Programmable superpositions of Ising configurations

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In this talk I will present a framework that allows one to prepare superpositions of bit strings, i.e., many-body spin configurations, with deterministic programmable probabilities[1]. The spin configurations are encoded in the degenerate ground states of the lattice-gauge representation of an all-to-all connected Ising spin glass[2]. In this model, the ground state manifold is invariant under variations of the gauge degrees of freedom, which take the form of four-body parity constraints. The protocol allows one to make use of these degrees of freedom to prepare programmable superpositions by quantum simulation of a transverse Ising model. The dynamics combines an adiabatic protocol with controlled diabatic transitions. I will present an effective model that allows one to determine the control parameters efficiently even for system sizes that cannot be simulated on a classical computer.
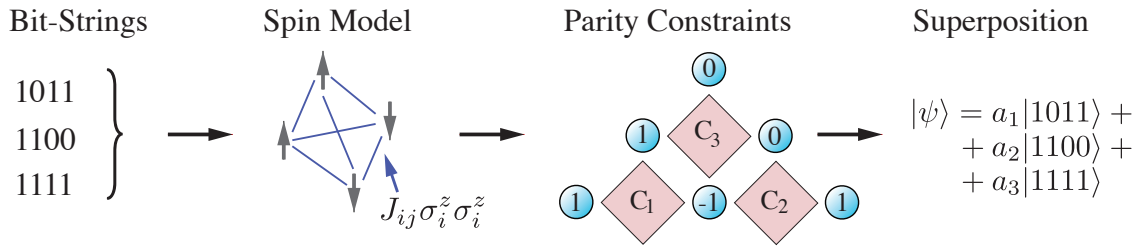
Figure 1. Illustration of the protocol that takes arbitrary bit-strings as input and puts out a superposition of these data with programmable amplitudes.

[1] L. M. Sieberer and W. Lechner, arXiv:1708.02533 (2017).
[2] W. Lechner, P. Hauke, and P. Zoller, Science Advances **1**, 1500838 (2015).