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# Variable-incidence-angle polarization-sensitive OCT.

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The Kroto Institute,  
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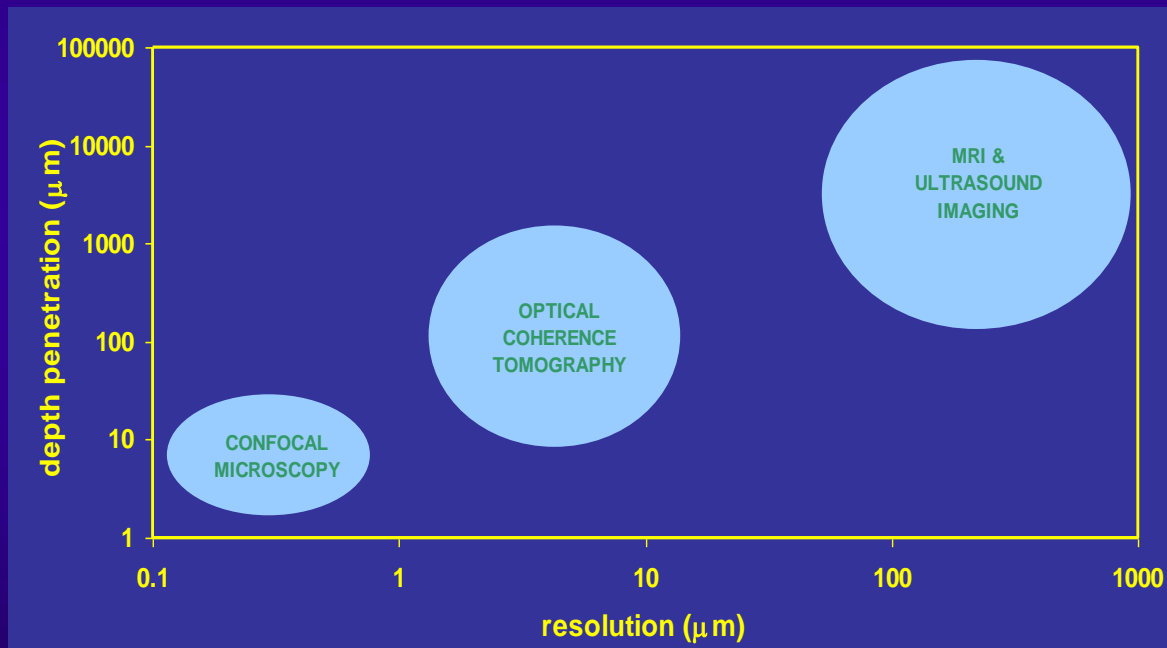


# Outline.

- OCT
- PS-OCT
- 3-D polarimetry of bovine cartilage
- Future work.

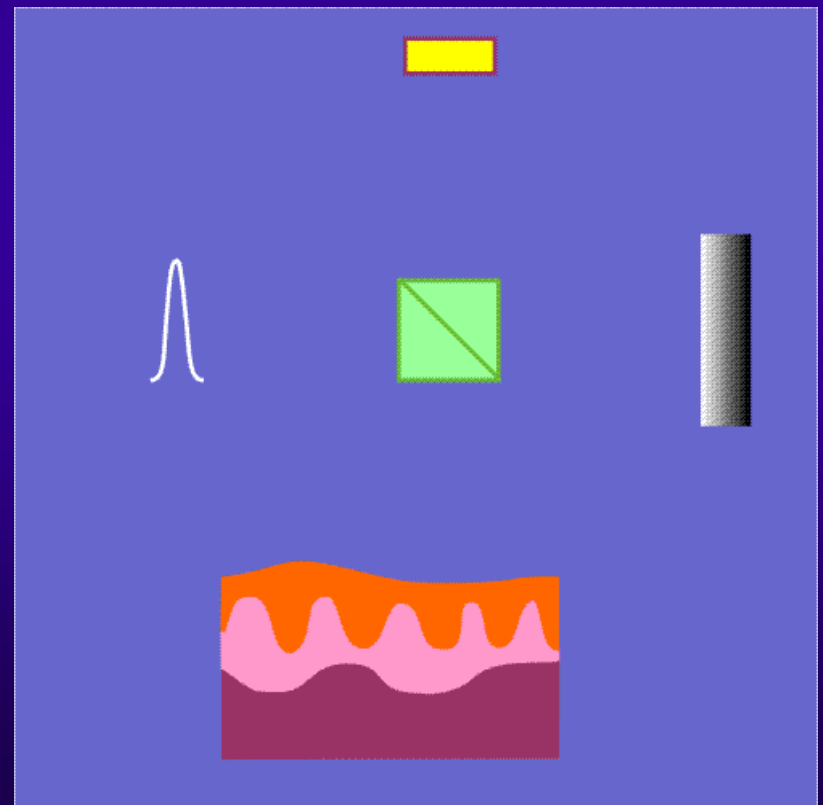
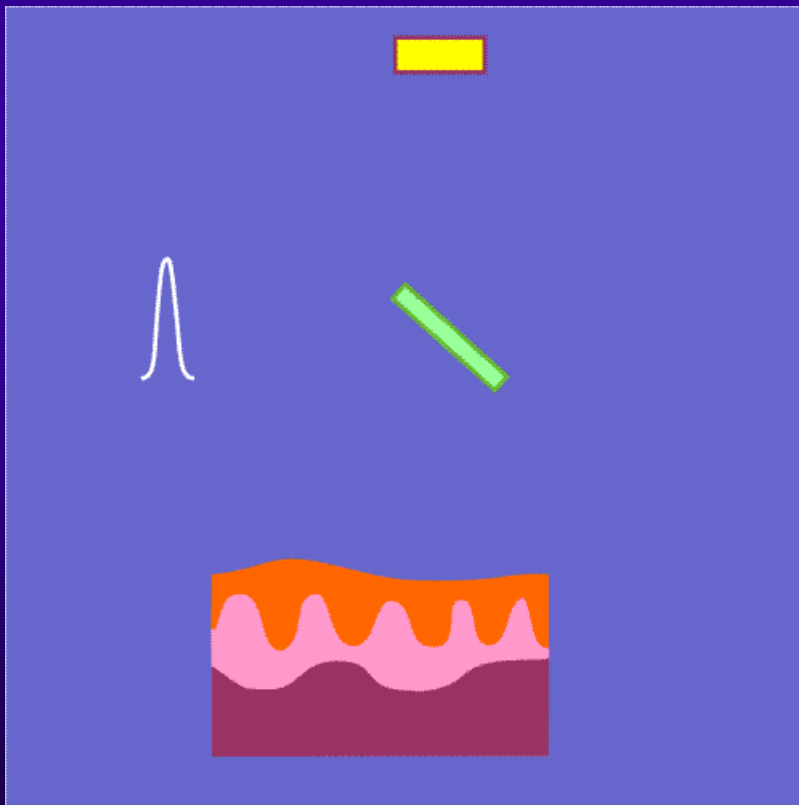
# OCT.

