Symmetry protection of topologically trivial phases in quantum spin chain

Yohei Fuji *Institute for Solid State Physics, University of Tokyo*

SPT phase

Gapped
Symmetric
No fractionalization

Haldane phase
Quantum spin Hall state
Topological insulator…

Gapless edge excitation
Nontrivial entanglement structure

Interesting, but NOT necessary

Symmetry-protected **topological** phase

Symmetry-protected **trivial** phase

Our case

Trivial in the sense of direct-product state

$$H = \sum_i \left[\vec{S}_i \cdot \vec{S}_{i+1} + D_z (S_i^z)^2 + h_z (-1)^i S_i^z + d_x (S_i^y S_{i+1}^z - S_i^z S_{i+1}^y) \right.$$

$|+-+-\cdots\rangle$ and $|0000\cdots\rangle$ are distinguished only by **site-centered inversion** combined with spin rotation.

Method:
Bosonization
Matrix-product state
Numerics