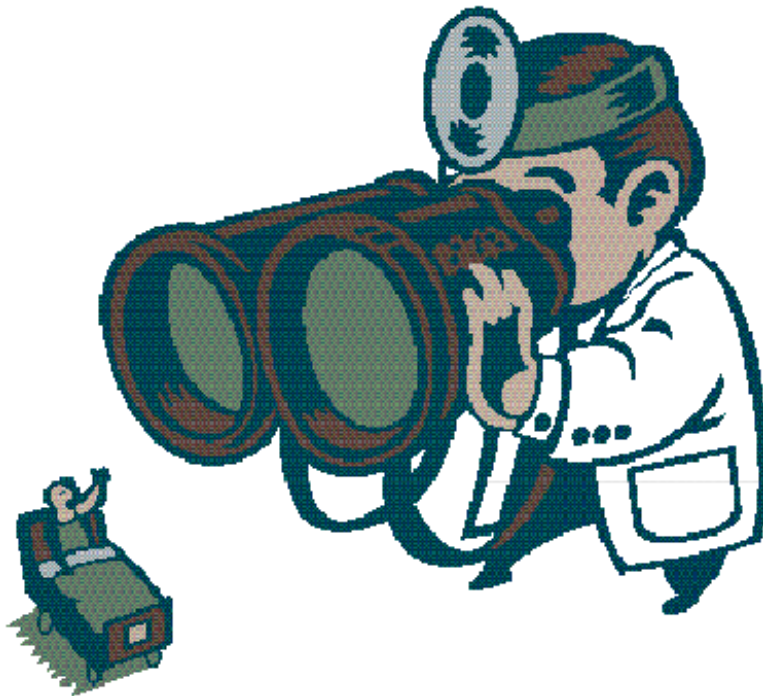


# Elastic-scattering spectroscopy for noninvasive detection of early cancer and pre-cancer

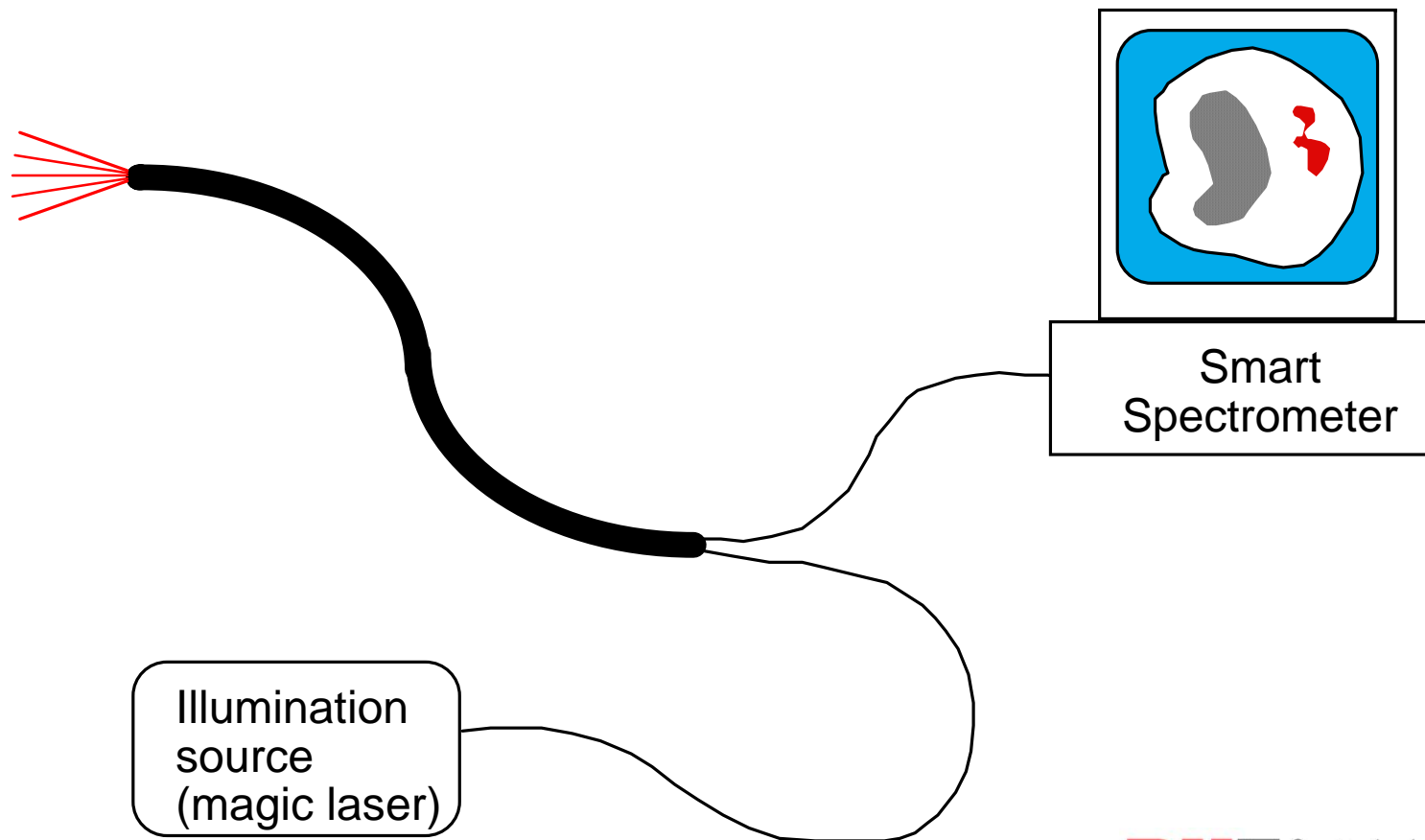


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Physics  
Boston University



# Optical spectroscopy in endoscopy

## The internist's dream: smart colonoscope



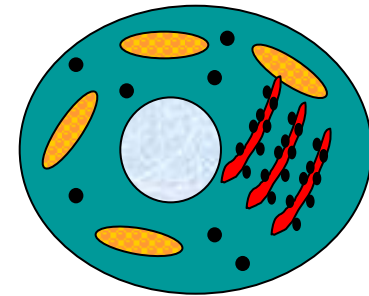
