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Random Harmonic Functions

Which Cayley graphs G admit a random harmonic function with translation-invariant law that is not an almost sure constant? Such a function must have infinite first moment. We show that G admits such a random harmonic function with multivariate Cauchy marginals, if and only if G admits a nonconstant deterministic bounded harmonic function. The proof is by integrating a Cauchy white noise with respect to harmonic measure on the Poisson boundary. Joint work with Alexander Holroyd and Mathav Murugan.