Poster 13

Dimensional crossover in strongly-interacting weakly-coupled chains

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We study the dimensional crossover that occurs in systems made of weakly-coupled one dimensional chains in presence of interactions U. We separately consider hard-core bosons (repulsive interaction) and spinful fermions (attractive interaction). We show that the excitation gap, due to the transverse coupling, scales as the critical temperature, therefore the ratio is constant and completely controlled by the only Luttinger parameter K [1]:

$$\frac{\Delta(T=0)}{k_b T_c} = f(K) \tag{1}$$

The results are in very good agreement with numerical simulations which combine numerical matrix product state (MPS) methods with mean-field (MF) theory.

Furthermore, we show how the results are also in good agreement with QMC data [2] which well simulate an experimental realisation of ultracold atoms undergoing a dimensional crossover [3].

[1] Gunnar Bollmark, Thomas Köhler, Lorenzo Pizzino, Yiqi Yang, Johannes S. Hofmann, Hao Shi, Shiwei Zhang, Thierry Giamarchi, and Adrian Kantian, Physical Review X **13**, 011039 (2023).

[2] Hepeng Yao, Lorenzo Pizzino, Thierry Giamarchi, and Adrian Kantian, SciPost Phys. **15**, 050 (2023).

[3] Yanliang Guo, Hepeng Yao, Satwik Ramanjanappa, Sudipta Dhar, Milena Horvath, Lorenzo Pizzino, Thierry Giamarchi, Manuele Landini, and Hanns-Christoph Nägerl, arXiv:2308.00411 (2023).