Joint Department of

# BIOMEDICAL ENGINEERING

UNC CHAPEL HILL | NC STATE UNIVERSITY

**Coulter Seminar Series Presents**

## "High resolution imaging and modeling of collagen architecture alterations in ovarian cancer and idiopathic pulmonary fibrosis"

**Paul Campagnola, PhD**
Professor
Department of Biomedical Engineering
University of Wisconsin-Madison

Paul J. Campagnola obtained his PhD in Chemistry from Yale University in 1992, after which he was a postdoctoral associate at the University of Colorado from 1992-1995. He was on the faculty in the Dept. of Cell Biology, Center for Cell Analysis and Modeling at the University of Connecticut Health Center from 1995-2010, having adjunct appointments in the Physics Dept. and Biomedical Engineering Program. In 2010 became an Associate Professor in the Departments of Biomedical Engineering and Medical Physics at the University of Wisconsin-Madison and was promoted to Professor in 2013. He is currently the Tong Biomedical Engineering Department Chair and UW Kellett Faculty Fellow. He is a Fellow of the Optical Society of America and American Institute for Medical and Bioengineering. His research is focused on studying structural and functional aspects of the extracellular matrix (ECM), where we have developed optical microscopy instrumental and analysis methods to study problems in basic science as well as those with translational potential. He has over 95 peer-reviewed journal articles, several review articles and book chapters, co-edited a book "Second Harmonic Generation microscopy" and given over 100 invited talks. He serves on the editorial board for the Journal of Biomedical Optics and serves on numerous NIH and NSF review panels.

### ABSTRACT

Many human diseases including all cancers, fibroses, cardiovascular disease and connective tissue disorders are characterized by alterations in the collagen organization relative to normal tissues. We have developed Second Harmonic Generation (SHG) microscope tools to selectively and specifically probe all levels of collagen architecture organization. First we present results for human ovarian cancer, which has a poor 5 year survival rate (~25%). Using a novel form of 3D machine learning, we successfully classified six types of ovarian tumors based on the observed collagen fiber morphology. We also developed polarization sensitive SHG methods to extract collagen macro/supramolecular structural aspects (α-chain pitch and chirality) and found significant differences between normal and malignant ovarian tissues. Collectively, this structural information provides insight into disease etiology and suggests future diagnostic approaches. We also used this set of SHG analyses to probe structural changes in idiopathic pulmonary fibroses (IPF). IPF is a devastating disease with poor prognosis and short expected lifespan following diagnosis and has limited effective treatment options. While characterized by increased collagen deposition, the structural aspects of the fibrotic collagen have not been well characterized. Similar to ovarian cancer, we found analogous changes in all levels of collagen architecture in IPF compared to normal lung tissues, providing the bases for new prognostic and diagnostic tools. Lastly, we have developed an SHG image-based fabrication approach to creating tissue engineered scaffolds of both ovarian cancer and IPF to study the effects of collagen remodeling on cell-matrix interactions including migration and cytoskeletal dynamics. Here, we utilize both normal and diseased cell lines on normal and diseased models of the ECM, which affords decoupling the roles of cell phenotype from matrix morphology on cell function. In all cases, we found the remodeled matrix drives the cell behavior to a larger extent than the initial cell phenotype.

**Friday, August 28th**
**12:00 Noon**

Seminar will be presented virtually via Zoom:

https://go.unc.edu/f3QHx