (MS) Interferometry. In this model, two functions, g and h are introduced to describe the modulation chirp of the channeled spectrum signal due to nonlinearities in the decoding process from wavenumber to time and due to dispersion in the interferometer. The utilization of these two functions brings two major improvements to previous implementations of the MS method. A first improvement consists in reducing the number of channeled spectra necessary to be collected at Master stage. In previous MSI implementation, the number of channeled spectra at the Master stage equated the number of depths where information was selected from at the Slave stage. The paper demonstrates that two experimental channeled spectra only acquired at Master stage suffice to produce A-scans from any number of resolved depths at the Slave stage. A second improvement is the utilization of complex signal processing. Previous MSI implementations discarded the phase. Complex processing of the electrical signal determined by the channeled spectrum allows phase processing that opens several novel avenues. A first consequence of such signal processing is reduction in the random component of the phase without affecting the axial resolution. In previous MSI implementations, phase instabilities were reduced by an average over the wavenumber that led to reduction in the axial resolution.

For more information see recent Article. Courtesy Adrian Podoleanu from University of Kent.

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Categories

Applications: Art, Cardiology, Dentistry, Dermatology, Developmental Biology, Gastroenterology, Gynecology, Microscopy, NDE/NDT, Neurology, Oncology, Ophthalmology, Other Non-Medical, Otolaryngology, Pulmonology, Urology

Business News: Acquisition, Clinical Trials, Funding, Other Business News, Partnership, Patents

Technology: Broadband Sources, Probes, Tunable Sources

Miscellaneous: Jobs & Studentships, Student Theses, Textboo

http://www.octnews.org/articles/6468639/feature-of-the-week-05-08-2016-complex-master-slav/

SCHOOL OF PHYSICAL SCIENCES

VIRTUAL CENTRE OF BIOMEDICAL OPTICS

Joint research developed between the Applied optics Group and numerous collaborators lead to translation of non invasive high resolution imaging technology from the Canterbury laboratories to several research institutes, hospitals and universities in the UK and abroad.
Instrumentation for high resolution opticsl imaging of patients and *in-vitro* tissue has been developed for:

- Retina
- Cornea
- Larynx
- Skin
- Basal cell carcinoma of eye lids
- Tympanic membrane
- Neuronal tissue
- Drosophila Embryos
- Dental constructs, abfraction, attrition

http://tinyurl.com/k26mdev

Non medical applications of high resolution imaging has been developed for

- Art conservation

Collaboration in the technology of:

- Optical Coherence Tomography;
- Adaptive Optics

LIST OF COLLABORATORS

ACTIVE COLLABORATORS

PAST COLLABORATORS
The collaborationactivity of the Centre resulted in 6 book chapters, 71 publications in peer reviewed journals, in over 160 publications in proceedings over 3 pages and in over 150 communications and seminars with summaries less than 2 pages.

Publications with joint authors

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- New York Eye and Ear Infirmary
- East Kent Hospitals University MHS Foundation Trust
- Maidstone Tunbridge Wells NHS Trust

- OTI Canada/Optos plc Scotland
- NKT Denmark
- Pfizer, Sandwich, Kent
- Superlum Moscow
- University of Kent

Any questions at
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