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**Abstract**

# Classical phase transitions

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Classical phase transitions take non-trivial matter (i.e., with interactions) from one (usually more ordered) state to a (usually more disordered) state by increasing the system's temperature. When Lev Landau had introduced his mean-field theory in 1937 the story looked as if it were done. But Onsager's exact solution of the 2D Ising model proved otherwise, with fluctuations and topological defects playing decisive roles in the behavior of matter, as the subsequent years amply demonstrated with many physical systems. We start our tour through classical phase transitions with the `drosophilas' of the field, the van der Waals gas and the Ising magnet, proceed with Landau's mean-field theory for 2nd and 1st order transitions, and then, rather than going to RG, continue with specific physical examples to understand what fluctuations (Gaussian fluctuations, spin waves) and defects (domain walls, vortices) do to real systems. We have a look at the Berezinskii-Kosterlitz-Thouless transition and the Hohenberg-Mermin-Wagner theorem and end with Ginzburg's criterion telling us where fluctuations are important.