Microcanonical Thermostatistics as Foundation of Thermodynamics.
The microscopic origin of condensation and phase separations.

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Conventional thermo-statistics address infinite homogeneous systems within the canonical ensemble. However, some 150 years ago the original motivation of thermodynamics was the description of steam engines, i.e. boiling water. Its essential physics is the separation of the gas phase from the liquid. Of course, boiling water is inhomogeneous and as such cannot be treated by conventional thermo-statistics. Then it is not astonishing, that a phase transition of first order is signaled canonically by a Yang-Lee singularity. Thus it is only treated correctly by microcanonical Boltzmann-Planck statistics. This is elaborated in the present article. It turns out that the Boltzmann-Planck statistics is much richer and gives fundamental insight into statistical mechanics and especially into entropy. This can be done to a far extend rigorously and analytically. The deep and essential difference between “extensive” and “intensive” control parameters, i.e. microcanonical and canonical statistics, is exemplified by rotating, self-gravitating systems.

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