



Nathan Taylor

Northside Hospital Award

Ph.D. Student, Chemistry and Biochemistry
First Year ARCS Scholar



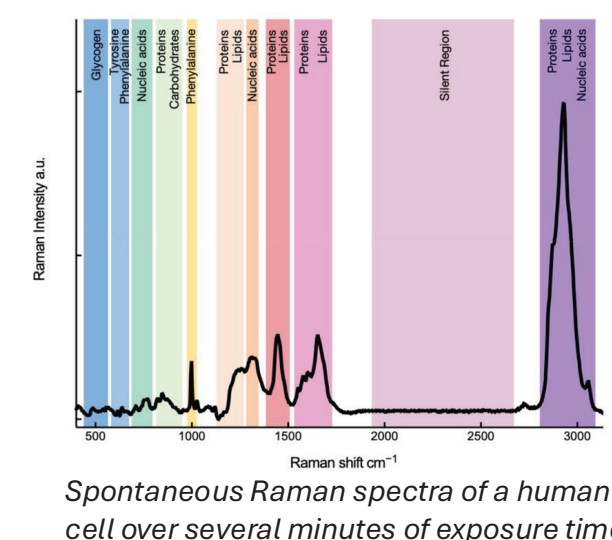
BCARS Enabled Molecular Investigations of Single Cells

With the rise in single-cell omics technology to address individual cellular expression within a population, Broadband Coherent anti-Stokes Raman Spectroscopy (BCARS) offers an exciting alternative to lengthy, expensive multi-omic studies in the form of a rapid, accurate, spatially resolved molecular analysis to better understand cellular mechanism and metabolic regulation.

Raman Spectroscopy for Biology

- Label-free
- Non-destructive
- Specific molecular analysis

- Time intensive
- Narrow window of molecular excitation



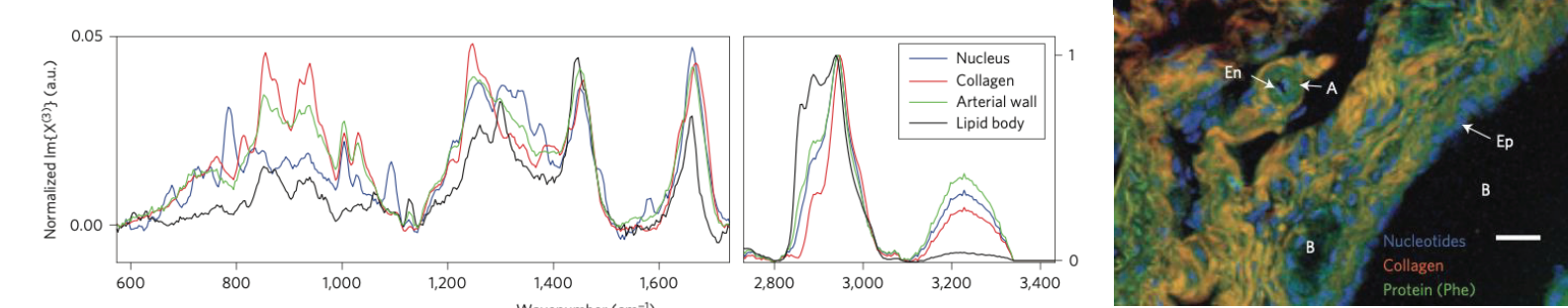
~ 50 peaks are readily detectable in biological specimens
✓ n = 50 dimensions for comparative spectral analysis

Xu, J.; et al. Unveiling Cancer Metabolism through Spontaneous and Coherent Raman Spectroscopy and Stable Isotope Probing. *Anal. Chem.* 2024, 96 (12), 4512–4523

What sets BCARS apart?

