M A T H E M A T I C A L P H Y S I C S S E M I N A R

Rutgers University
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Complex Dynamics of Transcriptional Response: How Do Cells Get On The Fast Lane?

Abstract

In response to external stimuli, cells adjust their behavior to a changing environment-for example, they start to divide or migrate. In order to perform these actions, the protein content of the cell must change. To accomplish this, a cell must modify the levels at which the genes that code for these proteins are transcribed. These transcriptional responses to extracellular stimuli are regulated by tuning the rates of both transcript production and degradation. I present here the results of an experimental study that uses a very simple theoretical model to infer dynamics of RNA production and degradation from measurements of the transcriptome, and to elucidate the operational strategy behind this dynamics.

Our main surprising findings were: a. in general one cannot infer the time-dependent RNA production profiles from measuring mRNA dynamics; b. mRNA degradation exhibits a controlled, transcript dependent temporal variation and c. production of many transcripts is characterized by a large dynamic range, which allow these genes to exhibit an unexpectedly strong transient "production overshoot", thereby accelerating their induction.

A serious attempt will be made to present these results in a way that is understandable to a general Physics audience.

A. Zeisel, W. Koestler et al, Molecular Systems Biology **7**, 529 (Sept 13, 2011) http://www.nature.com/msb/journal/v7/n1/full/msb201162.html