Forschungszentrum Karlsruhe
Technik und Umwelt

Two Aspects of Correlations in Spin-Chains: Breakdown of Universality in Random-Exchange $S = \frac{1}{2}$ XXZ Chains and Results for dimerized 2D-Heisenberg-Systems

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Breakdown of Universality

Hamiltonian:

$$H = J \sum_{i=1}^{N-1} \left[\lambda_i (S_i^x S_{i+1}^x + S_i^y S_{i+1}^y) + \Delta S_i^z S_{i+1}^z\right]$$

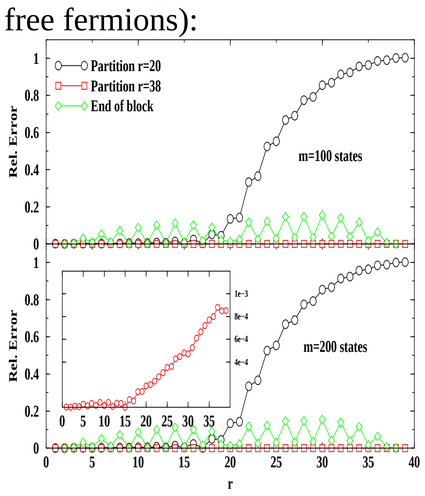
λ_i random: $1 - w \leq \lambda \leq 1 + w$

$w = 0$: critical groundstate[3]

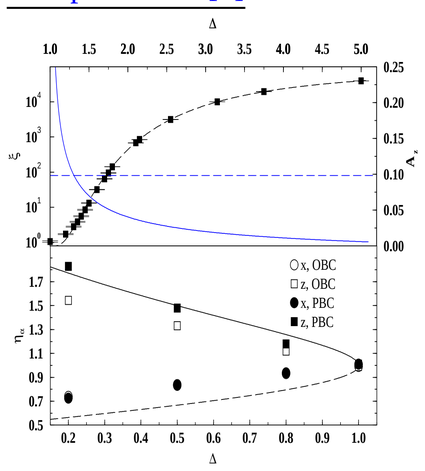
RSRG and *random-singlet* phase [1]:
Average correlation in the *random-singlet* phase:

$$|\overline{\langle S_i^\alpha S_j^\alpha \rangle}^{\text{conf}}| \sim |i-j|^{-2} \qquad (\alpha = x,y,z)$$

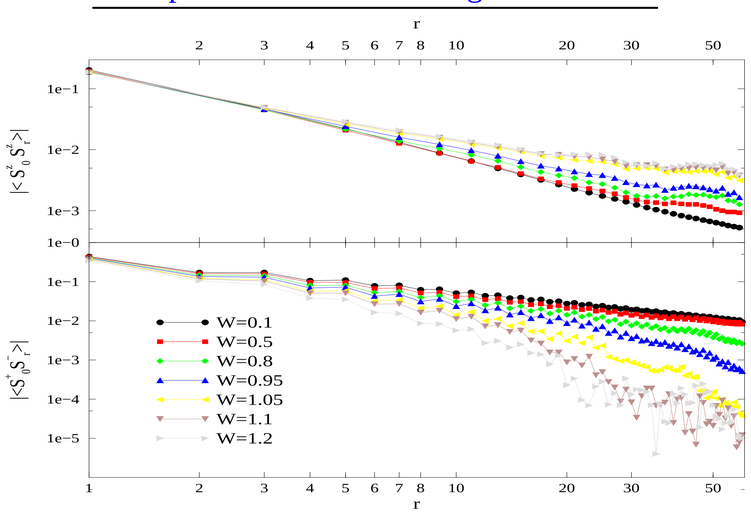
Strategies for computation of expectation values?
Comparison to $w = 0, \Delta = 0$ case (Jordan-Wigner transformation and free fermions):



Comparison to [3]

