Negative Casimir Entropies and their Implications

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It has been recognized for some time that even for perfect conductors, the interaction Casimir entropy, due to quantum/thermal fluctuations, can be negative. This result was not considered problematic because it was thought that the self-entropies of the bodies would cancel this negative interaction entropy, yielding a total entropy that was positive. In fact, this cancellation seems not to occur. The positive self-entropy of a perfectly conducting sphere does indeed just cancel the negative interaction entropy of a system consisting of a perfectly conducting sphere and plate, but a model with weaker coupling in general possesses a regime where negative self-entropy appears. The physical meaning of this surprising result remains obscure. In this presentation we re-examine these issues, using improved physical and mathematical techniques, partly based on the Abel-Plana formula, and present numerical results for arbitrary temperatures and couplings, which exhibit the same remarkable features. The extension of these results to include dissipation, and the significance of such a negative self-entropy is being explored.