Abstract Submitted
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Non-equilibrium phase transitions in a hot vapor OFER FIRSTENBERG, Weizmann Institute of Science — The spins of alkali atoms in a warm vapor are in thermal equilibrium, disordered and unpolarized. Most often, optical pumping with circularly-polarized light is used for driving the them into a particular orientation. Here we study unique pumping conditions that lead to bifurcation of the total spin orientation, i.e., to alignment of all spins (randomly) either parallel or anti-parallel to a defined axis. The bifurcation mechanism relies inter-atomic spin-exchange coupling that settles only when all spins point to the same direction. We show theoretically and experimentally that this collective mechanism is associated with a non-equilibrium phase transition. We identify the critical exponents and observe critical slowing down of the spin buildup time, which reaches several seconds, 2-3 orders of magnitude larger than the single-atom lifetime. Moreover, we observe similar substantial increase in the 'life-time' of the symmetry-broken spin when approaching the critical point. This system can be used to study critical phenomena in out-of-equilibrium scenarios. In particular, regarding a single ensemble as one 'collective' Ising spin, an array of such spins, coupled using light, can form an Ising machine or other condensed-matter spin models.

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