סמסטר ב - יום ראשון, 2/7/2017, אולם מלמד

זמן	תואר	שם הסטודנט	שם המנחה
יו"ר- פרופ' יורם דגן			
9:00-9:50	שלישי	איתם וינוגרד	פרופ' אורי צ'שנובסקי
9:50-10:15	שני	גל שביט	ד"ר משה גולדשטיין
10:15-10:45		הפסקת קפה	
יו"ר- ד"ר משה גולדשטיין			
10:45-11:35	שלישי	ערן מניב	פרופ' יורם דגן
11:35-12:00	שני	בנג'י רמז	ד"ר משה גולדשטיין
12:00-12:25	שני	לינור מיכאלי	ד"ר אלון באב"ד
12:25-13:10		ארוחת צהריים	
יו"ר- ד"ר רוני אילן			
13:10-13:35	שני	מרק שולמן	פרופ' משה פז
13:35-14:00	שני	יואב ספקטור	פרופ' משה שוורץ
14:00-14:25	שני	ערגה ליפשיץ	ד"ר חיים סוכובסקי
14:25-14:40		הפסקת קפה	
יו"ר- ד"ר ערן סלע			
14:40-15:05	שני	אוהד גולן	פרופ' דוד שפרינצק
15:05-15:30	שני	יסמין בר-אל	פרופ' יעל חנין
15:30-16:20	שלישי	אסף פרחי	פרופ' דוד ברגמן
		סיום+	

1. Eitam Vinegrad: Single particle spectroscopy
2. Gal Shavit: Bridging the Lab and Rotating Frame Master Equations for Open Quantum Systems
3. Eran Maniv: Probing the electronic structure of SrTiO3/LaAlO3 interface and its nano-structures
4. Benji Remez: The Self-Consistent Expansion: From Divergent Perturbation Theory to Exponential Convergence
5. Linor Michaeli: Genetic algorithm driven spectral shaping of supercontinuum radiation generated in a photonic crystal fiber
6. Mark Shulman: Structural and electronic studies of MFeO3 at elevated pressure
7. Yoav Spector: A Study of Hamiltonians for Quantum Graphity
8. Erga Lifshitz: Herriot FT-IR spectrometer
9. Ohad Golan: Quantitative Analysis Of the Notch Transcriptional Module
10. Yasmin Bar El: Neuron-Glia networks communication under the effect of neuromodulation
11. Asaf Farhi: Eigenstates of Maxwell's equations and their applications

Abstracts:

Gal Shavit: The classical problem of a two-level quantum system coupled to a bath and coherently driven may be treated using various approaches. Analyzing it using the common secular approximation in the lab frame (as usually done in the context of atomic physics) or in the rotating frame (prevailing in, e.g., the treatment of solid-state qubits) may yield di erent results. We show how to bridge between these two approaches by working in the rotating frame but not employing the secular approximation. The resulting master equations were further generalized to account for the frequency-dependence of the bath density of states and the possibility of longitudinal coupling between the bath and the two-level system. Using these equations we need the resulting dynamics and steady state of the density matrix, as well as the steady-state correlation functions, and in particular the photoluminescence spectrum. While in the appropriate limits we recover the results of the more traditional approaches, in the general case we need new features, such as population inversion and asymmetric Mollow triplet spectrum.

Eran Maniv: The introduction of exotic systems with strong electronic correlations with spin, charge, orbital and lattice degrees of freedom can lead to a variety of new functional properties. These materials can be potentially employed in quantum computation devices, ferroelectric memory devices and for spin-based electronics (spintronics). One of these fascinating systems is the SrTiO3/LaAlO3 oxide interface, which is essentially a two-dimensional electron liquid (2DEL), where the conducting layer forms at the interface between two insulating oxide materials (e.g. SrTiO3 and LaAlO3). This system is highly correlated, exhibiting phenomena such as superconductivity and spin-orbit interaction. These phenomena can be controlled by applying an electric field through a back/top gate. In this talk I will present the non-monotonic dependence of the superconducting critical temperature, inverse Hall coefficient and Shubnikov de-Haas frequency with gate voltage. To explain this we introduced electron-electron Coulomb interaction and calculated the band structure and critical temperature.

I will also present a new nano-lithography technique we established to create a quantum confinement inside the electron liquid. If I have time I will show some of our new and exciting results.

Benji Remez: For many nonlinear physical systems, an approximate solution is pursued by conventional perturbation theory (PT) in powers of the non-linear term. However, this frequently produces a divergent asymptotic expansion which does not permit high-accuracy solutions, particularly for strong couplings. An alternative method, the Self-Consistent Expansion (SCE), has been introduced by Schwartz and Edwards. Its basic idea is a rescaling of the zeroth-order system around which the solution is expanded, to achieve optimal results. It can be seen as a procedure to systematically improve upon the variational approximation. While low-order SCE calculations have been remarkably successful in describing the dynamics of non-equilibrium many-body systems (e.g., the Kardar-Parisi-Zhang equation), its convergence properties have not been elucidated before. To address this issue we apply this technique to the canonical partition function of the classical harmonic oscillator with a quartic g*x^4 anharmonicity, for which PT's divergence is well-known. We explicitly obtain the Nth order SCE approximation for the partition function, which is rigorously found to converge exponentially fast in N, and uniformly in g, for any coupling g>0. Comparing the SCE with other methods to improve upon perturbation theory (Borel resummation, hyperasymptotics, Padé approximants, and the Lanczos tau-method), it compares favorably with all of them for small g (overtaking them for large enough N), and dominates over them for large g. Our treatment is generalized to the case of many oscillators, as well as to a more general nonlinearity of the form g|x|^q with q of than 4 and complex g. The latter results allows us to treat the Airy function, and to see the fingerprints of Stokes lines in the SCE.