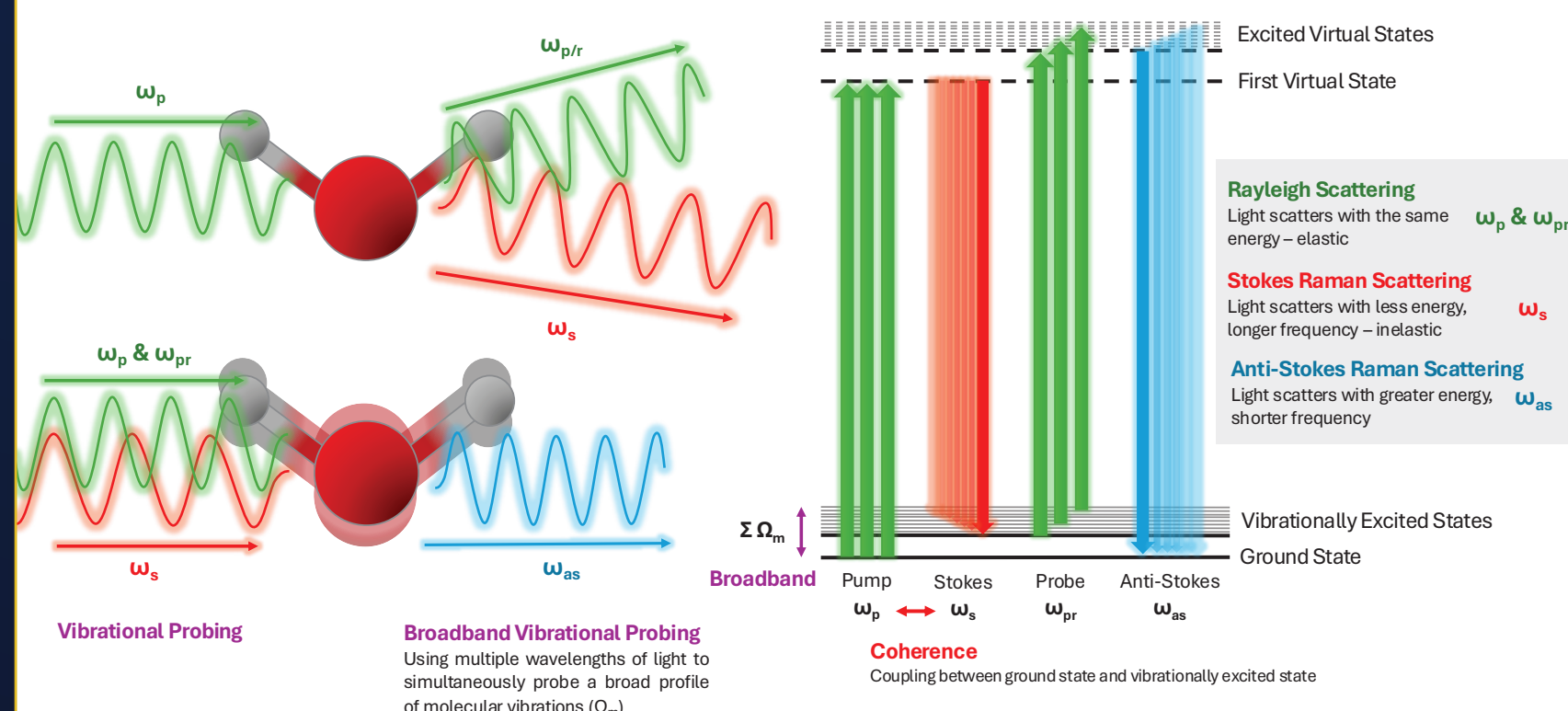
High efficiency activation – Coherent Raman spectroscopy
Wider biological molecular specificity – Broadband probing

- **Rapid Acquisition Speed** (4 millisecond / spectra)
- **Relevant Raman Information** (500 – 3200 cm⁻¹)
- **Large Data Analysis** (~900K Spectra / image)

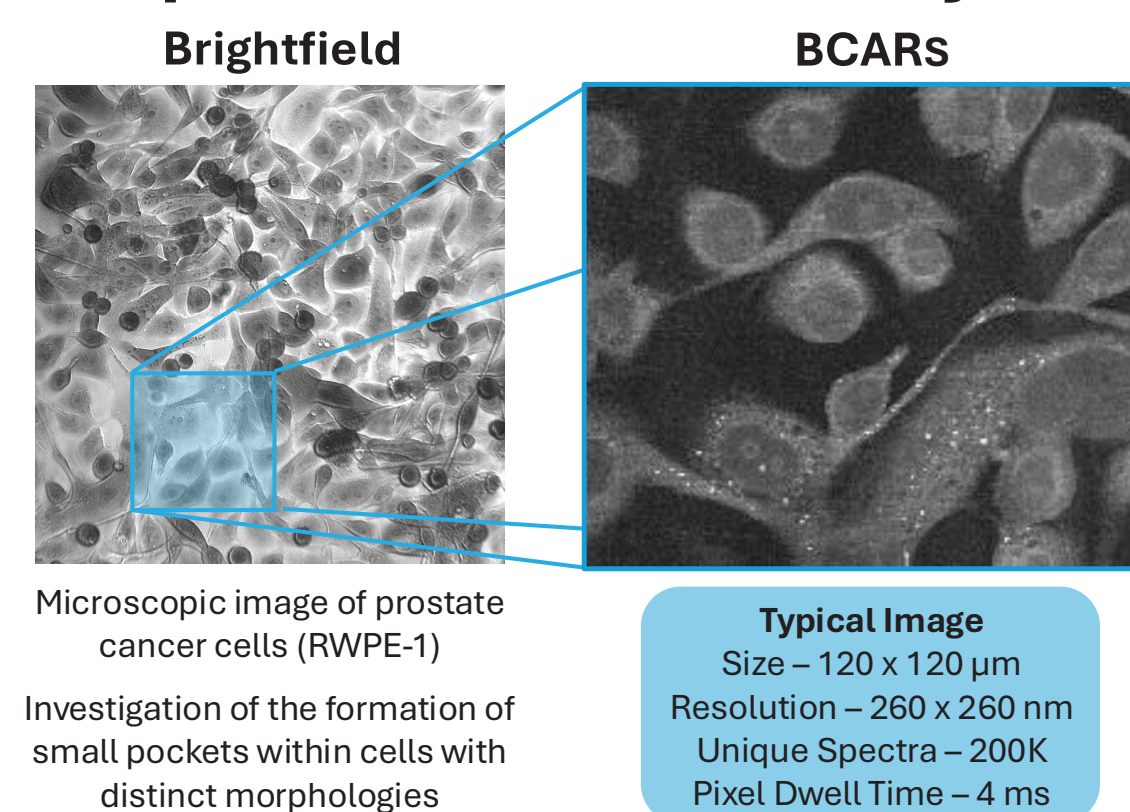


Camp, C. H., Jr.; et al. High-Speed Coherent Raman Fingerprint Imaging of Biological Tissues. *Nat. Photonics* 2014, 8 (8), 627–634

