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Persistence and the Global Attractor Conjecture: The Big Picture

We discuss the long-term behavior of population systems, and in particular of chemical reaction systems modeled by mass-action kinetics. We especially focus on the property of "persistence", and its connections to other dynamical properties of these systems. A system is called persistent if no positive trajectory has a limit point on the boundary of the positive orthant. Persistence is important in understanding properties of biochemical networks (e.g., will each chemical species be available indenitely in the future), and also in ecology (e.g., will a species become extinct in an ecosystem), and in the dynamics of infectious diseases (e.g., will an infection die o, or will it infect the whole population). We describe two important open problems for mass-action systems: the Persistence Conjecture and the Global Attractor Conjecture. The Persistence Conjecture says that weakly reversible mass-action systems are persistent, independent of the values of the reaction rate parameters. A proof of the Persistence Conjecture would also imply the Global Attractor Conjecture, which says that complex balanced systems have a global attractor. We explain the relationship between these conjectures, and other recent results. This is joint work with Casian Pantea and Fedor Nazarov.