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Disordered charged horizons

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We present a bottom-up model for the holographic dual of 2D and 3D strongly interacting systems with a disordered chemical potential along one spatial direction. On the gravity side, we introduce disorder through a space-dependent source for a U(1) gauge field sampled from a Gaussian white noise distribution; we ensure the disorder is Harris-relevant. At high temperatures, we observe disordered charged horizons. We find distinct behaviours for the two cases after lowering the temperature while remaining within the disordered regime. In the AdS_3 scenario, contrary to the expectation from the Harris criterion, inhomogeneities at the horizon die off as the temperature decreases, leading to the clean IR fixed point. Conversely, in the AdS_4 case, we propose that the dual theory flows to an inhomogeneous IR fixed point with finite conductivity. The average geometry of the inhomogeneous IR coincides with the clean fixed point.

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