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Quantitative Model of microRNA-mRNA interaction JAVAD NOORBAKHSH, ALEX LANG, PANKAJ MEHTA, Boston University — MicroRNAs are short RNA sequences that regulate gene expression and protein translation by binding to mRNA. Experimental data reveals the existence of a threshold linear output of protein based on the expression level of microRNA. To understand this behavior, we propose a mathematical model of the chemical kinetics of the interaction between mRNA and microRNA. Using this model we have been able to quantify the threshold linear behavior. Furthermore, we have studied the effect of internal noise, showing the existence of an intermediary regime where the expression level of mRNA and microRNA has the same order of magnitude. In this crossover regime the mRNA translation becomes sensitive to small changes in the level of microRNA, resulting in large fluctuations in protein levels. Our work shows that chemical kinetics parameters can be quantified by studying protein fluctuations. In the future, studying protein levels and their fluctuations can provide a powerful tool to study the competing endogenous RNA hypothesis (ceRNA), in which mRNA crosstalk occurs due to competition over a limited pool of microRNAs.

Javad Noorbakhsh
Boston University

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