

**642:564**

## **Rigorous Results in Statistical Mechanics II: Nonequilibrium**

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**Subtitle:** Emergent Phenomena

**Text:** None

**Prerequisites:** talk with me

**Description:** Statistical Mechanics: Exact Results

Emergent Phenomena in Multicomponent Systems

Statistical mechanics successfully explains how properties of macroscopic systems, such as a glass of water, originate in the cooperative behavior of atoms and molecules, the microscopic constituents of all matter. Some of the observed phenomena are paradigms of emergent behavior, having no direct counterpart in the properties or dynamics of individual atoms.

Particularly fascinating and important examples of such emergent phenomena are phase transitions. These correspond to abrupt changes in the behavior of a macroscopic system as some parameter is changed across some specified value. A familiar example is the melting of ice or the boiling of water at a precise value of the temperature, depending on the pressure. These would (or should) be astonishing if they were not so familiar.

Fortunately, many of these striking features of macroscopic systems can be obtained from simplified microscopic models. These can be treated in a mathematically rigorous way. Surprisingly these models are also applicable to systems where the microscopic entities are not atoms or molecules but viruses, fish, or Wall Street traders.

The course will develop the concepts and necessary mathematical tools for describing cooperative phenomena in systems consisting of many components.

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