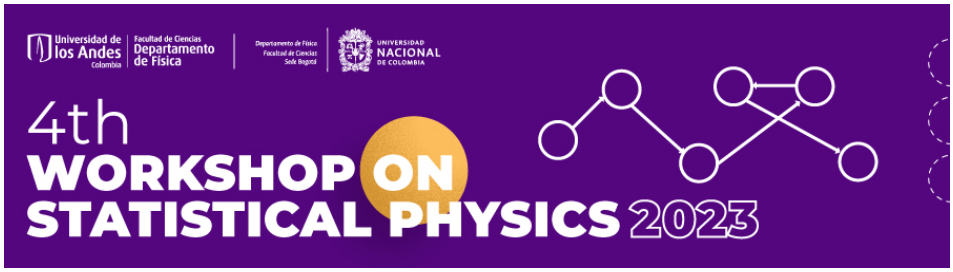

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Liouville's theorem, three converging points of view in mechanical and statistical physics

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The proof of Liouville's theorem is important in statistical physics because it establishes a fundamental principle in the theory of dynamical systems and statistical thermodynamics. Liouville's theorem states that in a conservative system (where the total energy is conserved), the volume in phase space occupied by a set of initial conditions is also conserved over time. Starting from three points of view, relevant considerations and postulates are collected, such as the phase space as a dynamic entity that flows following the laws of mechanics; the generalization of Louiville's theorem to non-Hamiltonian systems, such as dissipative systems, taking the invariance of the Jacobian; or reaching the Poincaré-Cartan Integral Invariant, incorporating the symplectic geometry to the phase space and the principle of minimum action.
The present work is framed in the pertinence of making a revision of the concepts even to arrive at the same proof of a theorem, by revisiting its proof and underlying concepts, physicists ensure the validity of this fundamental principle in the ever-evolving landscape of physical theories. It reaffirms the robustness of this principle and its applicability to a wide range of systems.

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