All that glitters is not gold

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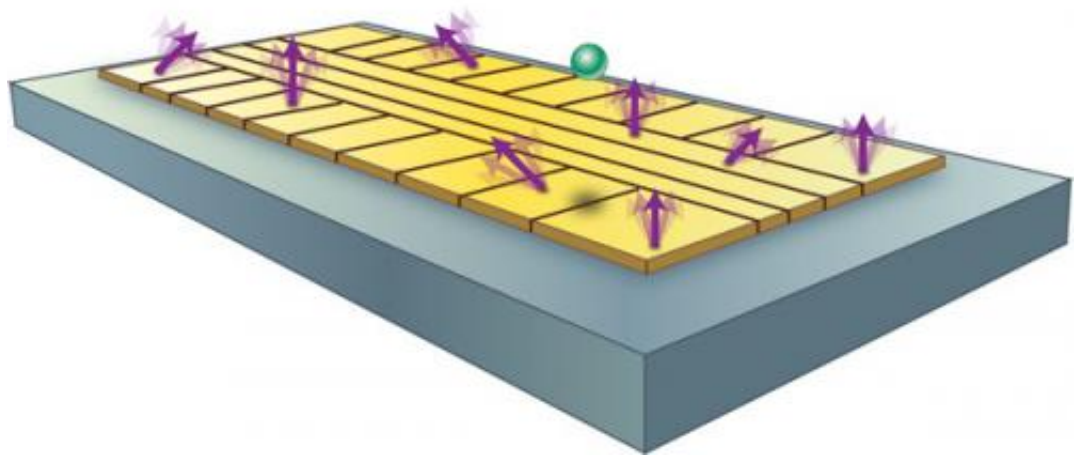

A schematic picture of a metal surface used in, for example, advanced detectors or quantum computers. New analysis has found that the excess noise levels seen in metal surfaces is caused by the thermal vibration of impurity atoms adsorbed onto the surface, shown here as purple arrows. (The green ball represents an ion - part of the electrical device's operational mechanism - that has been intentionally placed on the surface. Credit: Physics Magazine

(PhysOrg.com) -- Researchers developing key new technology electronics like quantum computing or advanced detectors, as well as those studying basic material science and metal surface properties, often find their experiments plagued by excess electrical noise arising from the surfaces of metals in their equipment, a kind of distracting surface glitter.

Scientists know that some electrical noise is the unavoidable

consequence of many electrons moving in metal surfaces, but in practice the measured noise levels can be tens of times stronger, hindering progress in research and development. A main reason why it has been difficult to reduce the noise to fundamental levels is that the source of the excess noise has been a mystery.

Over the years scientists have tested a variety of models of the noise, for example involving interfaces between materials in the surfaces, but without success.

Two CfA scientists, Arghavan Safavi-Naini and Hossein Sadeghpour, along with two colleagues, have now convincingly identified the pervasive culprit: impurity atoms adsorbed onto the surfaces of the metals. They show that small motions of these impurities, caused by ordinary thermal effects, can give rise to varying electrical fields that can in turn produce the observed levels of excess noise. The new paper is important in at least two respects.

First, it provides a detailed mechanism to explain the excess electric field noise observed, and second, the model gives clear guidance on how to reduce at least some of that excess noise. If those latter steps are successful, scientists can improve the performance of a wide range of high technology electrical components.

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