



Department of  
Theoretical Physics

# THE QUANTUM SPACETIME SEMINAR SERIES

## A theorem on extensive ground state entropy, spin liquidity and some related models

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Zoom link shall be shared separately



The physics of the paradigmatic one-dimensional transverse field quantum Ising model is well-known. Instead, let us imagine "applying" the transverse field via a transverse Ising coupling of the spins to partner auxiliary spins. If each spin of the chain has a unique auxiliary partner, then the resultant eigenspectrum is still the same as that of the quantum Ising model and the degeneracy of the entire spectrum is exponential in system size. We can interpret this as the auxiliary spins remaining paramagnetic down to zero temperature and an extensive ground state entropy. This follows from the existence of extensively large and mutually anticommuting sets of local conserved quantities. Such a structure will be shown to be not unnatural in the class of bond-dependent Hamiltonians. This thus forms the basis for an exact statement on the existence of extensive ground state entropy in any dimension. Furthermore this structure can be used to prove spin liquidity non-perturbatively in the ground state manifold. Higher-dimensional quantum spin liquid constructions based on this are given which may evade a quasiparticle description. Also by analogy with the Sachdev-Ye-Kitaev fermionic model, one may speculate if the above spin Hamiltonians saturate the quantum chaos bound of Maldacena-Shenker-Stanford and possibly have connections to quantum gravity as discussed in the final outlook section of [arxiv:2407.06236](https://arxiv.org/abs/2407.06236).