## Optical Coherence Tomography

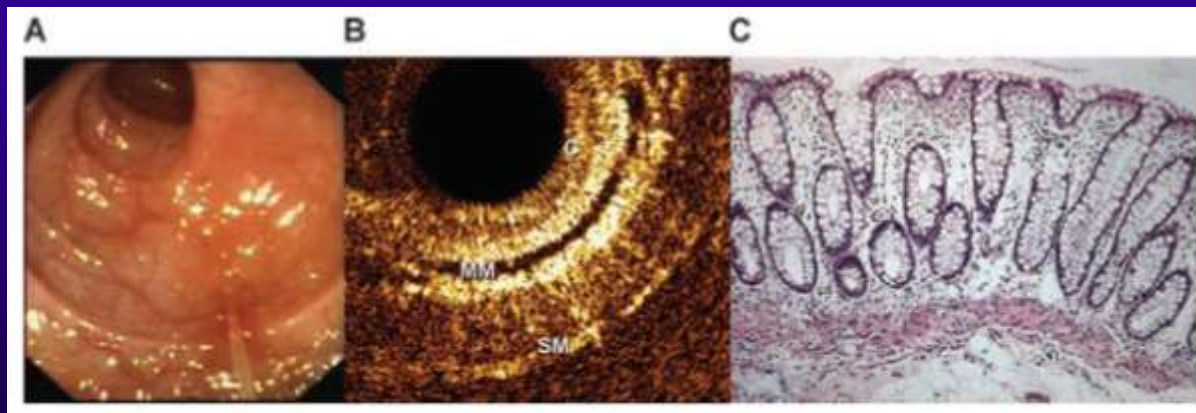
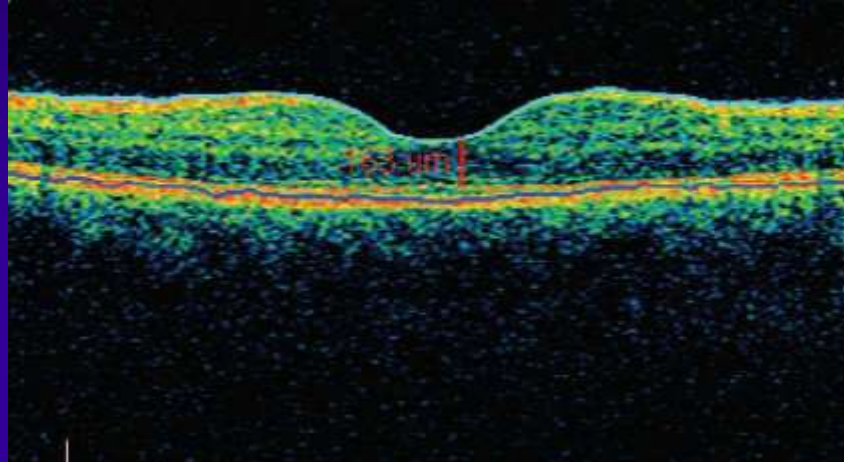


