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Asymptotics of the Fredholm determinant corresponding to the first bulk critical universality class in random matrix models

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Abstract:

We study the one-parameter family of determinants $det(I-\gamma K_{PII}),\gamma\in\mathbb{R}$ of an integrable Fredholm operator K_{PII} acting on the interval $(-s,s)$ whose kernel is constructed out of the Ψ-function associated with the Hastings-McLeod solution of the second Painlev\'e equation. In case $\gamma=1$, this Fredholm determinant describes the critical behavior of the eigenvalue gap probabilities of a random Hermitian matrix chosen from the Unitary Ensemble in the bulk double scaling limit near a

quadratic zero of the limiting mean eigenvalue density. Using the Riemann-Hilbert method, we evaluate the large s-asymptotics of $\det(I-\gamma K_{PII})$ for all values of the real parameter γ.

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