# Various spectroscopies can be used for optical tissue diagnostics

- Auto-fluorescence (native chromophores)
- Exogenous-drug fluorescence
- Raman
- IR-absorption
- Elastic scattering spectroscopy (ESS) ← **Our approach**

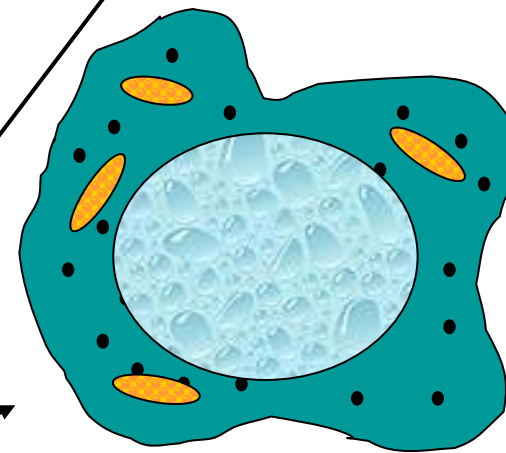
# What do Pathologists look For?

- Ratio - nucleus to cell
- Shape of nucleus
- Chromatin distribution
- Structure of organelles
- Shape of cell
- **PLEOMORPHISM**  
(variations in nuclear size and DNA density)

