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Gaussian Free Field on the Tree Subject to a Hard Wall

Tuesday, May 20, 2025 11:00 AM (1 hour)

We study the discrete Gaussian free field on the binary tree when all leaves are conditioned to be positive. We obtain sharp asymptotics for the probability of this "hard-wall constraint" event, and identify the repulsion profile followed by the field in order to achieve it. We then provide estimates for the mean, fluctuations and covariances of the field under the conditioning, which show that in the first log-many generations the field is super-exponentially tight around its mean. These results are then used to obtain a comprehensive, sharp asymptotic description of the law of the field under his conditioning. We provide asymptotics for both local statistics, namely the (conditional) law of the field in a neighborhood of a vertex, as well as global statistics, including the (conditional) law of the minimum, maximum, empirical population mean and all subcritical exponential martingales. We conclude that, even in a local sense, the recentered repelled field is asymptotically not the unconditional field, thereby resolving an open question of Velenik from 2006, albeit in the analogous case of the tree.

Joint work with Maximilian Fels (Technion) and Lisa Hartung (Mainz).

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