

Moorea, May 30, 2014

Resubmission of manuscript 1252319

Dear Dr. Ian Osborne,

We would like to hereby resubmit our manuscript 1252319. We are grateful to the reviewers for their constructive recommendations. We have revised the manuscript in accordance with the reviewer's suggestions and have substantially streamlined and shortened it to fit the style and length guidelines, focusing on the main message in the main text and moving details to the supplementary material.

We thank Reviewer 1 for the positive review of the manuscript. The reviewer's main concern was the applicability of our considerations to other types of quantum processors. The issues we discuss by using the illustrative results on the D-Wave devices will appear for other quantum processors and algorithms. In particular, the problem of extrapolation of run times to large problem sizes and the fact that suboptimal performance of a quantum algorithm for small problem sizes can fake a speedup will appear for any quantum algorithm or analog quantum processor where the runtimes need to be experimentally determined. The careful consideration of hardware scaling when comparing quantum and classical devices is also essential for correct comparisons but has not gained sufficient attention in the community yet. We have added a discussion of this issue as the final conclusions of the paper.

We also thank Reviewer 2 for the careful review and have taken the suggestions into account. As already mentioned above, we have added a final discussion of how our deliberations apply generally to quantum devices and are not just restricted to the D-Wave devices.

Following the suggestion of the reviewer we have tightened the discussion of the various types of speedup and have reformulated the discussion of NP-hardness to highlight that these spin glasses are hard not only in the worst case but also for typical instances.

We are grateful for the suggestion to earlier explain that quantum speedup refers to the inferred asymptotic scaling. This suggestion has indeed allowed us to simplify the discussion and helped with streamlining and shortening the manuscript. We similarly clarified and focused the discussion on hardware scaling. Taking into account feedback we received from discussions with various people we simplified the argument and made it more easily understandable.

We are similarly thankful for the suggestion to provide a more extensive discussion of the state of analysis of the D-Wave devices, and in particular in relation to the semi-classical model of Shin, Smolin, Smith and Vazirani. We have added such a discussion to the revised main text, and it explains the importance of checking for potential quantum speedup.

Finally, as suggested by the reviewer we have added a short description of quantum annealing to the main text, but have to refer to supplementary material for the main discussion due to space restrictions.

I apologize for the delay in the resubmission, which was caused by my absence from work. We hope that the revised manuscript is now suitable for publication.

Sincerely,

A handwritten signature in black ink, appearing to read "Matthias Troyer". The script is cursive and fluid, with the first name "Matthias" written in a larger, more prominent hand than the last name "Troyer".

Matthias Troyer, for all authors