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Asymptotics for the lower tail of the KPZ equation

Abstract

Fredholm determinants associated to deformations of the Airy kernel are known to be closely connected to the solution to the Khardar-Parisi-Zhang (KPZ) equation with narrow wedge initial data, and they also appear as largest particle distribution in models of positive-temperature free fermions. It is of particular importance in these models to understand the lower tail of the Fredholmdeterminants.

We show that logarithmic derivatives of the Fredholm determinants can be expressed in terms of a $2\tilde{A}-2$ Riemann-Hilbert problem, and we use this to derive asymptotics for the Fredholm determinants. As an application of our result, we derive precise lower tail asymptotics for the solution of the KPZ equation with narrow wedge initial data, thus refining recent results by Corwin and Ghosal.