A Hamiltonian approach to Thermodynamics

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In the present work we develop a strictly Hamiltonian approach to Thermodynamics. A thermodynamic description based on symplectic geometry is introduced, where all thermodynamic processes can be described within the framework of Analytic Mechanics. Our proposal is constructed on top of a usual symplectic manifold, where phase space is even dimensional and one has well-defined Poisson brackets. The main idea is the introduction of an extended phase space where thermodynamic equations of state are realized as constraints. We are then able to apply the canonical transformation toolkit to thermodynamic problems. Throughout this development, Diracs theory of constrained systems is extensively used. To illustrate the formalism, we consider paradigmatic examples, namely, the ideal, van der Waals and Clausius gases.