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Vacuum Energy from Qubit Entropy

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We develop a non-conventional description of the vacuum energy in quantum field theory in terms of quantum entropy. Precisely, we show that the vacuum energy of any non-interacting quantum field at zero temperature is proportional to the quantum entropy of the qubit degrees of freedom associated with virtual fluctuations. We prove this for fermions first and then extend the derivation to quanta of any spin. We also argue that essentially the same results are valid in the interacting case in the mean-field approximation and when the background is curved and static.

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