Table of Contents

About the Weizmann Institute of Science

Faculty of Biology

Department of Biological Regulation

Department of Neurobiology

Department of Immunology

Department of Molecular Cell Biology

Faculty of Biochemistry

Department of Biomolecular Sciences

Department of Molecular Genetics

Department of Plant and Environmental Sciences

Faculty of Chemistry

Department of Chemical and Biological Physics

Department of Structural Biology

Department of Earth and Planetary Sciences

Department of Organic Chemistry

Department of Materials and Interfaces

Faculty of Mathematics and Computer Science

Department of Computer Science and Applied Mathematics

Department of Mathematics

Faculty of Physics
The Weizmann Institute of Science is one of the world's leading multidisciplinary basic research institutions in the natural and exact sciences. The Institute's five faculties Biology, Biochemistry, Chemistry, Physics, Mathematics and Computer Science are home to scientists and students who embark daily on fascinating journeys into the unknown, seeking to improve our understanding of nature and our place within it. The Institute has been the venue of pioneering research in neuroscience, nanotechnology and alternative energy, the search for new ways of fighting disease and hunger and creating novel materials and developing new strategies for protecting the environment. Mathematicians and computer scientists working together with biologists are uncovering unseen patterns in everything from our DNA to the ways our cells age to personal nutrition. From participating in the discovery of the Higgs boson at CERN to joining in scientific missions to the planets in our solar system, Weizmann Institute researchers are helping lead international science. The campus comprises of 1.1sq km (280 acres) and includes over 240 buildings, research facilities, administration and housing; 2,500 faculty and staff; 1,400 students and postdocs Research volume annually is of more than $100m total worth of grants for Weizmann Institute research projects.
The Department of Biological Regulation is comprised of approximately 170 people organized in 14 research groups. We are located in the Candiotty and Britannia buildings, which are equipped with all the cutting-edge facilities required for running excellent research endeavors. Our research is concentrated on the regulation of processes responsible for the concerted action of cells, tissues, and organs. A diversity of methodologies and experimental approaches are being used in order to tackle these pivotal issues in biology. These include biochemical, molecular and physiological methods, organ and tissue cultures, and whole animal studies utilizing mice and fish. In addition, some researchers of the Department are using methodologies and concepts of systems biology, host-pathogen interactions and a variety of imaging methods, including magnetic resonance imaging (MRI). Since de-regulation of biological control circuits often underlies human diseases (e.g., malignant transformation, stroke, infertility, and defective tissue regeneration after injury), we make many efforts to implement the results of our studies in research projects leading to the development of new tools for early diagnosis, along with novel compounds suitable for pharmacological interventions. The main projects that are currently performed in the department are: Host-pathogen interactions - Dr. Roi Avraham Cell metabolism in health and disease - Dr. Ayelet Erez Gut tissue dynamics - Dr. Moshe Biton Mitochondria Biology - Prof. Atan Gross Protein degradation by the ubiquitin/proteasome system - Prof. Ami Navon Vascularization during pregnancy and cancer development - Prof. Michal Neeman ECM remodeling: from biophysical principles to drug design - Prof. Irit Sagi Intracellular signaling cascades in health and disease - Prof. Rony Seger Epigenetics in stem cells and cancer: developing and applying single-molecule imaging technologies to study the epigenetic code - Dr. Efrat Shema Epigenetics in development and disease - Prof. Amos Tanay Cellular functions of long noncoding RNAs - Dr. Igor Ulitsky The development of the vascular system - Dr. Karina Yaniv Growth factors and their receptors in cancer - Prof. Yossi Yarden Cellular structural biology of human amyloid proteins - Prof. Philipp Selenko Investigating functional, metabolic and architectural features of normal and malignant tissues with magnetic resonance techniques - Prof. Hadassa Degani The meiotic cell cycle, angiogenic events associated with follicle development and embryo plantation - Prof. Nava Dekel Investigating ovarian follicle physiology, regulation and demise in mammals with emphasis on the ovulatory response, including the control of oocyte maturation, transformation of the follicle into corpus luteum and culminating with the release of the fertilizable ovum - Prof. Alex Tsafirri