# OCT.

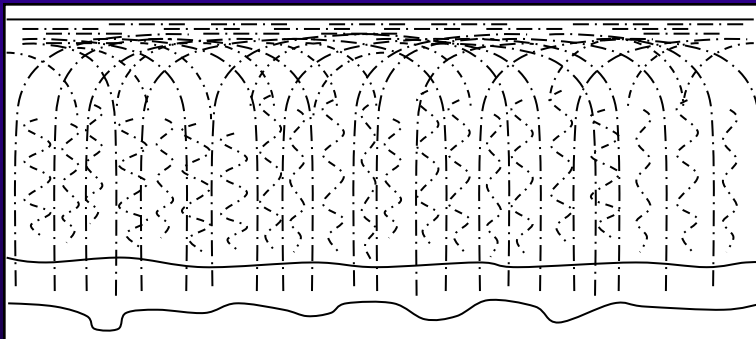
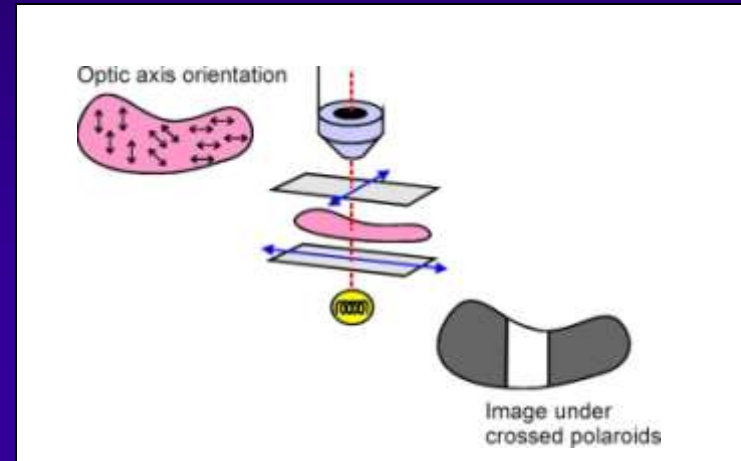
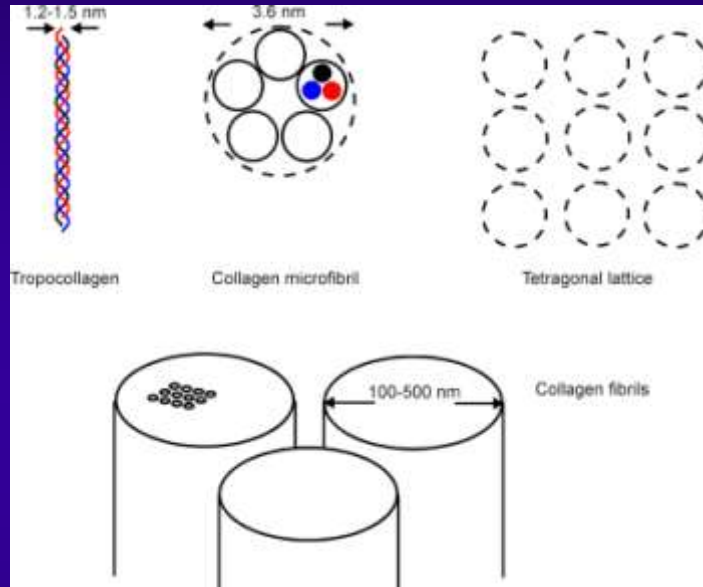
- J Fujimoto 1991.
- Optical analog of ultrasound imaging:-



# Structural OCT



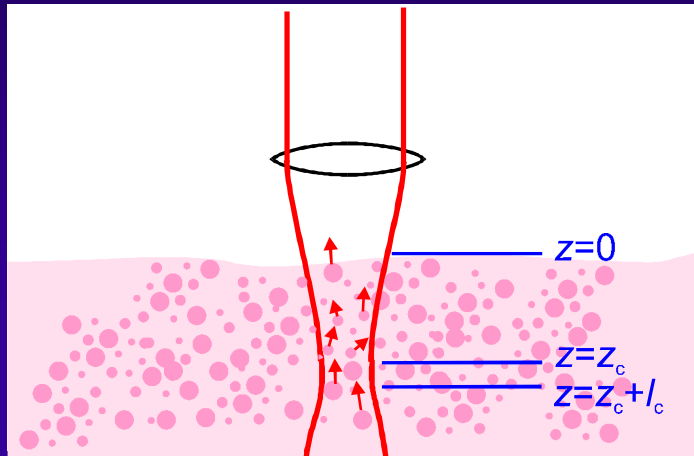
# Birefringence imaging.



