University of BRISTOL

SCHOOL OF PHYSICS

FINAL YEAR PROJECT REPORT

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DEGREE COURSE:	MSci Theoretical Physics
PROJECT TITLE:	Custom Project: Quantum Thermodynamics Related
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SUPERVISOR:	Stephen R. Clark
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Declaration

We produced all of the data presented in this project. Both partners produced code to contribute to the final results and obtained the same results with slightly differing implementations at times. All of the data produced was produced in python using methods from literature. Our supervisor helped us in the interpretation of our results, specifically how the entanglement entropy can saturate at a lower value in fermionic circuits. In terms of how work was divided between my partner and myself, we both wrote our respective programs to achieve the results, so that we may troubleshoot any issues faster. We both played an equal role in data collection, analysis and interpretation.

Acknowledgements

I'd like to thank Stephen Clark, for his enthusiastic attitude and continued guidance throughout the project.

Abstract

Using atypical quantum circuit models, specifically super-Clifford and non-interacting fermion circuits, we explore the dynamics of operator space entanglement entropy and the process known as scrambling. In super-Clifford circuits, we reproduce the work from Blake and Linden, and achieve a maximal entanglement entropy using the stabilizer formalism. We find that no local operators can generate non-trivial entanglement dynamics within super-Clifford circuits. By using non-interacting fermion circuits we show that fermionic systems subject to random unitary circuits exhibit weak entangling dynamics in operator space, with it's entanglement entropy saturating at a fraction of the Page value.