QUANTUM TUNNELING IN THE LANDSCAPE OF OPTIMIZATION

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This is a non-technical review, intended for a broad audience from diverse fields of science. Here we discuss searches as solutions to optimization problems, and how quantum mechanics can possibly help in it. To maintain unrestricted search over the whole space of interest, the search dynamics must be ergodic. This is often not the case when the searcher is "classical", i.e., behaving like a classical system moving through a rugged energy landscape. This has remained a major hindrance for versatile heuristics like simulated thermal annealing in finding a good (not to talk about the best) solution in presence of high energy/cost barriers. The stagnated situation was stirred fundamentally by the idea of quantum tunnelling, or, to be more precise, it's dramatic role proposed in the context of spin glass[1], which eventually helped forming the rationale behind one of the most promising form of quantum computation of the present day, namely, quantum annealing. The potential of the idea, however, is not limited to the strict framework of its most popular version, the adiabatic quantum annealing, but can possibly extend more effectively to other, less restrictive forms of quantum search heuristics that could be designed.