



BIOINFORMATICS SEMINAR

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DESIGN PRINCIPLES OF DYNAMIC GENE CONTROL

Traditional studies of gene regulation in the *Drosophila* embryo centered primarily on the analysis of fixed tissues. These methods provided considerable insight into the spatial control of gene activity, such as the borders of *eve* stripe 2, but yielded only limited information about temporal dynamics. Here, we use a combination of live imaging and quantitative analysis in early *Drosophila* embryos to characterize dynamic gene control mediated by enhancers, non-coding regulatory DNA elements. We demonstrated stochastic nature of transcriptional activity in early *Drosophila* embryos by visualizing transcriptional bursting, where transcriptional activity consists of a series of sequential and stochastic bursts. Also, we provided evidence that enhancers regulate the frequency of transcriptional bursts such that strong enhancers produce more bursts than weak enhancers. While working to understand the mechanism of transcriptional bursting, we found that a shared enhancer can co-activate two linked reporter genes both in *cis* and in *trans*, arguing against conventional enhancer-promoter looping models, which would express sequential activation of two reporter genes. We hypothesize that multi promoter-enhancer interaction is facilitated by the formation of chromosomal loops, which helps both target genes to be in proximity of the enhancer at the same time. We suggest that a shared enhancer and two target genes share a common local pool of transcriptional machineries during co-activation, shedding a light on a basal mechanism of enhancer-promoter interactions.

BIOGRAPHY

Bomyi Lim is an Assistant Professor of Chemical and Biomolecular Engineering at the University of Pennsylvania. She received her B.S. in Chemical and Biomolecular Engineering from University of Pennsylvania in 2010, and Ph.D. in Chemical and Biological Engineering from Princeton University in 2015. She was a NIH F32 postdoc fellow at the Lewis-Sigler Institute for Integrative Genomics in Princeton University. Her lab is interested in regulation of chemical kinetics in biological systems, especially in understanding how inherently stochastic gene expression dynamics are “tamed” to produce reliable cellular outcomes. The lab uses combination of molecular experiments, quantitative live imaging, kinetic modeling and other fundamental engineering principles to obtain spatio-temporal control of gene activity.

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