Optical resonators constitute a universal spin simulator

W. Verstraelen [*], **T.C.H. Liew**

Majulab, International Joint Research Unit UMI 3654, CNRS, Université Côte d'Azur, Sorbonne Université, National University of Singapore, Nanyang Technological University, Singapore, Singapore 117543
Division of Physics and Applied Physics, School of Physical and Mathematical Sciences, Nanyang Technological University, Singapore 637371, Singapore

A promising approach to solve computationally complex (NP-hard) problems efficiently is through analog simulation of frutrated spin Hamiltonians with optics and polaritonics [3, 4]. For many of these problems, the mapping to the specific spin confituration is known [5]. If a simulator is constructed to represent a specific spin Hamiltonian, it will lose the flexibility to solve many subsequent tasks.

Here, we introduce a *universal* simulator [1] that has a fixed geometry but can nonetheless tackle any problem (up to certain size). It is based on the earlier setup to eliminate amplitude heterogeneity [2], by using resonators or micropillars in a chain and feedback. While it is well known that the 2D Ising model on a square lattice is universal, it would create an immense overhead [6]. The current simulator instead represents a linear Ising chain with effective nonlocal interactions. We show by explicit example how this simulator can solve traveling salesman and other problems.

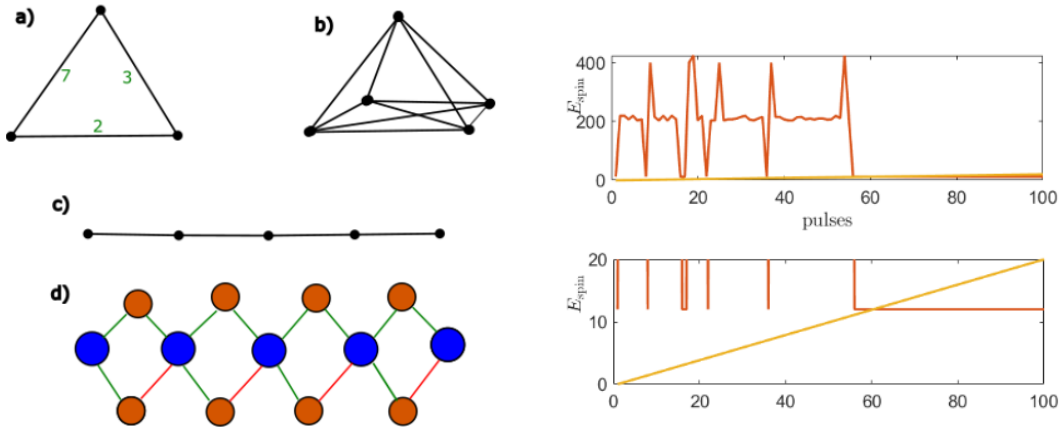

Figure 1: Left: the traveling salesman problem in geometry a) is equivalent to high-dimensional Ising graph b). We can represent it as a chain c) however, with a geometry in micropillars depicted in d). Right: The simulator samples configurations during pulses, until it converges to the solutin at lowest Energy.

References

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*E-mail: verstraelenwouter@gmail.com