Dissipation and the Foundations of Statistical Thermodynamics

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Over the last 15 years we have discovered a group of related theorems that enable us to prove the "laws" of thermodynamics. Each of these "laws" is provable for time reversible, deterministic equations of motion that satisfy a mathematical condition called T-mixing. The axiom of causality is also required. These proofs involve a new mathematical quantity first defined in 2000, namely *dissipation*. Dissipation, not entropy, turns out to be the central quantity for the fluctuation theorems, the dissipation theorems, linear and nonlinear response theory, and the relaxation theorem. Using dissipation we can also derive Clausius' Inequality and Equality, without *assuming* the Second "Law" of thermodynamics.