A proof of multistability in a phosphorylation cycle

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Phosphorylation networks are chemical reaction networks which are used to propagate signals in living cells. An important example is the multiple futile cycle, which can be modelled using a system of $3n + 3$ ordinary differential equations in the case that there are n phosphorylation sites. Central mathematical questions about this system, which are also of biological importance, are the following. How many steady states exist and how many of them are stable? A lower bound for the number of steady states which can occur was proved by Wang and Sontag but no rigorous results were available about their stability. We have proved a lower bound for the number of stable steady states which grows linearly with n. The proofs involve slow-fast systems and intricate centre manifold calculations.

References

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