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Recurrence of planar graph limits

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We prove that any distributional limit of finite planar graphs in which the degree of the root has an exponential tail is almost surely recurrent. As a corollary, we obtain that the uniform infinite planar triangulation and quadrangulation (UIPT and UIPQ) are almost surely recurrent, resolving a conjecture of Angel, Benjamini and Schramm.

We also settle another related problem of Benjamini and Schramm. We show that in any bounded degree, finite planar graph the probability that the simple random walk started at a uniform random vertex avoids its initial location for T steps is at most $C/\log T$.

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