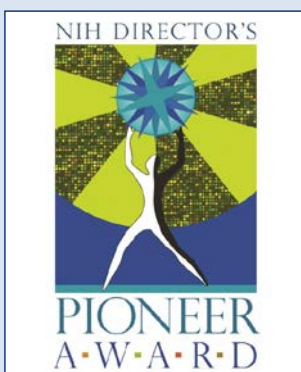# Congratulations to Andy Yun, PhD

Associate Professor of Dermatology, Harvard Medical School

*Andy is one of 12 recipients of the **2016 NIH Director's Pioneer Award** which challenges investigators at all career levels to pursue new research directions and develop groundbreaking, high-impact approaches to a broad area of biomedical or behavioral science.*

MASSIVE WAVELENGTH-DIVISION MULTIPLEXING AND IMAGING WITH LASER PARTICLES

ABSTRACT Fluorescence is the current standard method of choice for intravital microscopy and cytometry. However, the broad emission spectrum of fluorescent probes–dyes, fluorescent probes, and quantum dots–limits the number of cells that can be tracked simultaneously without ambiguity. DNA barcodes can label cells but cannot be visualized in vivo, as they require in vitro genetic reading. The optical principle of stimulated emission and cavity resonance used in a laser can generate extremely narrow spectral line-widths over a broad spectral range. This project will miniaturize lasers to the sizes of mitochondria or viruses and develop instrumentations to utilize the laser particles as novel probes for massively parallel imaging and assays. By tracing individual cells over time in mice, the proliferation, migrations and cell-cell and cell-tissue interactions can be studied in vivo. The cells can be further analyzed by flow cytometry and sorted for gene profiling and single-cell RNA sequencing, providing comprehensive information from molecular, cellular, tissue, and systems levels over millions to billions of cells in a single animal experiment. The first specific aim is to create a new paradigm for imaging-compatible cellular labeling using injectable, biocompatible micro- and submicron-cavity lasers. The second aim is to develop Laser Particle Stimulated Emission (LASE) Microscopy for conducting labeled microscopy in vivo at depths of up to 3 mm. The third specific aim is to demonstrate massively multiplexed, high-throughput cell tracking and analysis. The breakthrough capabilities will be used to dissect tumor heterogeneity in progression, metastasis, and response to therapy at unprecedented single-cell resolution.