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**The spontaneous emergence
of collective phenomena:
from magnetization to
synchronisation**

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Abstract

Spontaneous magnetization is a physical phenomenon in which interacting magnetic dipoles cooperate to create a macroscopic magnetisation below the Curie temperature. Synchronisation is a remarkable collective effect observed in nature (circadian rhythms, heart cells, coupled Josephson junctions, etc.), whereby a population of oscillating units, which have diverse natural frequencies and are in weak interaction with one another, evolves to spontaneously exhibit collective oscillations at a common frequency. I will draw an analogy between the two, apparently quite different, effects and I will show that they can be described in the context of statistical mechanics as a symmetry breaking phenomenon.

Bio sketch: Stefano Ruffo is full professor of condensed matter physics at SISSA, Trieste, Italy. He is the Director of SISSA for the term 2015-2021. His research field is statistical physics and complex systems. In this area of research he has given contributions to Hamiltonian dynamics, cellular automata, space-time chaos, long-range interactions, immune system and DNA modeling. He is editor of *Communications in Nonlinear Science and Numerical Simulations* (Elsevier) and member of the Editorial Board of *Physica A* (Elsevier). He has been Weston Visiting Professor at the Weizmann Institute of Science (2009-2010) and Excellence Chair at the Physics Laboratory of the Ecole Normale Supérieure in Lyon (2011-2013). He has been the Chairman of the C3 Commission (Statistical Physics) of the International Union of Pure and Applied Physics (IUPAP) and Vice-President of the IUPAP for the triennium 2012-2014. He is a member of the scientific council of the Erwin Schrodinger Institute in Vienna (2016-2018).