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Evolutionary games of condensates in coupled birth-death processes MARKUS F. WEBER, JOHANNES KNEBEL, TORBEN KRUEGER, ERWIN FREY, Ludwig-Maximilians-Universitaet Muenchen — Condensation phenomena occur in many systems, both in a classical and a quantum mechanical context. Typically, the entities that constitute a system collectively concentrate in one distinct state during condensation. For example, cooling of an equilibrated bosonic gas may lead to condensation into the quantum ground state. Notably, the mathematical theory of this Bose-Einstein condensation is not limited to quantum theory but was also successfully applied to condensation in random networks. In our work, we follow the opposite path. We apply the theory of evolutionary dynamics to describe condensation in a bosonic system that is driven and dissipative. It was shown that the system may condense into multiple quantum states, but into which states has remained elusive. We find that vanishing of relative entropy production determines these states. We illuminate the physical principles underlying the condensation and show that the condensates do not need to be static but may engage in "evolutionary games" with exchange of particles. On the mathematical level, the condensation is described by coupled birth-death processes. The generic structure of these processes implies that our results also apply to condensation in other systems, ranging from population biology to chemical kinetics.

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