Random singlets and permutation symmetry in higher-spin Heisenberg chains

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We explore the effects of randomness and dimerization in the S=1, S=3/2, and S=2 Heisenberg antiferromagnetic chains using a tensor network renormalization group method adapted from the strong-disorder renormalization group [1, 2]. We systematically vary bond randomness and dimerization to calculate dimer order parameters, string-order parameters, and spin correlations. This allows us to classify distinct random valence-bond solid phases and identify critical phase boundaries governed by permutation-symmetric fixed points [3, 4].

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