Faculty

The Theoretical Groups

- Ady Stern, Quantum Electronic Phenomena
- Ehud Altman, Quantum condensed Matter
- Yehoshua Levinson, Semiconductor Physics
- A. Finkel'stein, Condensed Matter Physics
- Yuval Gefen, Nanophysics and Spintronics
- Yuval Oreg, Confined Correlated Electrons
- Shimon Levit, Condensed Matter Physics

The Experimental Groups

- Dan Shahar, Low Temperature
- Eli Zeldov, Superconductivity
- Israel Bar-Joseph, Optical Spectroscopy
- Shahal Ilani, Nanoelectronics
- Motty Heiblum, Transport

Submicron Center

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Dr. Diana Mahalu
Eng. Olga Raslin

With the support of:
Eng. Yoram Rotblat
Typical Scientific Projects
Observation of neutral modes in the fractional quantum Hall regime

Aveek Bid, N. Ofek, H. Inoue, M. Heiblum, C. L. Kane, V. Umansky & D. Mahalu

Affiliations | Contributions | Corresponding author

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Abstract

The quantum Hall effect takes place in a two-dimensional electron gas under a strong magnetic field and involves current flow along the edges of the sample. For some particle-hole conjugate states of the fractional regime (for example, with fillings between 1/2 and 1 of the lowest Landau level), early predictions suggested the presence of counter-propagating edge currents in addition to the expected ones. When this did not agree with the measured conductance, it was suggested that disorder and interactions would lead to counter-propagating modes that carry only energy—the so-called neutral modes. In addition, a neutral upstream mode (the Majarana mode) was expected for selected wavefunctions proposed for the even-denominator filling 5/2. Here we report the direct observation of counter-propagating neutral...
Self-assembly of metallic double-dot single-electron device

FIG. 1. (Color online) (a) Scanning electron microscope image of the double-dot device. The dimer, which is composed of 17 nm NPs, is aligned in series with the lead electrodes (L and R). (b) A sketch of the dimer and leads region, showing the capping layers and the linker molecule. (c) Gel matrix loaded with 34 nm NPs’ solution that includes the linker molecule (right) and a corresponding control (left).
Quantum phenomena in small systems, such as carbon nanotubes and graphene. Study of quantum behavior in highly-controlled settings, including:

- Physics of electrons in one and two dimensions
- Imaging of quantum phenomena on atomic scales
- Single-spin quantum manipulation

Dr Shahal Ilani

Dr Hadas Strikman

• GaAs and InAs nano wires
Collaborations with other Centers/Universities
International Programs
Dephasing time of GaAs electron-spin qubits coupled to a nuclear bath exceeding 200 µs

Hendrik Bluhm, Sandra Foletti, Izhar Neder, Mark Rudner, Diana Mahalu, Vladimir Umansky & Amir Yacoby

Affiliations

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Qubits, the quantum mechanical bits required for quantum computing, must retain their quantum states for times long enough to allow the information contained in them to be processed. In many types of electron-spin qubits, the primary source of information loss is decoherence due to the interaction with nuclear spins of the host lattice. For electrons in gate-defined GaAs quantum dots, spin-echo measurements have revealed coherence times of about 1 µs at

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Diana Mahalu & Vladimir Umansky

Contributions
Electron-beam lithography and molecular-beam-epitaxy growth were carried out by D.M. and V.U., respectively. H.B., S.F. and A.Y. fabricated the sample, planned and executed the experiment and analysed the data. I.N., M.R., H.B. and A.Y. developed the theoretical model. H.B., S.F., I.N., M.R. and A.Y. wrote the paper.

Professor Yacoby is an experimental condensed matter physicist. His current research interests are focused on unraveling the underlying phenomena governing low dimensional systems. Starting with two dimensional electron systems, the group uses novel scan probe techniques that are capable of detecting electric charge with a resolution of 10–4 of one electron and spatial resolution of 100 nm. This technique enables them to image the distribution of electrons and the way they localize in space in various material systems such as gass or single monolayers of graphene as well as under various ground state conditions such as the integer and fractional quantum Hall effect. Of particular interest is the 5/2 fractional quantum Hall ground state where the elementary excitations carry a fractional charge of e/4 and obey non-Abelian statistics. Such a system is a model system for topological quantum computation.

