Mathematical Physics

Sharp asymptotics for Toeplitz determinants, fluctuations and the gaussian free field on a Riemann surface

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We consider canonical determinantal random point processes with N particles on a compact Riemann surface X defined with respect to the constant curvature metric. In the higher genus (hyperbolic) cases these point processes may be defined in terms of automorphic forms. We establish strong exponential concentration of measure type properties involving Dirichlet norms of linear statistics. This gives an optimal Central Limit Theorem (CLT), saying that the fluctuations of the corresponding empirical measures converge, in the large N limt, towards the Laplacian of the Gaussian free field on X in the strongest possible sense. The CLT is also shown to be equivalent to a new sharp strong Szeg\"o type theorem for Toeplitz determinants in this context. One of the ingredients in the proofs are new Bergman kernel asymptotics providing exponentially small error terms in a constant curvature setting.

Comments:	v1: 15 pages, v2: 21 pages, added new Bergman kernel asymptotics with exponentially small error terms
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