Normal  
cell



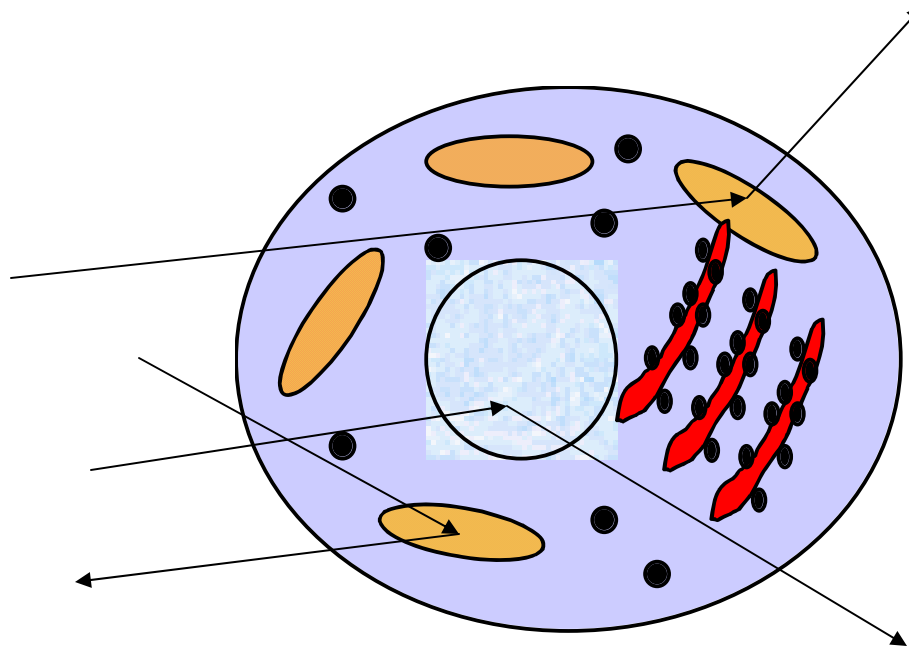
Cancer  
cell



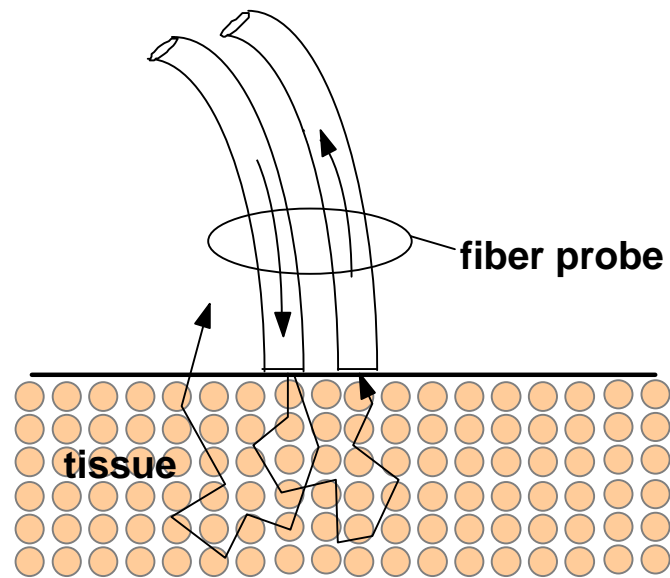
Physicist's cartoons

# Photon scattering

Photons scatter off gradients in the refractive index

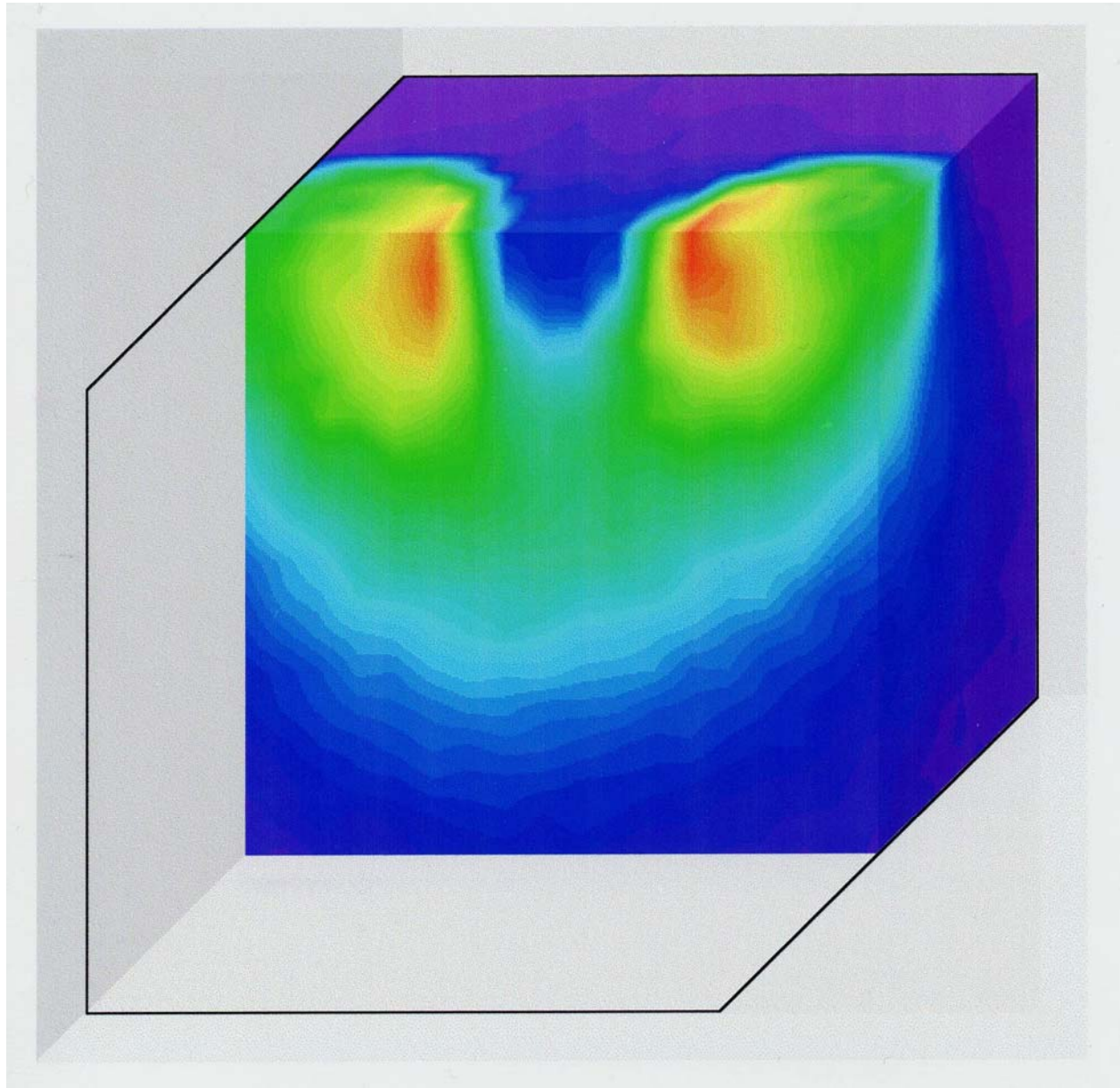


