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Condensation and transport in the totally asymmetric inclusion process (TASIP)[1] JOHANNES KNEBEL, MARKUS F WEBER, LMU Munich, TORBEN KRUEGER, IST Austria, ERWIN FREY, LMU Munich — Transport phenomena are often modeled by the hopping of particles on regular lattices or networks. Such models describe, e.g., the exclusive movement of molecular motors along microtubules: no two motors may occupy the same site. In our work, we study inclusion processes that are the bosonic analogues of the fermionic exclusion processes. In inclusion processes, many particles may occupy a single site and hopping rates depend linearly on the occupation of departure and arrival sites. Particles thus attract other particles to their own site. Condensation occurs when particles collectively cluster in one or multiple sites, whereas other sites become depleted.
We showed that inclusion processes describe both the selection of strategies in evolutionary zero-sum games and the condensation of non-interacting bosons into multiple quantum states in driven-dissipative systems. The condensation is captured by the antisymmetric Lotka-Volterra equation (ALVE), which constitutes a nonlinearly coupled dynamical system. We derived an algebraic method to analyze the ALVE and to determine the condensates. Our approach allows for the design of networks that result in condensates with oscillating occupations, and yields insight into the interplay between network topology and transport properties.

[1]Deutsche Forschungsgemeinschaft (SFB-TR12), German Excellence Initiative (Nanosystems Initiative Munich), Center for NanoScience Munich

Johannes Knebel
LMU Munich

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