

Critical Phenomena and Breaking Drops: Infinite Idealizations in Physics

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Abstract

Thermodynamics and Statistical Mechanics are related to one another through the so-called "thermodynamic limit" in which, roughly speaking the number of particles becomes infinite. At critical points (places of physical discontinuity) this limit fails to be regular. As a result, the "reduction" of Thermodynamics to Statistical Mechanics fails to hold at such critical phases. This fact is key to understanding an argument due to Craig Callender to the effect that the thermodynamic limit leads to mistakes in Statistical Mechanics. I discuss this argument and argue that the conclusion is misguided. In addition, I discuss an analogous example where a genuine physical discontinuity---the breaking of drops---requires the use of infinite idealizations.

Keywords: Thermodynamic Limit, Scaling, Theory Reduction, Critical Phenomena, Idealizations

[General Issues: Models and Idealization](#)

Subjects: [Specific Sciences: Physics](#)

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