# ESS is sensitive to scattering changes due to changes in sub-cellular morphology

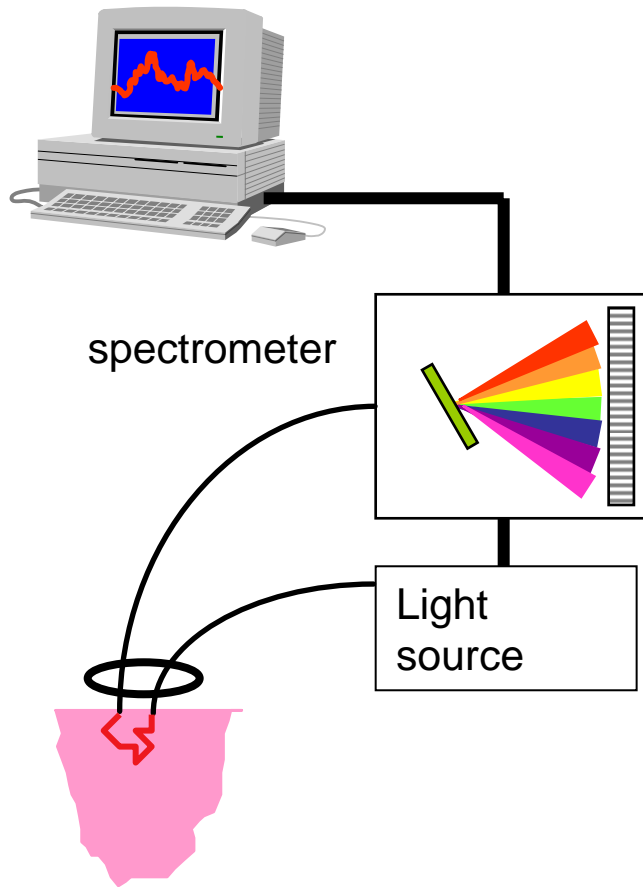


- optical geometry enhances sensitivity to higher-angle scattering events
- wavelength dependence of collected light changes with variations in microscopic tissue morphology