Research activities

Dr. Avraham Roi

Dr. Moshe Biton

Collaboration with: Prof. Omer Yilmaz, Prof. Eduardo Villablanca, Prof. Yinon Ben-Neriah, Prof. Steffen Yung

Prof. Hadassa Degani

Collaboration with: Dr. Talia Golan and her team, Sheba Medical Center
Prof. Nava Dekel

Prof. Erez Ayelet

Collaboration with: Eytan Ruppin Uri Tabori Angel Progador

Prof. Atan Gross

Prof. Michal Neeman

Collaboration with: Prof Nava Dekel, Weizmann Prof Lucio Frydman, Weizmann Prof Joel Garbow, Washington Univ. St Louis Prof Silvio Aime, Univ Torino Prof Simcha Yagel and Dr Ofer Behavior, Hadassah Medical Center Prof Michal Kovo, Meir Medical Center Prof Tal Raz, HUJ

Prof. Irit Sagi

Prof. Rony Seger

Prof. Philipp Selenko

Collaboration with: Daniella Goldfarb, Hagen Hofmann, Ori Avinoam, Atan Gross, Ami Navon

Collaboration with: Daniella Goldfarb, Hagen Hofmann, Koby Levi

Prof. Alex Tsafri

Collaboration with: Helena Ashkenazi, Shmulik Motola, Xiumei Cao, Malka Popliker, Seymour Pomerantz, Marco Conti, Stanford

Collaboration with: Atan Gross, KerenYacobi

Dr. Igor Ulitsky

Prof. Yosef Yarden

Collaboration with: Julian Downward Nadege Gaborit Belinda Sanchez Raya Eilam Eli Pikarsky Luis Paz-Ares

Department of Neurobiology
Research in Neuroscience in the Department of Neurobiology encompasses a wide variety of subjects, in areas including cellular and molecular biology, neuroanatomy, functional magnetic resonance imaging (fMRI), physiology, pharmacology, psychophysics, and computational sciences.

Basically, the research of the various groups of the Department covers, among others, the following topics:

1. Analysis of the molecular and cellular basis of neuronal and synaptic function.
2. Imaging of neuronal activity underlying higher brain functions.
3. Tracing and characterization of neuronal communication profiles.
4. Characterization of the CNS response to trauma and lesion; developing molecular and cellular therapeutic agents.
5. Determination of the underlying processes and mechanisms of vision, perception, learning, and memory in behaving rodents and primates.

At the Neurobiology Department, the structure, function, development, and plasticity of the nervous system are studied at various levels of analysis, using different types of cell and experimental animal models. The groups studying neuronal function at the molecular and cellular levels use *in vitro* systems ranging from non-neuronal and neuronal cell lines to primary neuronal and glial cells of cerebellar, hippocampal and cortical origin. In many cases, the cells studied are transfected with genes of interest. These cell systems allow the study of the roles of various components of the nervous system, including cell surface membrane components, specific enzymes, neurotransmitters, neuromodulators, growth factors, neuroreceptors, lipid components, ionic channels and cytoskeletal constituents. Algorithms for the synaptic plasticity between neurons, and the role of dendritic ion channels in synaptic input and information processing, are also being studied. Injury models of nerve lesion and oxidative stress paradigms are applied to examine the principles of CNS regeneration, rescue from ischemia and stroke, and apoptotic cell death and senescence.

