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Exact results for integral thresholds in models of stochastic oscillatory gene expression SRIVIDYA IYER BISWAS, NORBERT SCHERER, AARON DINNER, James Franck Institute, University of Chicago — Oscillatory stochastic gene expression is often combined with threshold regulation to ensure periodic occurrence of some cellular activity, such as cell division. In this work we first demonstrate the virtue of implementing such regulation using an integral threshold, rather than a step threshold, in the fluctuating numbers of the regulator. We then develop a general theoretical framework using which we derive a model independent result that relates the stochastic distribution of the time oscillating regulator numbers to the distribution of event (cell division) times, regardless of the underlying mechanism that generates a specific form of oscillations in the regulator copy numbers. We then use this result in conjunction with a simple model of stochastically oscillating gene expression to show how the shape of the division time distribution can be used to make deductions about the underlying stochastic dynamics of the oscillating regulator. Specifically, we show that bimodal division time distributions can occur, even in the absence of any bistability in the underlying model, and connect that observation to general features of the underlying stochastic model. Finally, we discuss connections to ongoing single cell experimental studies of Caulobacter cell-cycle division times.

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