אוניברסיטת בן-גוריון בנגב
Ben-Gurion University of the Negev

**The Physics Department announces**
**A series of lectures, given by the Distinguished visiting professor**

# Robert Shekhter

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**<u>November 7, 15:30: Physics Colloquium</u>:**

## "Spintro-Mechanics of Single-Electronic Nanostructures"

A new perspective on nano-electro-mechanics opens up if one considers how the electronic spin - in addition to (or instead of) the electronic charge - couples to mechanical degrees of freedom [1, 2]. Such a possibility naturally occurs if magnetic materials are employed to build nano-mechanical devices. Nano-mechanics induced by magnetic exchange forces become possible as a result of spin-mechanical coupling. This talk presemts a short review of recent theoretical results illustrating the above mentioned phenomena in magnetic shuttle devices.

1. 1. R. I. Shekhter, L. Y. Gorelik, I. V. Krive, M. N. Kiselev, A. V. Parafilo, and M. Jonson, Nonoelectromech. Systems **1**, (2013).
2. R. I. Shekhter, A. Pulkin, and M. Jonson, Phys. Rev. **B 86**, 100404(R) (2012).

**<u>November 4, 11:30: Condensed Matter Seminar:</u>**

## "Mechanically Assisted Transport of Electrons in Highly Deformable devices (polaronic approach)"

Coupling between electronic and mechanical degrees of freedom in nano-electro-mechanical (NEM) devices is considered beyond the weak coupling limit. New device operations caused by polaronic NEM coupling are suggested for suspended

nanowire-based electric weak links. Those are a) mechanically induced magneto conductance of 1D nanowire, and b) effect of mechanically controlled spin-splitting of electronic waves caused by Rashba interaction in a bended nanowire [1, 2].


1. R.I.Shekhter, L.Y.Gorelik, L.I.Glazman & M.Jonson, PRL **97**, 156801 (2006).
2. R.I.Shekhter, O.Entin-Wohlman & A.Aharony, arXiv:1306.5125v1 21 Jun 2013.


## October 30 & November 6, 13:30:

## "A mini-course on Mesoscopic Nano-Electro-Mechanics (NEM)".

### Lecture 1. : "Mechanically Assisted Single-Electronics".

This lecture will present a short introduction into the history of single-electronics, as well as examples of NEM experimental Set-Up's. Tunneling of electrons through a Coulomb dot, which vibrates in-between electronic source and drain electrodes (leads) (NEM–SET device) will be considered. The classical theory of NEM instability, which develops into a pronounced self-supported vibration of the dot, accompanied by inter-lead mechanical transportation (shuttling) of single electrons, will be discussed.

### Lecture 2. : "Quantum Nano-Electro-Mechanics".

The quantum approach to the description of both electronic and vibrational degrees of freedom of a NEM-SET device will be developed. The main result of this approach is the conclusion that quantum fluctuations of the mechanical displacement do not destroy shuttle instability (introduced in Lecture 1). Mechanically induced quantum interference of electrons will be demonstrated.

### Lecture 3. : "Mechanically Assisted Superconductivity".

This lecture is devoted to superconducting properties of the NEM-SET device (which was introduced and discussed in Lectures 1,2). The first part discusses the

basic facts concerning the phenomenon of superconductivity and especially to weak superconductivity. Thesecond part presents a theory of “mechanical transportation” of superconducting Cooper pairs, allowing the mechanically assisted supercurrent flow through NEM-SET device.

## Bsckground Materials for the mini-course can be found in the reviews:

1. R.I.Shekhter, L.Y.Gorelik, I.V.Krive, M.N.Kiselev, A.V.Parafilo & M.Jonson, Nanoelectromechanical Systems**, 1**, 1 (2013).

**2.** R. I. Shekhter, Y. M. Galperin, L. Y. Gorelik, A. Isaksson, and M. Jonson, J. Phys.: Condens. Matter **15**, R441 (2003).