Towards the automatic arrangement of music via quantum annealing

L. Kirby
Durham University
Submitted: 27th December 2024

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

I. INTRODUCTION

II. THEORY

The general form of a QUBO is

$$f(x) = \sum_i Q_{i,i}x_i + \sum_{i<j} Q_{i,j}x_i x_j \tag{1}$$

where Q is a coefficient matrix (??).

III. D-WAVE

The maximum independent set (MIS) QUBO takes the form

$$f(x) = A\sum_{ij\in E} x_i x_j - B\sum_i x_i \tag{2}$$

IV. PROBLEM FORMULATION

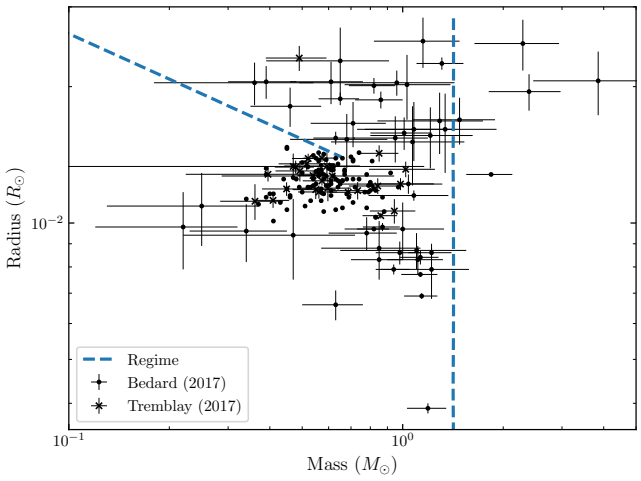

Figure 1

Table I: Summary of frational changes to best-fit parameters due to electron energy density and electrostatic corrections.

Correction	$\lvert\Delta A\rvert/A$	$\lvert\Delta B\rvert/B$	$\lvert\Delta q\rvert/q$
$\varepsilon_{\rm elec}$	0.026	0.0031	0.0442
p_c	0.009	0.0114	0.0005

V. CORRECTIONS

VI. NON-DEGENERATE LIMIT

$$p = \frac{\hbar c}{12\pi^2}\left(\frac{3\pi^2}{m_n c^2\eta}\right)^{4/3}\left[\frac{1+2d(S_e)^2+\frac{7}{15}d(S_e)^4}{(1+d(S_e)^2)^{4/3}}\right]\varepsilon^{4/3} \tag{3}$$

$$= \bar{K}(S_e)\varepsilon^{4/3}\,. \tag{4}$$

VII. CONCLUSIONS

The study of white dwarfs is very much ongoing research, with new models arising with the advancement of computational power and new satellite observations that test these models. It is incredible that an investigation such as this, through the application of fundamental statistical physics and computer modelling, can attempt to understand the nature of stellar remnants that seem so unreachable.

REFERENCES

[1] Andrew Lucas. Ising formulations of many NP problems. Frontiers in Physics, 2, February 2014. Publisher: Frontiers.
[2] William S. Moses and Erik D. Demaine. Computational Complexity of Arranging Music, July 2016. arXiv:1607.04220.
[3] Jiun-Long Huang, Shih-Chuan Chiu, and Man-Kwan Shan. Towards an automatic music arrangement framework using score reduction. ACM Trans. Multimedia Comput. Commun. Appl., 8(1):8:1–8:23, February 2012.
[4] Eita Nakamura and Kazuyoshi Yoshii. Statistical piano reduction controlling performance difficulty. APSIPA Transactions on Signal and Information Processing, 7:e13, January 2018.
[5] Hao-Wen Dong, Chris Donahue, Taylor Berg-Kirkpatrick, and Julian McAuley. Towards Automatic Instrumentation by Learning to Separate Parts in Symbolic Multitrack Music, October 2021. arXiv:2107.05916 [cs].

[6] Moyu Terao, Eita Nakamura, and Kazuyoshi Yoshii. Neural Band-to-Piano Score Arrangement with Stepless Difficulty Control. In ICASSP 2023 - 2023 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), pages 1–5, June 2023. ISSN: 2379-190X.

SCIENTIFIC SUMMARY FOR A GENERAL AUDIENCE

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.