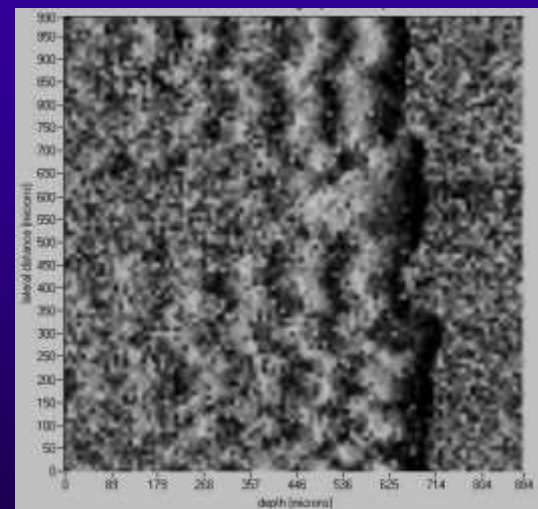
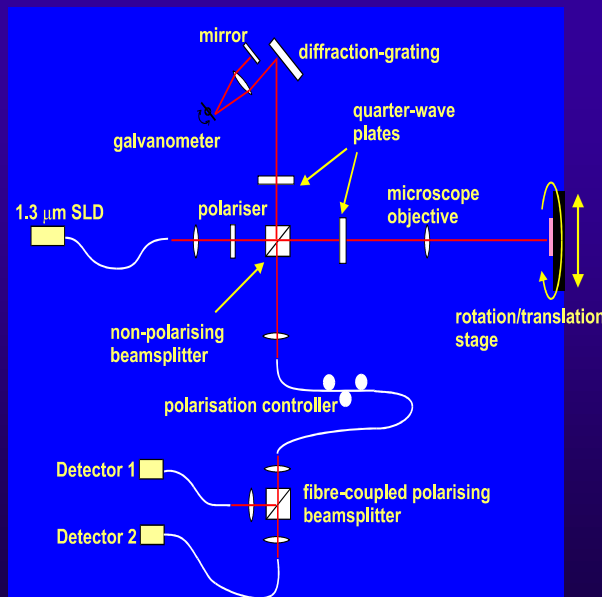
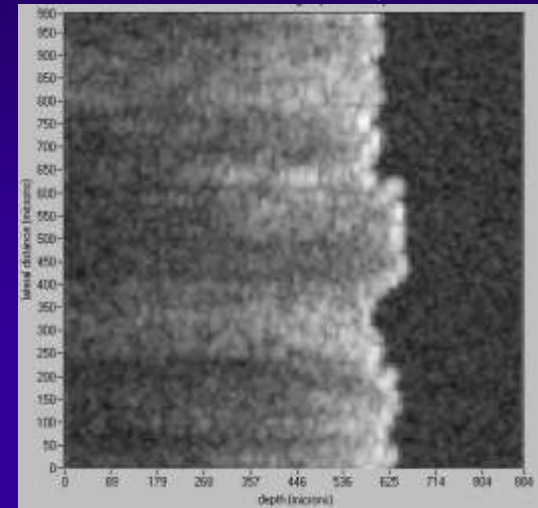
★ Tangential zone  
↑ Medial zone  
↓ Radial zone  
↓ Calcified zone  
bone



