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Questioning the activity of active matter: the case of bird flocks
THIERRY MORA, ALEKSANDRA WALCZAK, Ecole normale superieure and CNRS, LORENZO DEL CASTELLO, University of Rome and CNR, FRANCESCO GINELLI, University of Aberdeen, STEFANIA MELILLO, LEONARDO PARISI, MASSIMILIANO VIALE, ANDREA CAVAGNA, IRENE GIARDINA, University of Rome and CNR — Animal flocking is a natural instance of active matter. What makes flocks active is the rearrangement of neighborhoods, which constantly remodels the network of interactions between individuals in the group, keeping the system out of equilibrium. Despite the predicted importance of this reshuffling, its true impact for natural flocks is not well understood. Here we analyse films of flocks of startlings with a novel statistical inference technique based on dynamical maximum entropy to measure the parameters of flock alignment - alignment strength, interaction range, and noise. We show that birds align their flight orientations must faster than they change neighbors. In the statistical mechanics sense, this means that flocks remain adiabatically in equilibrium, allowing for a rigorous analogy with equilibrium systems of interacting spins, and we show that an inference method based on equilibrium assumptions gives fully consistent results.

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