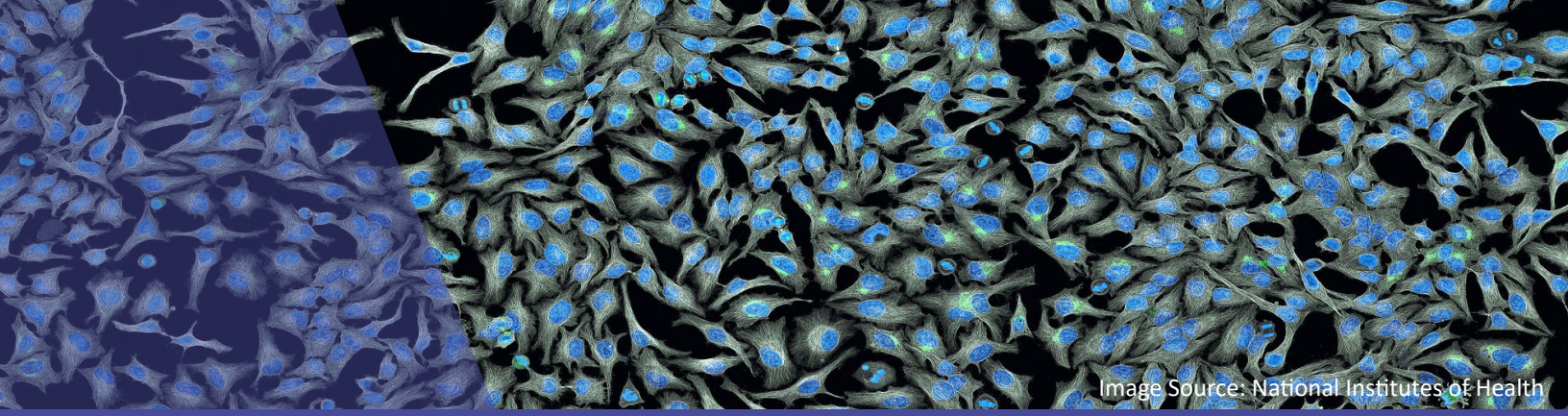


Robert H. Lurie Comprehensive Cancer Center of Northwestern University

Lurie Cancer Center's Basic Research Seminar Series

Decoding the Human Genome by Multi-Omics in Cell-Free DNA and Single-Cells

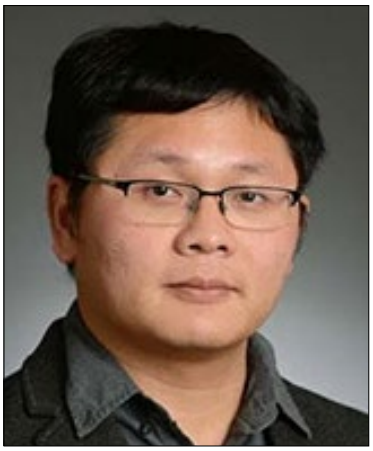
Tuesday, November 19, 2024

11:00 a.m.- 12:00 p.m. CT

Baldwin Auditorium, 1st Floor

Robert H. Lurie Medical Research Center
303 E. Superior St., Chicago, IL

Epigenetic modifications, including DNA methylation, histone modifications, and three-dimensional (3D) genome topology, combine with genetic content to determine the mammalian transcriptional factor (TF) binding and, thus, gene regulation. At present, we are limited by the number of simultaneous measurements that we can perform in the same DNA molecules and single cells. We developed single-cell Methyl-HiC to reveal the heterogeneity of DNA methylation, long-range DNA methylation concordance, and 3D genome in the same cells. Recently, we improved this technology to jointly profile genetic variants, DNA methylation, chromatin accessibility, and 3D genome in the same DNA molecules and in single cells at both cell lines and flash-frozen tissues. To non-invasively monitor the dynamics of regulatory elements in vivo, we developed a set of computational methods to study the cellular epigenomes from cell-free DNA (cfDNA) fragmentation patterns. Specifically, we developed a computational method to de novo characterize the genome-wide cfDNA fragmentation hotspots, infer the open chromatin regions within cells, and boost the power for the cancer early detection. We also developed a computational model to accurately predict DNA methylation and identify the tissues-of-origin in cfDNA from both high-coverage and low-coverage cfDNA whole-genome sequencing. The experimental approaches in single-cell multi-omics and computational methods in cell-free DNA epigenomics developed in our lab will eventually pave the road for our understanding of the variation of cis-regulatory elements non-invasively across different physiological and pathological conditions.



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