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Stochastic dynamics of genetic broadcasting networks. DAVIT POTOYAN, PETER WOLYNES, Center for Theoretical Biological Physics, Rice University — The complex genetic programs of eukaryotic cells are often regulated by key transcription factors occupying or clearing out of a large number of genomic locations. Orchestrating the residence times of these factors is therefore important for the well organized functioning of a large network. The classic models of genetic switches sidestep this timing issue by assuming the binding of transcription factors to be governed entirely by thermodynamic protein-DNA affinities. Here we show that relying on passive thermodynamics and random release times can lead to a "time-scale crisis" of master genes that broadcast their signals to large number of binding sites. We demonstrate that this "time-scale crisis" can be resolved by actively regulating residence times through molecular stripping. We illustrate these ideas by studying the stochastic dynamics of the genetic network of the central eukaryotic master regulator $NF\kappa B$ which broadcasts its signals to many downstream genes that regulate immune response, apoptosis etc.

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