Reducing dimensionality further to one dimension opens up a fascinating world where electrical conduction is strongly governed by the interaction between electrons. Here the group explores experimentally Luttinger liquid behavior whose strongest manifestation is the separation of spin and charge of the elementary excitations.

Finally going down to zero dimensional systems, known as quantum dots, the group studies various approaches to storing and manipulating quantum information using the spin of individual electrons.
Mesoscopic and Quantum Device Laboratory

In Mesoscopic and Quantum Device Laboratory, we study quantum-mechanical properties of electrons in quantum devices such as electron interferometer, quantum dots and etc. To achieve this goal, we study electron transport through our quantum devices at an extremely low temperature (~around 10mK) in a dilution fridge. To fabricated such quantum device, electron-beam lithography technique is used. The SEM picture shown below is one example picture of our devices.

An electron interferometer fabricated on top of ultra-high mobility 2DEG wafer with a quantum dot embedded inside the interferometer and a nearby by electron detector to collect path information of the electrons inside the interferometer. The overall size of the device (honeycomb-shaped structure) is around 1μm in diameter.

Currently, we are interested in observing single electron interference and realizing spin entangled quantum states of electrons by using two-path electron interferometer, which is quite similar to the one described above. We are also interested in observing orbital Kondo effect by using parallel double quantum dots.

Collaborators

We really thank to our collaborators who have been helping us in many ways and supportive for years. The links shown below are our collaborators’ websites.

[Logos of WEIZMANN INSTITUTE OF SCIENCE, KRISS, and other institutions]

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Career
Research Associate at Oxford University, 1996 ~ 2000
Visiting Scientist at Weizmann Institute of Science, 2000 ~ 2003
Assistant Professor at Pusan National University, 2003. 11. ~ 2008. 2
Associate Professor at Pusan National University, 2008. 3. ~ present
Grating size: 2 mm X 2 mm (4[mm^2])
Period of 520nm and stripe width of 150nm (~ 1% error measured)
Lift –off of Cr followed by Etching on fused silica.

Period of 520nm and stripe width of 25nm
Lift –off of Cr followed by Etching on fused silica.
Biocatalytic microreactor incorporating HRP anchored on micro-/nano-lithographic patterns

Madalina Tudorache, Diana Mahalu, Cristian Teodorescu, Razvan Stan, Camelia Bala, Vasile I. Parvulescu

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Special Electron Beam Lithography WorkShop
organized by
Nezih Unal (GenISys GmbH.) and
Diana Mahalu (Weizmann)
http://www.genisys-gmbh.de/
http://www.weizmann.ac.il/condmat/mahalu.html

July 14th
Weizmann Inst. of Science – SubMicron Center
Session 1: 10.00h – 13.00h
Lunch: 13.00h – 14.00h
Session 2: 14.00h - 16.00h

Session 1:
- Layout preparation strategies for e-beam writing ~45 min
  o “Cleaning” overlaps gaps
  o Design grid vs fracture grid vs shot pitch
  o Field positioning strategies
  o Writing time optimization (bordering, coarse-fine split,
- Proximity Effect and Correction strategies ~45 min
Third dimension of proximity effect correction (PEC)


Abstract: New nano applications, like T-gates, bridges, mirror arrays, blazed gratings, 3D zone plates, 3D holograms and MEMS devices require highly process for high resolution patterning in lateral dimensions. The aforementioned 3D applications, imply accurate control of resist thickness, after develop dimension. We show a feasibility test for a new 3D PEC approach, using Layout BEAMER e-beam lithography software. [All rights reserved Elsevier].

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Document Type: Journal Paper

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Treatment: Practical, Experimental

Controlled Indexing: electron beam lithography; nanotechnology; photoresists; proximity effect (lithography)

Uncontrolled Indexing: proximity effect correction; T-gates; mirror arrays; bridges; blazed gratings; 3D zone plates; 3D holograms; MEMS devices; 3D pal process; 3D PEC approach; layout BEAMER e-beam lithography software

Classification Codes: B2550G Lithography (semiconductor technology)

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Floating Fields
Alignment (mix and match MM - Floated)

Floated < 15nm MM alignment

311nm

283nm

297nm

こんにちは！
JEOL！
LB extract layers 34,100,110 with extraction region 101 (block size)