# Polarization-sensitive OCT.

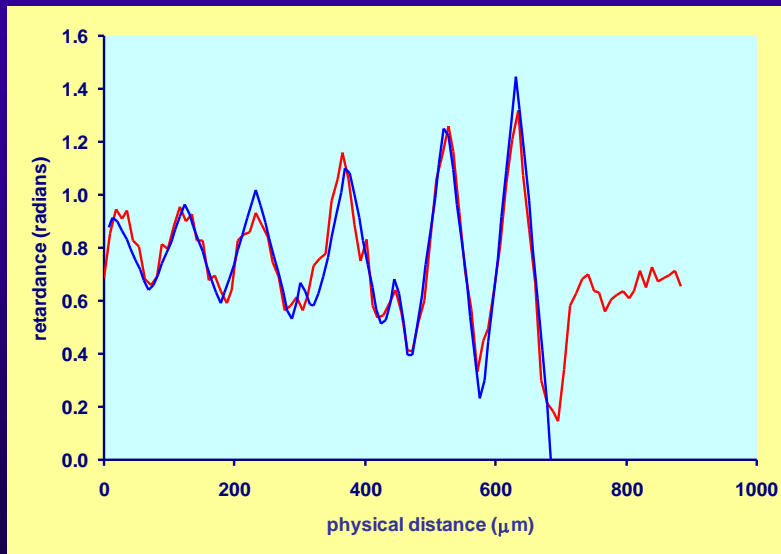
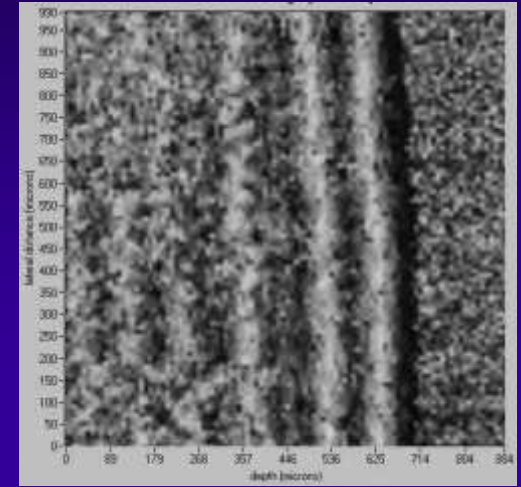
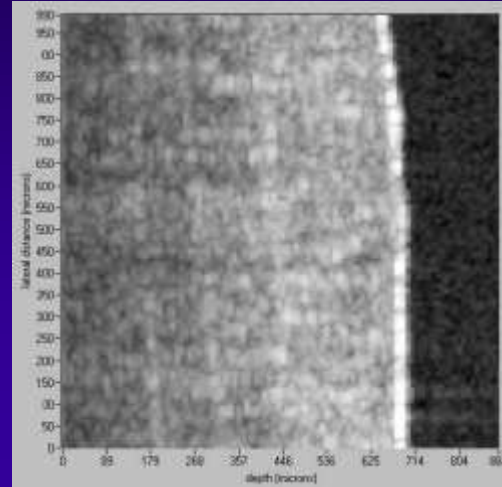
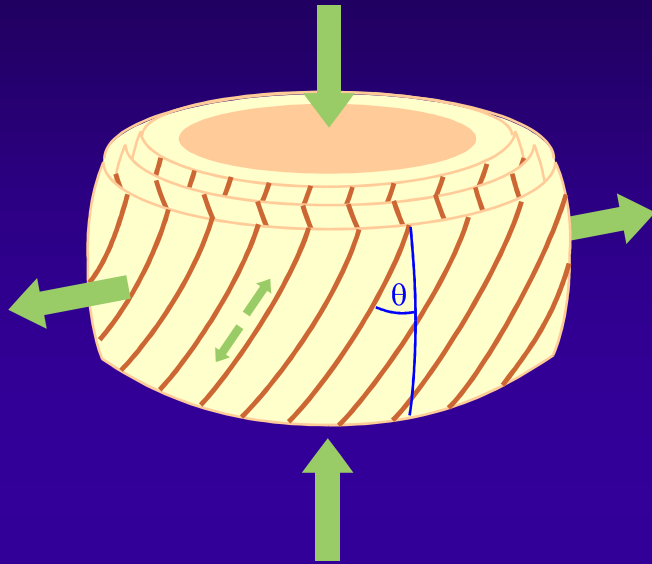


Reflectivity



Retardance

# Intervertebral disk imaging.

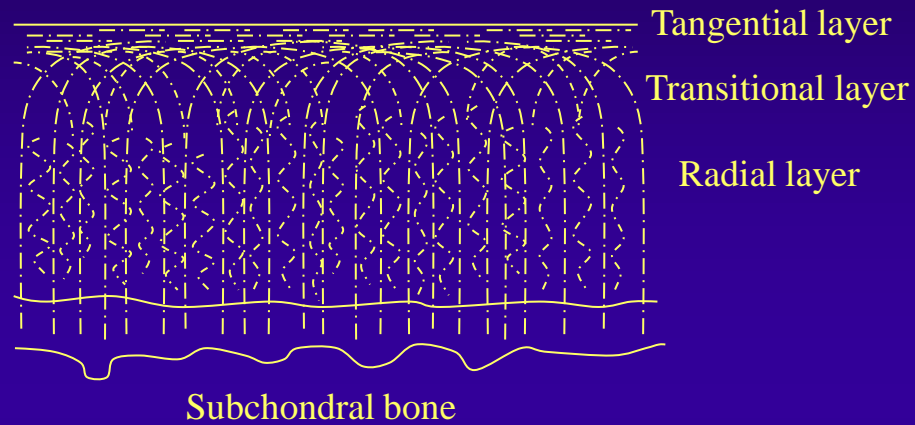


$\Delta n = 4.3 \times 10^{-3}$ ,  
 $z_1 = 240 \mu\text{m}$   $z_2 = 140 \mu\text{m}$ ,  
 $\theta = 51^\circ$ .

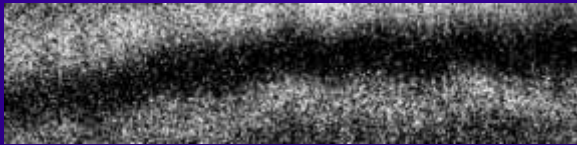
Matcher, Winlove, Gangnus: *Phys. Med. Biol.* (2004)