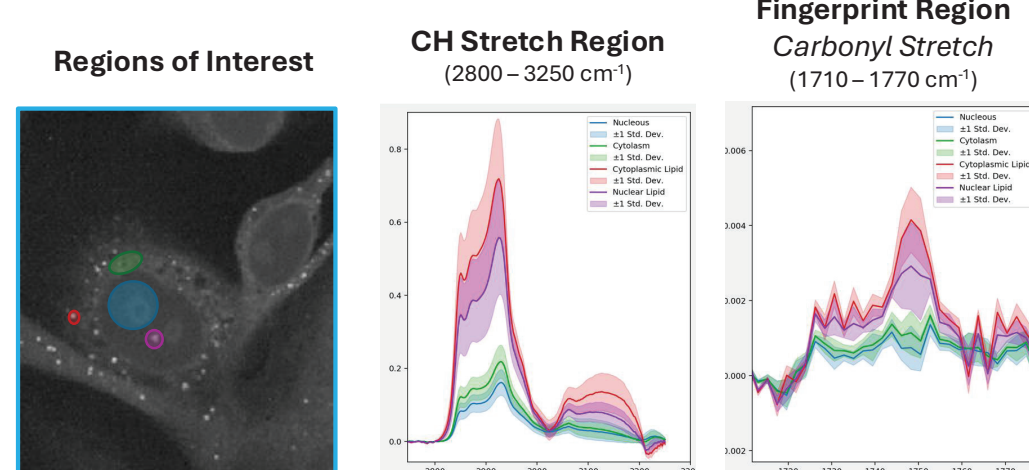
Using Light to Probe Molecules



Spatial Molecular Analysis



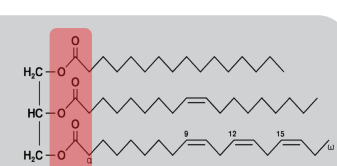
BCARS-Lipidomic Analysis



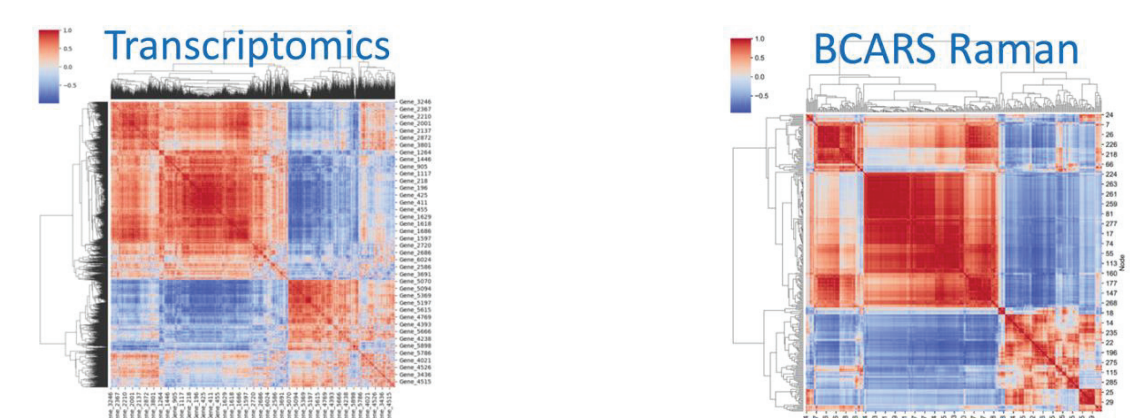
Spectral Analysis

CH Stretch can report on lipid density, saturation, or familial identity
Fingerprint region can confirm these findings to hypothesize origin or destination

Triacyl glycerides are neutral lipids rich in carbonyl bonds derived from mitochondrial waste; indicative of cellular stress



BCARS-Transcriptomic Correlation



6000 Gene Correlation Map
C. elegans gonad tissue
Months-long study

Raman Spectral Ranking
C. elegans gonad tissue
5 minutes of data acquisition

Used only 50 peaks for comparative spectral analysis

Tzu, Y. B.; et al. Spatiotemporal Gene Expression Analysis of the Caenorhabditis elegans Germline Uncovers a Synovial Expression Switch. *Genetics* 2018, 210 (2), 587–605

Scholar Awards Celebration
November 12, 2025



Igniting
Innovation
in Georgia