Stationary fluctuations in integrable spin chains and KPZ universality with boundaries

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KPZ universality, from Kardar, Parisi and Zhang, describes the dynamics of large scale fluctuations in a variety of settings, such as growing interfaces, one-dimensional classical and quantum fluids, or random geometry, which exhibit characteristic long range correlations generated by local interactions. In the past decade, it has become a prominent topic at the interface between non-equilibrium statistical physics and probability theory, with recent experimental observations in a few classical and quantum systems [1].

KPZ fluctuations have in particular been observed in integrable classical and quantum spin chains [2], in the early time regime where the correlation length is small compared to the system size. A goal of the proposed thesis would be to explore the longer time scale associated with the relaxation of fluctuations to a non-equilibrium stationary state, when correlations eventually span the whole system. There, KPZ fluctuations *in finite volume* [3], taking into account boundary effects responsible for the spin current flowing into the system, are expected [4].

From a technical point of view, tools from integrability will likely be a core part of the thesis, supplemented by numerical computations when needed. Depending on the direction taken by the thesis, topics related to combinatorics, Brownian paths or Riemann surfaces may be needed as well.

References

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[2] M. Ljubotina, M. Žnidarič, T. Prosen 2019 *Phys. Rev. Lett.* 122:210602.
   K.A. Takeuchi et al 2025 *Phys. Rev. Lett.* 134:097104.

[3] S. Prolhac 2024 *SciPost Phys. Lect. Notes* 81.

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