Partial yet definite emergence of the Kardar-Parisi-Zhang class in isotropic spin chains

(Session 3, Oral)

Kazumasa A. Takeuchi[1,2]

1 Department of Physics, The University of Tokyo

2 Institute for Physics of Intelligence, The University of Tokyo

I will discuss connections between the following, apparently unrelated topics in condensed matter physics, first pointed out by Prosen and coworkers [1]: the Kardar-Parisi-Zhang (KPZ) universality class for non-equilibrium phenomena such as growing interfaces and equilibrium spin fluctuations of integrable isotropic spin chains such as the isotropic Heisenberg model. First, I will briefly review the main outcomes of studies of exact solutions to the KPZ class and corresponding experiments using liquid crystal turbulence, emphasizing characteristic distribution and correlation properties [2]. These will be compared, in the second half, with anomalous transport properties of equilibrium spins in integrable isotropic spin chains. Although the connection to the KPZ class was most recently questioned by full counting statistics for classical and quantum spin chains [3], here, by combining simulations of an integrable classical spin chain and the framework of the exact studies on KPZ, we reveal that a variety of two-point quantities show full quantitative agreement with the KPZ class [4], despite disagreement in higher-order quantities. This establishes the partial yet definite emergence of the KPZ class in integrable isotropic spin chains. The main results [4] are based on collaboration with J. De Nardis, O. Busani, P. L. Ferrari, R. Vasseur.

References

[1] M. Ljubotina et al., Kardar-Parisi-Zhang Physics in the Quantum Heisenberg Magnet. Phys. Rev. Lett. **122**, 210602 (2019).

[2] For a review, see, e.g., K. A. Takeuchi, An appetizer to modern developments on the Kardar-Parisi-Zhang universality class. Physica A **504**, 77 (2018).

[3] Ž. Krajnik et al., Dynamical Criticality of Magnetization Transfer in Integrable Spin Chains. Phys. Rev. Lett. **132**, 017101 (2024); E.Rosenberg et al., Dynamics of magnetization at infinite temperature in a Heisenberg spin chain. Science **384**, 48 (2024).

[4] K. A. Takeuchi et al., Partial yet definite emergence of the Kardar-Parisi-Zhang class in isotropic spin chains. arXiv:2406.07150.