The groups studying the CNS at the system level are striving to understand the complex neuronal mechanisms underlying learning, memory, and sensory processing (vision, taste, smell), and to determine the relationship between brain and mind. Using track tracing methods, the rules governing the interconnections in the visual cortex are being unraveled. Behavioral studies focus on principles of learning and consolidation, cortical information processing, learning disabilities, and addiction. Functional brain imaging of the human visual cortex is being studied by various techniques, including fMRI. Psychophysical approaches are being used to define processes involved in image segmentation, learning and memory skill acquisition, motor control, and language. Nearly 20 groups of researchers carry out both independent studies and collaborative research with colleagues from within the Department and outside it.

**Research activities**

*Prof. Ehud Ahissar*

*Prof. Shabtai Barash*

*Prof. Yadin Dudai*

*Prof. Amiram Grinvald*
Collaboration with: D. Omer, M. Tsodyks
Collaboration with: D. Omer, L. Rom M. Tsodyks
Collaboration with: D. Omer, L. Rom
Collaboration with: D. Omer, L. Rom,
Collaboration with: S. Naaman

Prof. Tali Kimchi

Prof. Yitzhak Koch

Prof. Ilan Lampl

Collaboration with: Heinz Beck, Bonn Alex Binshtok, Hebrew University Nicholas Priebe, Austin

Dr. Yoav Livneh

Prof. Rony Paz

Dr. Michal Ramot

Dr. Michal Rivlin

Prof. Dov Sagi

Dr. Rita Schmidt

Prof. Elad Schneidman

Prof. Michal Schwartz

Collaboration with: Prof. Ido Amit
Collaboration with: Prof. Eran Elinav
Collaboration with: Prof. Naomi Habib, Hebrew University; Prof. Anna Greka, Broad
Department of Immunology

The immune system was originally recognized for its role in defense of the organism against pathogens, including bacteria and viruses. However, we have come to realize that the system not only reacts to exogenous pathogen attacks, but also to internal challenges posed by tissue remodeling, aging, metabolic unbalance and cancer. Moreover, immune cells are also critically involved in normal developmental processes and the maintenance of adult homeostasis in light of innocuous and beneficial environmental challenges such as the microbiome.

Research in the Department of Immunology addresses the challenge to understand contributions of
immune cells to physiology and pathophysiology, with the aim to deepen our knowledge and develop new strategies for therapeutic intervention. Accordingly, our research spans a wide range from studying basic mechanisms of development, inter-cellular communication, cell trafficking and effector functions of immune cells to the definition of their specific roles in aging, autoimmune disorders, allergies and cancer. Department members investigate cellular and molecular mechanisms underlying immune disorders, such as aging, immunodeficiencies, innate immunopathologies, autoimmunity, as well as infectious diseases. Using pre-clinical mouse models and patient samples, we develop novel therapeutic strategies including check-point blockade, immunotherapies and improved vaccination protocols. We develop and employ state-of-the-art approaches ranging from intra-vital imaging and conditional gene manipulation, to advanced bulk and single cell genomics and proteomics to uncover physiological and pathological roles of the immune system. For more details on our exciting research projects and specific groups in the Immunology Department, please see our web page https://www.weizmann.ac.il/immunology/

**Research activities**

**Dr. Jakub Abramson**

**Prof. Ronen Alon**

**Collaboration with:** Ziv Shulman (WIS) Steffen Jung (WIS)

**Collaboration with:** Natalio Garbi (Bonn)

**Collaboration with:** Moshe Biton (WIS)

**Prof. Ido Amit**

**Prof. Ruth Arnon**

**Collaboration with:** R. Aharoni

**Collaboration with:** R. Aharoni; M. Sela

**Collaboration with:** M. Sela; R. Aharoni

**Collaboration with:** R. Maron; M. Wilchek

**Prof. Gideon Berke**

**Collaboration with:** Hassin D. and Sevilya Z.; Assuta Ashdod Medical Center.

**Prof. Irun R. Cohen**

**Dr. Rony Dahan**
Collaboration with: yardena samuels, david bassan, adam solomon, esther tzehoval

Collaboration with: David Bassan
Collaboration with: Dr Gideon Gross

Collaboration with: Marco Prinz, University of Freiburg, Germany Pablo Blinder, TAU, Israel

Collaboration with: Avraham Yaron, Weizmann Institute

Prof. Edna Mozes

Collaboration with: Prof. Zev Sthoeger, Kaplan Medical Center.

