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Carrier-number fluctuations in the 2-dimensional electron gas at the $LaAlO_3/SrTiO_3$ interface

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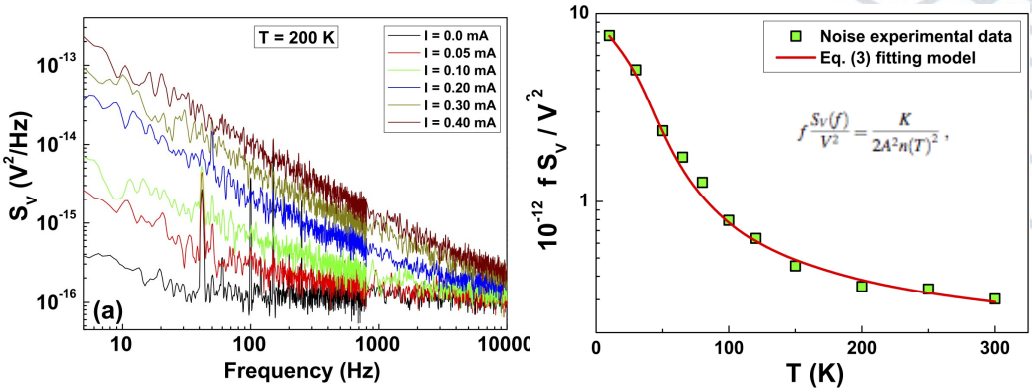
The voltage-spectral density $S_V(f)$ of the 2-dimensional electron gas formed at the interface of $LaAlO_3/SrTiO_3$ has been thoroughly investigated. The low-frequency component has a clear 1/f behavior with a quadratic bias current dependence, attributed to resistance fluctuations. However, its temperature dependence is inconsistent with the classical Hooge model, based on carrier-mobility fluctuations. The experimental results are, instead, explained in terms of carrier-number fluctuations, due to an excitation-trapping mechanism of the 2-dimensional electron gas.



(Left) Voltage spectral traces at 200 K and for different bias currents.(Right) Normalized noise level fS_V/V^2 vs. T (dots). Red solid curve is the fitting function given in the inset.

The experimental findings support the existence of a thermally activated mechanism which promotes charge carriers from a narrow, underlying band (attributed to polarons or to Anderson-localized states), to the conduction band. The low-frequency Flicker noise spectra have pure 1/f dependence, with a I^2 scaling, allowing the attribution of the noise to resistance fluctuations. The noise level dependence on temperature cannot be consistently explained in terms of the classical Hooge picture. It is, instead, shown that a model based on the fluctuation of the carrier number describes correctly the experimental observations.