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Semiclassical Limit of Entropies and Free Energies

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Entropy and free energy are central concepts in both statistical physics and information theory, with quantum and classical facets. In mathematics these concepts appear quite often in different contexts (dynamical systems, probability theory, von Neumann algebras,etc.). In this work, we study the von Neumann and Wehrl entropies from the point of view of semiclassical analysis. We first prove the semiclassical convergence of the von Neumann to the Wehrl entropy for quantum Gibbs states (thermal equilibrium), after a suitable renormalization has been taken into account. Then, we show that, in the same limit, the free energy functional defined with the Wehrl entropy $\Gamma-$converges to its classical counterpart, so implying convergence of the minima and the associated minimizers.

Joint work with Z. Ammari (Besancon), M. Falconi (Polimi), R. Gautier (Polimi & Rennes).

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