Prof. Roald Nezlin

Collaboration with: No

Prof. Israel Pecht

Collaboration with: Prof. Ole Farver, U. of Copenhagen, Denmark. Prof. Scot Wherland, Washington state university, Pullman, USA.

Collaboration with: Prof. J. Abramson, WIS.

Collaboration with: Pro.Mudi Sheves, WIS. Prof. D.Cahen, WIS.

Prof. Yair Reisner
The molecular mechanisms underlying cell structure, dynamics and fate, and their involvement in embryonic development and cancer are among the primary topics of interest of the Department. These include studies on the mode of action of growth factors and the nature of signals triggered by them in target cells following binding to specific surface receptors. Growth regulation is also approached through the study of suppressor genes encoding such proteins as p53, which inhibit proliferation and drive cells towards differentiation or apoptosis. These studies, focusing on the mechanisms stimulate cell proliferation, differentiation, or death, can elucidate the basis for cancerous transformation in a large variety of systems. Overproduction or hyperactivation of growth-promoting systems was shown to have an oncogenic (cancer-causing) effect, and a similar process may be induced when growth-suppressor or apoptosis-inducing genes fail to function. The levels at which cell structure, activity and fate are studied in this department and the focus of these studies are many and diverse, including the characterization of soluble growth factors and their receptors, the nature of complex signal transduction pathways, the action of specific regulators of cytokine action, rearrangement of genes associated with oncogenic processes, and the properties of tumor suppressor and apoptosis promoting genes. Since such processes involve networks of interacting factors, we are also interested in mathematical modeling and computerized analysis of biological gene circuits.

In addition, there is broad interest in the molecular mechanisms of cell adhesion and their involvement in the regulation of cell fate. These studies include characterization of the basic rules underlying adhesive interactions, the binding of surface-associated adhesion molecules with the cytoskeleton, and the nature of growth- and differentiation-promoting signals triggered by adhesive interactions. Of special interest are...
proteins such as β-catenin, which play a crucial role in reinforcing cell-cell adhesions as well as triggering gene expression.

Research activities

Prof. Uri Alon

Collaboration with: Nir Friedman

Prof. Avri Ben-Ze'ev

Prof. Alexander D. Bershadsky

Prof. Eli Canaani

Prof. Benjamin Geiger

Dr. Shalev Itzkovitz

Professor Emeritus Zvi Kam

Collaboration with: Benjamin Geiger, John Sedat, David Agard (UCSF)

Prof. Valery Krizhanovsky

Collaboration with: Uri Alon

Collaboration with: Ittai Ben-Porath, Hebrew University

Collaboration with: Dr. Tal Biron-Shental, Meir Hospital

Prof. Sima Lev

Collaboration with: Thomas Karn, Eytan Ruppin, Gordon Mills, Flavio Maina, Frank Westermann, Yosef Yarden

Prof. Gil Levkowitz

Prof. Moshe Oren
Collaboration with: Prof. Michal Lotem, Hadassah Medical Center Prof. Yinon Ben-Neriah, Hebrew University Medical School
Collaboration with: Prof. Varda Rotter, Weizmann Institute; Prof. Vassilis Gorgoulis, Athens University Medical School

Prof. Varda Rotter

Prof. Yardena Samuels

Prof. Oren Schuldiner

Dr. Yonatan Stelzer

Dr. Ravid Straussman

Dr. Itay Tirosh

Collaboration with: Mario Suva, Massachusetts General Hospital. Sid Puram, Washington University.

