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Single promoters as regulatory network motifs
CHRISTOPHER ZOPF, NARENDRA MAHESHRI, Massachusetts Institute of Technology — At eukaryotic promoters, chromatin can influence the relationship between a gene's expression and transcription factor (TF) activity. This additional complexity might allow single promoters to exhibit dynamical behavior commonly attributed to regulatory motifs involving multiple genes. We investigate the role of promoter chromatin architecture in the kinetics of gene activation using a previously described set of promoter variants based on the phosphate-regulated PHO5 promoter in S. cerevisiae. Accurate quantitative measurement of transcription activation kinetics is facilitated by a controllable and observable TF input to a promoter of interest leading to an observable expression output in single cells. We find the particular architecture of these promoters can result in a significant delay in activation, filtering of noisy TF signals, and a memory of previous activation – dynamical behaviors reminiscent of a feed-forward loop but only requiring a single promoter. We suggest this is a consequence of chromatin transactions at the promoter, likely passing through a long-lived "primed" state between its inactive and competent states. Finally, we show our experimental setup can be generalized as a "gene oscilloscope" to probe the kinetics of heterologous promoter architectures.

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