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Noise and Fluctuations in Circuits, Devices, and Materials

Massimo Macucci
Lode K. J. Vandamme
Carmine Ciofi
Michael B. Weissman
Editors

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Introduction

As device dimensions are scaled down the importance of fluctuations and noise is rapidly increasing as a result of the inherent degradation of the signal-to-noise ratio. Indeed smaller devices are characterized by reduced currents, yet while the useful signal power scales with the square of the current, the shot noise power spectral density scales only linearly with the current. Therefore in future generations of devices shot noise resulting from the granularity of charge carriers is poised to become dominant over the signal unless ingenious solutions are devised and implemented.

Noise is not always an undesired effect disrupting the operation of a device or the acquisition of data; it can also be an asset. It can be exploited to increase the sensitivity in several types of measurements, can be used to probe physical properties that may be elusive otherwise, and can represent the basis for novel schemes of secure communication.

Noise is not only important from the point of view of applications but also from that of basic research because its origin is often deeply intertwined with fundamental phenomena. Therefore it prompts the development of new theories while offering opportunities for their experimental verification.

In this conference on Noise and Fluctuations in Circuits, Devices, and Materials, participants have had an opportunity to interact on aspects of noise research which have few points of contact or exchanges of information elsewhere. As a result bridges have been built on the basis of observations that some techniques are of more general applicability and that there is a continuum of open issues going from materials to devices and then to circuits.

The contributions in these proceedings cover all of the above-mentioned aspects of noise, including a wide range of approaches from basic theory to specific applications, thus demonstrating how lively and active this field of research currently is.

Massimo Macucci