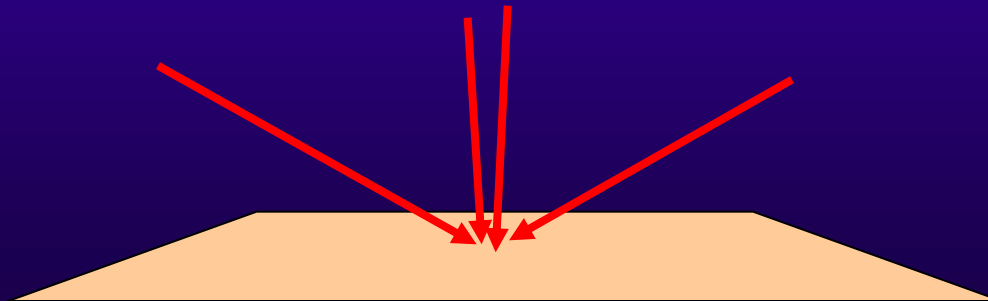
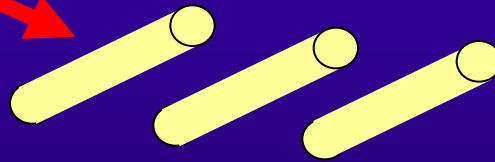
# Variable-incidence-angle PS-OCT



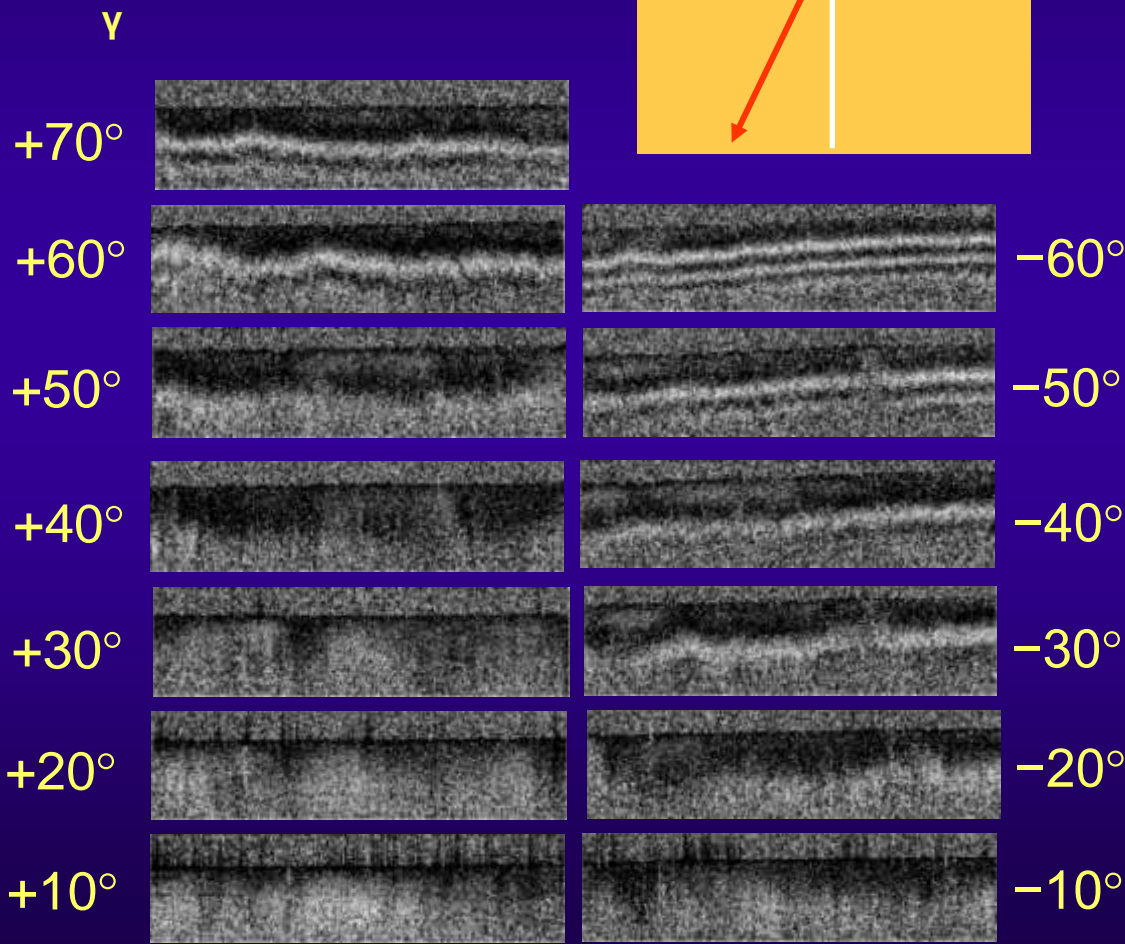
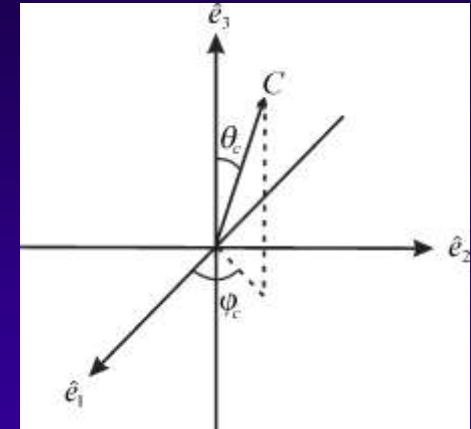
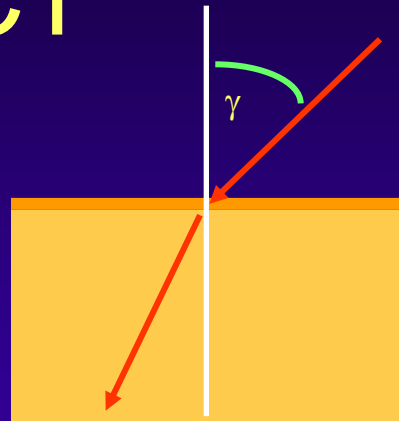
Strong birefringence



