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Competition enhances stochasticity in biochemical reactions TAYLOR FIRMAN, KINGSHUK GHOSH, University of Denver — We investigate the complex interplay between competition and stochasticity using coupled complexation reactions, (i) $A+B \leftrightarrow AB$ and (ii) $A+C \leftrightarrow AC$, as the model system, a reaction scheme common in biology. Within the master equation formalism, we compute the exact distribution of the number of complexes to analyze equilibrium fluctuations of several observables, which reveals that the presence of competition from one reaction can enhance fluctuation in the other. We provide quantitative estimates of this enhancement for different combinations of rate constants and reactant molecule quantities typical to biology. We notice that fluctuations can be significant even when two of the reactant molecules (say B and C) are infinite in number, maintaining a fixed stoichiometry, while the other reactant (A) is finite. This is purely due to the coupling mediated via resource sharing and is in stark contrast to the single reaction scenario, where large numbers of one component ensure zero fluctuation. These observations indicate that averages can be a poor representation of the system, hence analysis that is purely based on averages such as mass action laws can be potentially misleading in such noisy biological systems.

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