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DK Seminar

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The Touchdown Singularity in Models of Micro-Electro Mechanical Systems (MEMS)

Micro-Electro Mechanical Systems (MEMS) are very small structures that combine electrical and mechanical components on a common substrate to perform a variety of tasks. Due to their importance in various fields such as medicine, transport industry and technology MEMS have been studied intensively. Mathematical modeling and analysis have been successfully employed in the design and improvement of these devices. The aim of this talk is to give a general introduction to the topic and then focus the attention on a specific type of device (electrostatic-elastic). In the standard model, the dynamics of a thin membrane under the influence of elastic and electrical forces is described by a parabolic PDE with a particular nonlinear source term. Special attention will be given to the so-called touchdown phenomenon, leading to unbounded electric field. Mathematically, touchdown causes non existence of steady states and/or finite time blow-up of solutions. We present a recent more detailed model depending on a small regularization parameter ε in which the singularities are avoided by considering additional insulating effects. Its interesting dynamics and bifurcation structure have been studied numerically and by formal asymptotic methods. The main difficulty is that close to touchdown the problem depends singularly on two parameters. Our future goal is a rigorous analysis of these phenomena by means of dynamical systems methods.