Weak birefringence



# VIA-PSOCT

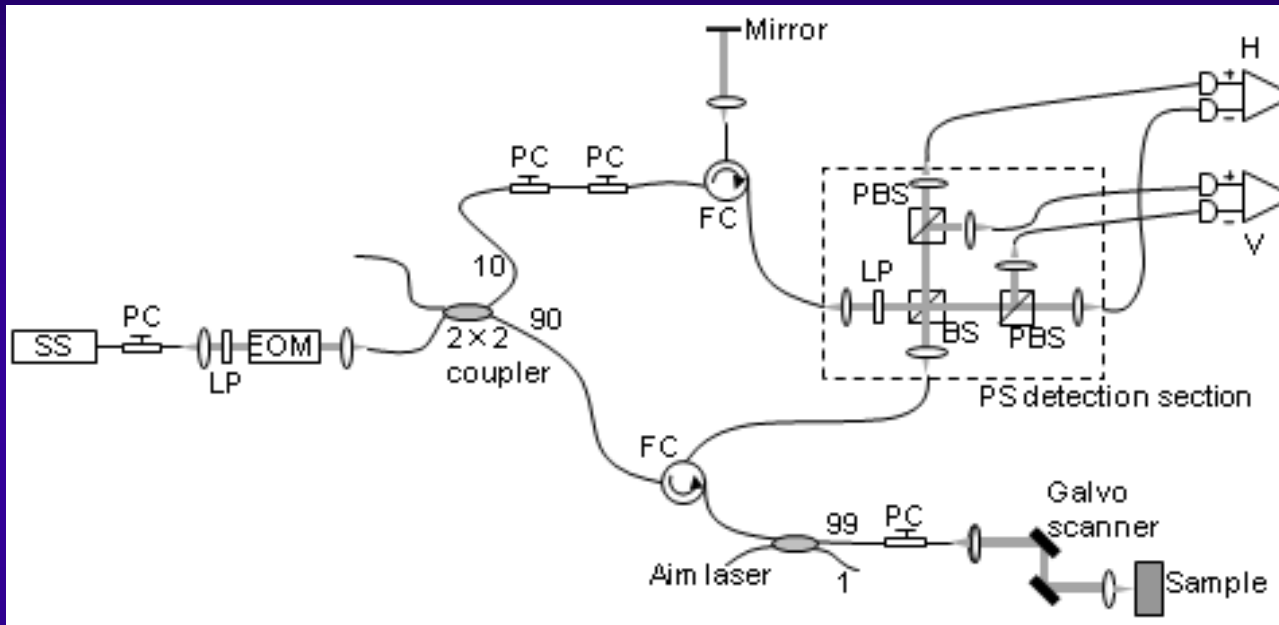


$$\frac{1}{n^2} = \frac{\sin^2 \theta_C}{n_e^2} + \frac{\cos^2 \theta_C}{n_o^2}$$

