Bar Ilan University , Colloquium

Prof. Itamar Procaccia

Dept. of Chemical Physics, Weizmann Institute

Physics Department (Building 202), room 301

Statistical Physics of Pure Barkhausen Noise

Abstract:
We discuss a model metallic glass in which Barkhausen Noise can be studied in exquisite detail, free of thermal effects and of the rate of ramping of the magnetic field. The mechanism of the jumps in magnetic moment that cause the Barkhausen Noise can be fully understood as consecutive instabilities where an eigenvalue of the Hessian matrix hits zero, leading to a magnetization jump Δm which is simultaneous with a stress and energy changes $\Delta \sigma$ and ΔU respectively. Contrary to common belief we find no ``movements of magnetic domain boundaries'' across pinning sites, no fractal domains, no self-organized criticality and no exact scaling behaviour. We present a careful analysis of the statistical properties of the phenomenon, and show that with every care taken this analysis is tricky, and easily misleading. Without a guiding theory it is almost impossible to get the right answer for the statistic of Barkhausen Noise. We therefore present an analytic theory, showing that the probability distribution function (pdf) of Barkhausen Noise is not a power law times an exponential cutoff. On the basis of the theory we explain why standard methods to extract the form of the pdf are likely to fail, as indeed happened until now.