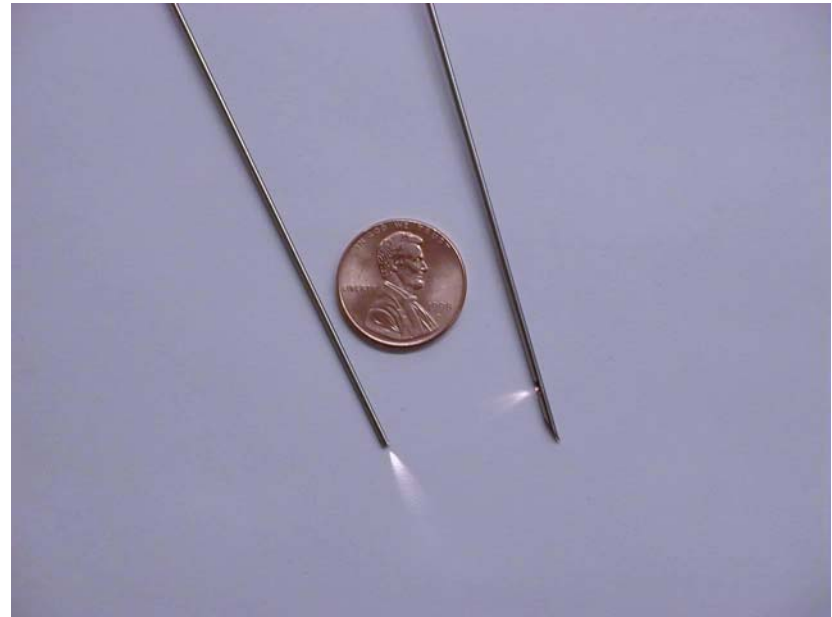
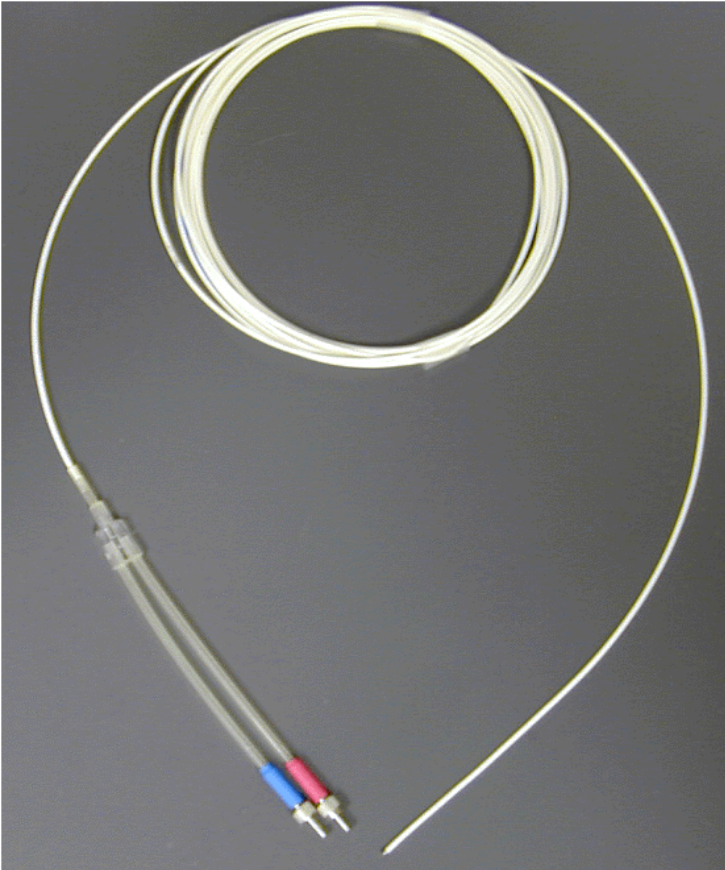
# Voxel visitation histories of collected photons



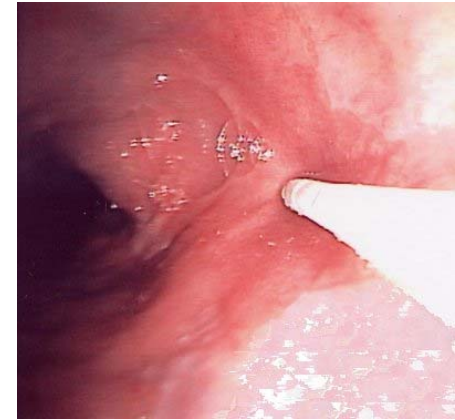
# The ESS system components



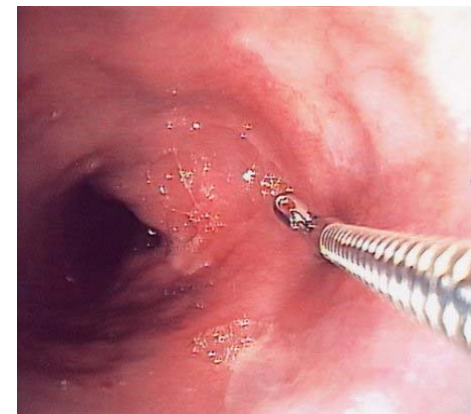
# Optical fiber probes



# GI endoscopy with ESS



Optical “biopsy”



Surgical biopsy

# Spectra from Barrett's patients

