

John Toner: "Fish Gotta swim, birds gotta fly, I gotta do Feynmann graphs 'til I die: A continuum theory of flocking"

Thursday 21 June 2018 15:15 (45 minutes)

Flocking - i.e., the collective motion of large numbers of self-propelled entities - provides a classic illustration of the differences between equilibrium and non-equilibrium systems. Like an equilibrium ferromagnet, a non-equilibrium flock breaks rotation invariance by spontaneously choosing a direction of motion. Unlike a ferromagnet, it can even do so in two dimensions, in apparent violation of the Mermin-Wagner theorem, which states that it is NOT possible to spontaneously break a continuous symmetry in two dimensions.

In this talk, I'll describe a "hydrodynamic" theory of flocking, which resolves this apparent contradiction by demonstrating that flocks can spontaneously break rotation invariance in two dimensions. Furthermore, the theory shows that they do so by developing anomalous hydrodynamics, in which all correlation functions scale differently than predicted by the linearized version of the theory, for all spatial dimensions $d < 4$. I'll discuss numerous numerical experiments supporting this striking prediction.

Session Classification: Afternoon session