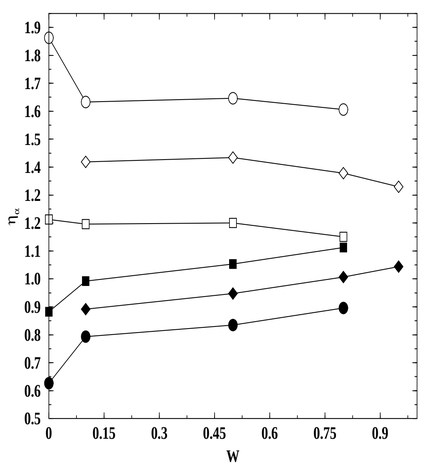


Examples of random-exchange correlations

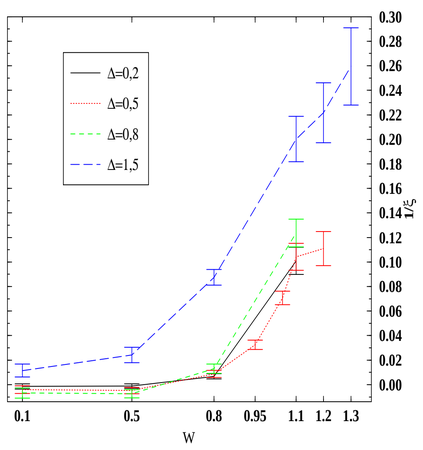


Are the exponents really universal?
What values do we get for the η_α ?

$$|\overline{\langle S_i^\alpha S_j^\alpha \rangle}^{\text{conf}}| \sim |i-j|^{-\eta_\alpha} \qquad (\alpha = x,y,z)$$

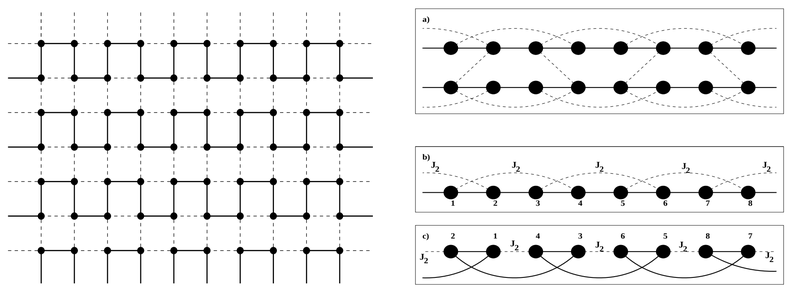


A quantum phase transition

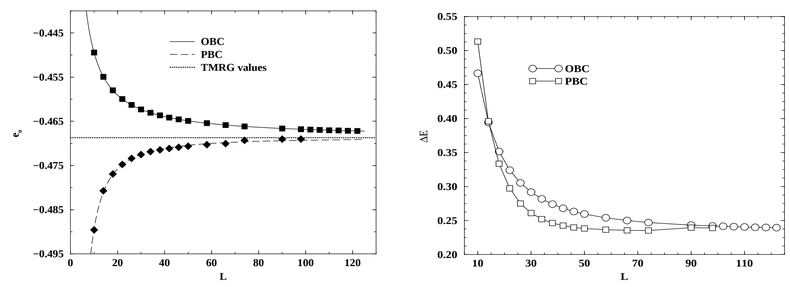


2D dimerized Heisenberg systems

One topological representation



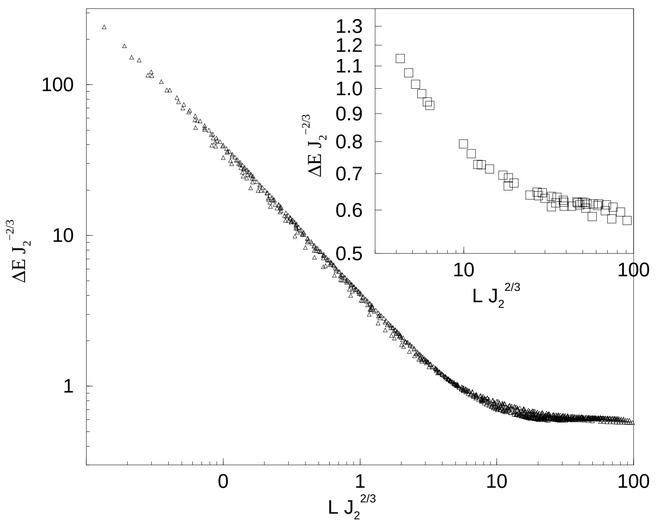
Reproduction of values from an extrapolation $T \to 0$ of TMRG-values:



Values ($J_2 = 0.25$)	TMRG	DMRG(OBC)	DMRG(PBC)
Groundstate-energy per spin	-0.468709	-0.46843	-0.46841
Gap	0.212	0.238342	0.236522

Comparison with RG

Prediction of the RG[2]: $\Delta E \sim J_2^{\frac{2}{3}}$
Reproduction by 862 different (L, J_2) combinations



Acknowledgments & Contact

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[3] Luther and Peschel, Phys. Rev. B, **12**(1975)3908 and R.J. Baxter, J. Stat. Phys., **9**(1973)145