Almost Perfect State Transfer Over Arbitrary Distances

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In recent years, the creation of models to transfer quantum states between distant locations has become a growing industry. Such models are applicable to many quantum information protocols [1]. For instance, in a quantum computer, it is ideal to have a quantum data bus capable of transferring qubits between quantum registers and processors with high accuracy. An initial method to achieve such qubit transfer is the implementation of SWAP gates, but this process is too difficult to control and is very susceptible to errors [2]. Instead, passive transmission devices that facilitate state transfer with minimal control are desired and quantum spin chain networks are currently a leading candidate for such systems. A key advantage is that the transfer of quantum information is realized by the intrinsic dynamics of the networks themselves and requires minimal external intervention [1].

In this project I have created a family of quantum spin chain networks that allow for highly accurate and secure transfer of quantum information over arbitrary distances. The time required to achieve the state transfer is exponentially smaller than current literature values. These networks are the first known case of Almost Perfect State Transfer (APST) working over large distances in short time, and could have an impact on many quantum information systems. Furthermore, these networks provide us with a mathematical basis to develop a deeper understanding of how APST works.

References

[1]Luc Vinet, Alexier Zhedanov, *Almost perfect state transfer in quantum spin chains*, 19 November 2012, Physical Review **A 86**, 052319 (2012), pg 1-3

[2]Ruben Sousa, Yasser Omar, *Pretty good state transfer of entangled states through quantum spin chains*, 13 Jun 2014, arXiv:1405.1296v2[quant-ph]