

# Role of microscopic quenched disorder in macroscopic stability

## Opportunity

Fluctuations or disorder can be of different types: thermal annealed, usually invoked in stability considerations, and quenched. It is the last one that in particular adds some much needed realism to thermodynamic models of (meta)stability of various nanostructures.

## Meso Challenge

The challenge is to understand and describe quenched disorder effects without really knowing their seldom available microscopic Hamiltonian. Quenched disorder is usually related to the mesoscale because its phenomenological description by necessity spans all scales above the microscopic one.

References:

Ali Naji, Jalal Sarabadani, David S. Dean, Rudolf Podgornik, Sample-to-sample torque fluctuations in a system of coaxial randomly charged surfaces, *Eur. Phys. J. E* 35, 24 (2012)

David S. Dean, Ali Naji and Rudolf Podgornik, Sample-to-sample fluctuations of electrostatic forces generated by quenched charge disorder, *PRE* 83, 011102 (2011).

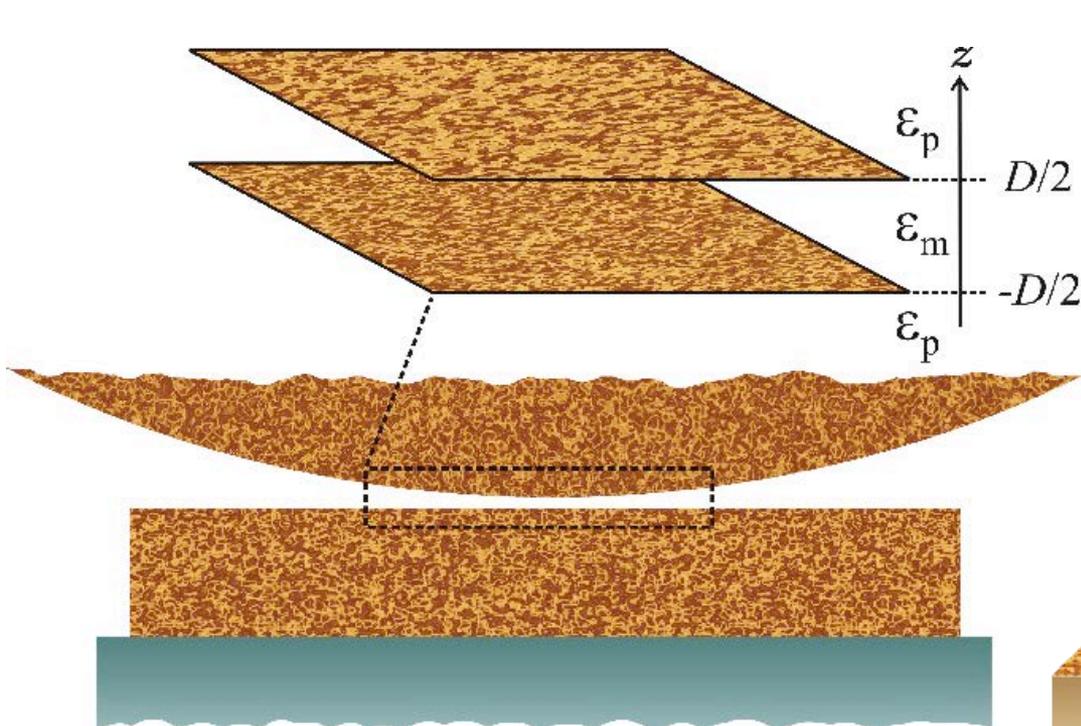
## Approach

Formulate the formation free energy of a quintessential nanoobject and investigate the role of quenched disorder on its stability. Tools and techniques stemming from disordered systems theory would need to be developed and extended for this undertaking.

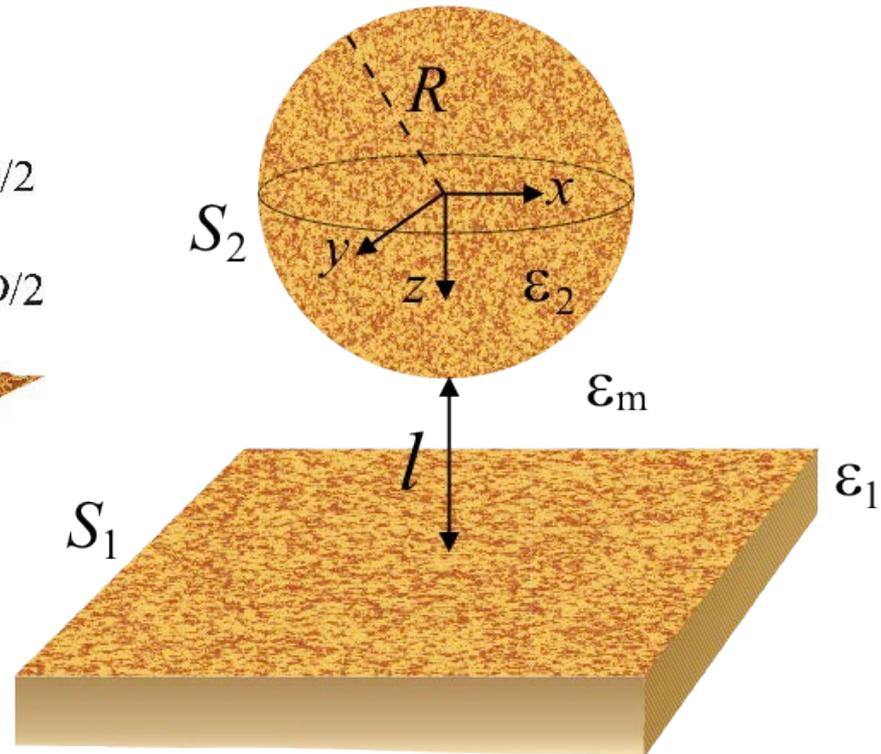
## Impact

Impact is both fundamental and applied: quenched, and thus poorly controlled, disorder is always present (one batch differs from the next one) but almost never incorporated into the understanding of stability. Our proposal would rectify this long overdue upgrade of theoretical framework. It would allow our scientific understanding to apply to realistic, real world systems, beyond the currently tractable idealized systems.

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Interactions between bodies with dielectric properties- and charge-disorder – disorder-generated forces



Interactions between bodies with dielectric properties- and charge-disorder – disorder-generated torques

Generalize to other types of structural quenched disorder and assess the stability properties of the free energy