Elastic-scattering spectroscopy for noninvasive detection of early cancer and pre-cancer
Optical spectroscopy in endoscopy

The internist's dream: smart colonoscope

Illumination source (magic laser)

Smart Spectrometer
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

Barretts with and without Dysplasia

Elastic Scatter signal

Wavelength (nm)