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Information flow through calcium binding proteins JI HYUN BAK, WILLIAM BIALEK, Princeton University — Calcium signaling is a ubiquitous mode of biological communication, which regulates a great variety of vital processes in living systems. Such a signal typically begins with an elementary event, in which calcium ions bind to a protein, inducing a change in the protein's structure. Information can only be lost, from what was conveyed through this initial event, as the signal is further transduced through the downstream networks. In the present work we analyze and optimize the information flow in the calcium binding process. We explicitly calculate the mutual information between the calcium concentration and the states of the protein, using a simple model for allosteric regulation in a dimeric protein. The optimal solution depends on the dynamic range of the input as well as on the timescale of signal integration. According to our result, the optimizing strategy involves allowing the calcium-binding protein to be "activated" by a partial occupation of its sites, and tuning independently the strengths of cooperative interactions in the binding and unbinding processes.

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