

**Zeros of the Dispersion Relation of the Elementary
Excitation and the Correlation Length of Strongly
Correlated Quantum Systems**

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We argue that the imaginary part of a zero of the dispersion relation of the elementary excitation of quantum systems is equal to the inverse correlation length. We confirm the relation for the Hubbard model[1] in the half-filled case; it has been confirmed only for the S=1/2 antiferromagnetic XXZ chain[2]. In order to search zeros of the dispersion relation in the complex momentum space efficiently, we introduce a non-Hermitian generalization of quantum systems by adding an imaginary vector potential ig to the momentum operator[3]. We also show for the half-filled Hubbard model the reason why the non-Hermitian critical point[4] is equal to the inverse correlation length[5] by noting the dispersion relation of the charge excitation.

- [1] Y. Nakamura and N. Hatano, in preparation.
- [2] K. Okunishi, Y. Akutsu, N. Akutsu and T. Yamamoto, Phys. Rev. B 64 (2001) 104432.
- [3] Y. Nakamura and N. Hatano, Physica B 378-380 (2006) 292; J. Phys. Soc. Jpn. 75 (2006) 114001.
- [4] T. Fukui and N. Kawakami, Phys. Rev. B 58 (1998) 16051.
- [5] C. A. Stafford and A. J. Millis, Phys. Rev. B 48 (1993) 1409.