Yoav Spector: Forming a single successful theory that reconciles quantum mechanics with general relativity is an endeavor attracting a lot of research and remains an unsolved challenge in theoretical physics. Many approaches for quantum gravity assume that the geometry of space-time is an emergent phenomenon, and that space-time is actually composed of some discrete building blocks. Quantum graphity is a background independent model for emergent geometry, in which space is represented as a dynamical graph. The graph evolves under the action of a Hamiltonian from a high-energy pregeometric state to a low energy state in which geometry emerges as a coarse-grained effective property of space. I investigate the dynamics of the Quantum Graphity model, and specifically the properties of Hamiltonians that are needed to make the low energy state similar to a lattice. For this purpose, I considered several Hamiltonians and used Monte-Carlo simulations of the graph evolving under these

Hamiltonians from an initial pregeometric state to these Hamiltonians' ground states. The properties of these ground states were also studied.

I show that the simple Hamiltonians usually used in Quantum Graphity models are highly degenerate, having multiple ground states that are not lattices. In order to assess the distance of the resulting graphs from a lattice graph, I proposed a new measure which measures the equivalence of vertices in the graph. I then propose a Hamiltonian that has a rectangular lattice as a ground state that appears to be non-degenerate.

Erga Lifshitz: A Fourier Transform Infra-Red spectrometer (FT-IR) is a tool widely used to characterize materials by collecting an interference pattern (interferogram) of an infrared signal passed through a sample, and performing a Fourier Transform on it to obtain the absorption or emission spectrum. The resulting spectral resolution is determined by the size and accuracy of its interferometer, thus state-of-the-art FT-IRs are large and expensive. Here I present a novel way to improve the spectral resolution of the FT-IR by effectively increasing the size of the interferometer, without compromising its accuracy. The "Herriot FTIR" is achieved by embedding a curved mirror resonator (Herriot cell) at one of the interferometer's arms. The cell's modes are employed as jumping steps - increasing the optical path difference in the interferometer, without changing its total size.

Ohad Golan: Understanding the qualitative and quantitative behavior of transcriptional regulatory system is the next frontier in developmental biology. In recent years, it has become clear that statistical mechanics approaches can be used to understand and model the behavior of such systems [Brewster R.C., Weinert F.M., Garcia H.G., Song D., Rydenfelt M., Phillips R. Cell. 2014;156:1312–1323]. In such models, a state of the system can be defined by the combination of transcription factors (TFs) occupying the promoter and the promoter sequence. Complex transcriptional responses can arise when a promoter contains a combination of transcription factor binding sites (TFBSs) that bind different TFs present at different concentration and with different binding energy. Here, we study the transcriptional response downstream of Notch signaling, which is a conserved signaling pathway regulating developmental processes in practically all animals, from flies to humans. At its core, The interaction between Notch receptors and ligands leads to cleavage of the Notch intercellular domain (NICD) which then translocates to the nucleus and forms an activating complex with a DNA binding protein called CSL. Interestingly, the same CSL protein can bind a repressor module (called Hairless) that represses expression of downstream genes. Hence, the same DNA binding site can be used for both activation and repression of Notch target genes. Despite the molecular understanding, we still lack a quantitative description of how the expression of Notch targets depends on the concentrations of the different factors, and the architecture of the promoters (number and strength of TFBSs). In this work I use a statistical mechanics approach to address this question. The analysis can explain non-intuitive behaviors observed in different tissues in fruit flies.

Yasmin Bar El: The concerted activity of neuron-glia networks are responsible for the fascinating dynamics of brain functions, including its information and signal processing capabilities. Although these networks were extensively investigated using a vast variety of experimental (in vivo and in vitro), and theoretical models, the manner by which neuron-glia networks interact is not fully understood, in particular the role of glia cells as a signaling entity in brain circuits is still under debate. As these networks are built from tens of billions of cells, consisting of a variety of cell types and connections, they are exceedingly complex and a reductionist approach is highly desired to better understand high-level functions of brain networks. In this work, we focus on experimental investigation of the effects of global perturbations applied on neuron-glia networks and their signaling. We use in vitro setup, for recording network signaling and for applying neuromodulation and electrical stimulation. Our results show dramatic changes in network activity under the applied perturbations. First, under neuromodulation, glia cells show marked rise in oscillatory behavior. Second, neuronal spontaneous activity is reduced and third, the communication between the two networks is perturbed. Finally, we observed spatial influence on behavior of subgroups in the glial network. In light of the experimental results, we present a simple model to describe the network collective behavior in response to global chemical and electrical perturbations.

Asaf Farhi: A setup of an $\varepsilon 1$ inclusion in an $\varepsilon 2$ host medium and a source can be used to analyze many interesting light-matter interaction phenomena. The propagation of an electric field of a source in such a system is highly complex since the field experiences multiple scattering from the inclusion surface. An eigenstate of Maxwell's equations for such a system is an electric field, which can exist in the system without a source. Inclusion permittivity eigenvalues are resonances of the setup and when the physical permittivity value approaches an eigenvalue the corresponding mode is enhanced. The physical electric field for such a setup can be expanded in the basis of the eigenstates, without having to account for multiple scattering. We present an approach to account for charge and current distributions analytically in a two-constituent composite medium and apply it to several setups of practical importance. In addition, we present the spherical analogue of a plane phased array.