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Influence of intrinsic disorder on the critical slowing down of the charge carrier dynamics at the Mott metal-insulator transition in κ-(BEDT-TTF)$_2$X

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The quasi-2D organic charge-transfer salts κ-(ET)$_2$X are considered as model systems for studying the Mott metal-insulator transition (MIT) in reduced dimensions. Both the nature of the static and dynamic criticality of the Mott transition and the influence of disorder on the MIT recently have been in the focus of intense experimental and theoretical efforts. By means of fluctuation (noise) spectroscopy as a powerful new tool to study these materials, for the first time, we have observed a pronounced and sudden slowing down of the carrier dynamics near the finite-temperature critical endpoint (p_0/T_0) of the Mott transition, which may be a universal feature of MITs, irrespective of the dimensionality of the electronic system [1]. In these experiments, the low-frequency noise power spectral density of the resistance/conductance fluctuations of fully deuterated κ-(D$_8$-ET)$_2$Cu[N(CN)$_2$]Br exhibits a strong increase near T_0 accompanied by a substantial shift of spectral weight to low frequencies. In this work, we present a comprehensive investigation of the glass-like structural kinetics of the ET molecules' ethylene endgroups, which is related to a controllable disorder potential influencing the electronic ground state properties strongest in the vicinity of the Mott transition. We utilize the possibility to reversibly tune the degree of disorder by employing different cooling rates in partially deuterated κ-[(H$_8$-ET)-0.2(D$_8$-ET)$_{0.8}$]$_2$Cu[N(CN)2]Br, which is located very close to p_0, i.e. in the critical region of the generalized phase diagram. We report on a striking near divergence of the low-frequency resistance fluctuations at T_0 for a slow cooling rate and discuss our systematic studies of the influence of disorder on the low-frequency critical dynamics of the charge carriers.

[1] J. Brandenburg, J. Müller, J.A. Schlueter, *New J. Phys.* **14**, 023033 (2012).