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Thermalization, freeze-out and J-chaos: deciphering experimental quantum annealers ITAY HEN, JEFFREY MARSHALL, Univ of Southern California, ELEANOR RIEFFEL, QuAIL, NASA Ames Research Center — By contrasting the performances of two prototypical quantum annealing optimizers held at different temperatures, we address and resolve several recent pressing questions pertaining to the role of temperature in these devices. In particular, we study the ability of experimental quantum annealers to function as 'Boltzmann samplers'. While to date the discrepancies between the observed output and theoretical predictions have been prone to conjecture, we demonstrate how the simultaneous benchmarking on two devices sheds light on the inner workings of these otherwise inaccessible processors. Our results show that the output distributions of the annealers do not in general correspond to classical Boltzmann distributions but rather correspond to distributions generated by Hamiltonians with a non-negligible quantum part. Moreover, we find that the observed effective temperatures of these devices are significantly higher than their physical temperatures and argue that this is in accord with the 'freeze-out' picture. We also find that J-chaos plays an increasingly dominant role in determining these instance-dependent effective temperatures. We discuss the implications of our results to potential applications of current and near future practical quantum annealing.

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