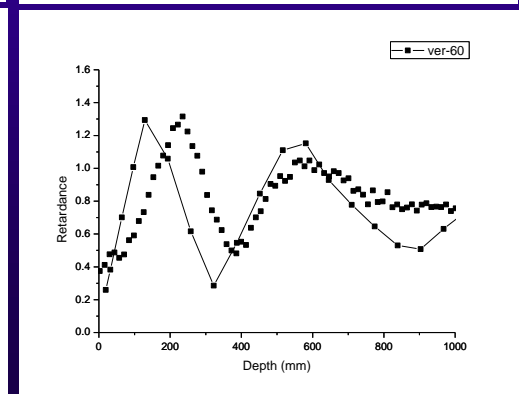
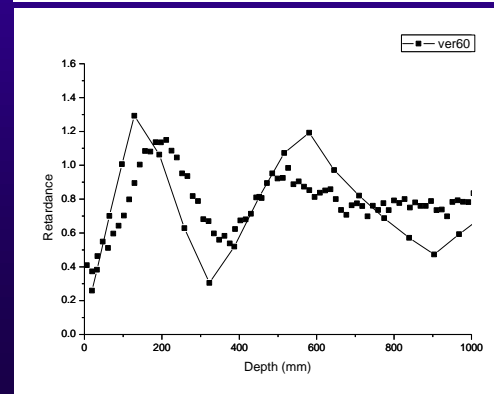
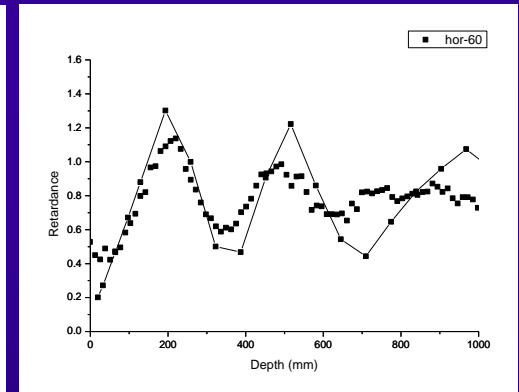
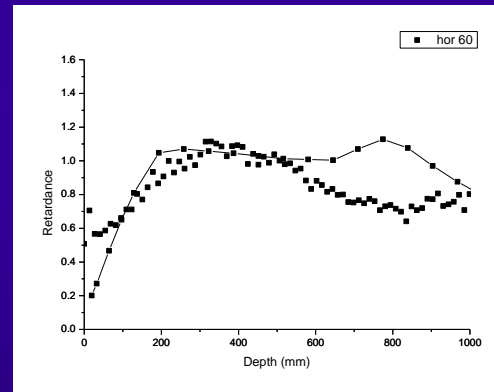
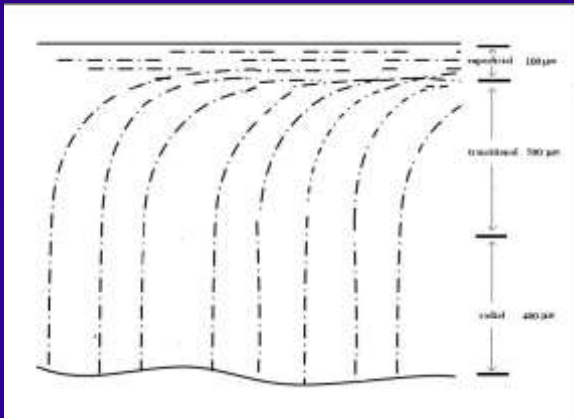
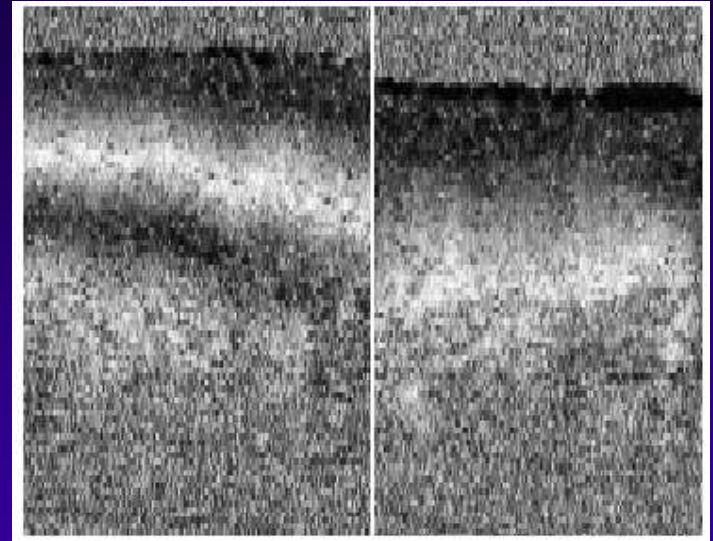
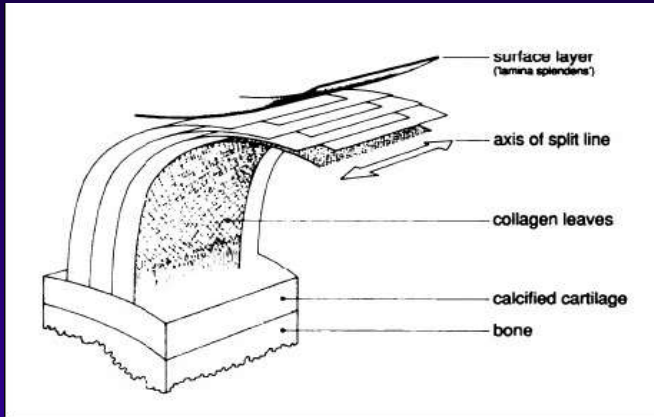


Ugryumova, Attenburrow, Winlove, Matcher: *J Phys D* (2005)  
 Ugryumova, Gangnus, Matcher: *Opt Lett* (2006).  
 Ugryuymova, Jacobs, Bonesi, Matcher (2008)

# Fourier domain PS-OCT.



- 2003 Leitgeb *et al* and Choma *et al*
  - No moving mirror
  - 100-fold increase in SNR
  - Video-rate image acquisition



Gu and Yeh, 1993

Extended Jones Matrix calculus

# Future work.

- Inversion algorithm.
- Incorporate fast-axis information.
- In-vivo probe design.

# Acknowledgments

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