Prof. Eldad Tzahor

Dr. Leeat Yankielowicz-Keren

Collaboration with: Prof. Michal Lotem Prof. Eli Pikarsky Dr. Jonathan Cohen Prof. Yardena Samuels Prof. Steve Hodis Prof. Scott Rodig
Collaboration with: Prof. Gerard Socie
Collaboration with: Dr. David van Valen

Prof. Yehiel Zick
Faculty of Biochemistry

Department of Biomolecular Sciences

The scientific activities in the Department of Biomolecular Sciences span several areas in the Life Sciences. The common thread is the study of the biochemistry of life and disease. Emphasis is given to the examination of proteins, whether soluble or membrane-bound, and their key biological functions and we seek a molecular understanding of their evolution, cellular interactions, structures and functions. A variety of biochemical, biophysical, structural, molecular-biological, and state of the art imaging methodologies are employed in our department. Overlapping interests and inter-group cooperations signify the spirit of our research. The department has more than 20 research groups whose activities are centered around the following foci of interest:

Protein science and macromolecular machines. Several groups investigate the basic principles governing protein-protein interactions; composition, assembly, and architecture of multi-enzyme and other large complexes; catalytic mechanisms and the evolution of proteins and enzymes. A major aim is to understand how the findings relate to intricate biological processes.

DNA and regulation of gene expression. Various aspects of nucleic acids research are addressed in our department including: DNA repair and mutagenesis in mammals; basal and activated transcription; mRNA translation; specific gene expression in the pancreas; phylogenetic analysis of accumulated somatic mutations.

Structure, function, and biogenesis of membrane proteins. We investigate important integral membrane proteins on the biochemical, biophysical, structural, and physiological levels. This includes Na+ and K+ channels, Na+/K+ ATPase and its FXYD protein regulators, multidrug transporters, intra-membrane proteases, and peptides that integrate into membranes in various systems.

Membranes, lipids, and organelle structure, function, and biogenesis. Studies in our department include the biosynthetic pathway of membrane proteins; intracellular protein traffic, especially during the process of autophagy; lysosome biogenesis and lipid homeostasis; Calcium homeostasis; and, assembly and function of membrane proteins involved in the immune response, infectious diseases, and viral envelopes.

Signaling within and between cells. Several researchers in the department are interested in problems related to signal transduction. Cell guidance and navigation; axon guidance; cell death and tissue damage; long distance intracellular signaling; regulation of expression of virulence factors; regulation of the circadian rhythm; epigenetic gene silencing; epigenetics and developmental regulation.

Molecular basis of disease. Many research programs in our department involve human disorders, diseases, and syndromes. This includes inflammation, infections by various pathogens and antibiotic resistance, organophosphate detoxification, obesity and diabetes, cancer, and lysosomal storage diseases. Many of these disorders are investigated at the molecular level. A variety of methodologies are being utilized, with an emphasis on biochemistry, biophysics, molecular genetics, advanced light microscopy, computation methods, and structural tools (such as crystallography, atomic force microscope, mass spectrometry). Additional information can be obtained in the department's Home Page.

Research activities

Prof. Gad Asher
Dr. Ori Avinoam

**Collaboration with:**

**Collaboration with:** Prof. Benny Shilo

**Collaboration with:**

**Prof. Ed Bayer**

**Collaboration with:** Raphael Lamed, Tel Aviv University Yuval Shoham, Technion, Haifa
Itzhak Mizrahi, Ben-Gurion University, Beer Sheva Oded Livnah, Hebrew University of
Jerusalem Yitzhak Hadar, Hebrew University of Jerusalem Shi-You Ding, Michigan State
University Nicole Koropatkin and Eric Martens, University of Michigan Rafael Bernardi,
Auburn University Hermann Gaub, Ludwig Maximilian University Don C. Lamb, Ludwig
Maximilian University Bryan White, University of Illinois Klaus Schulten, University of
Illinois Bernard Henrissat, Marseille Mirjam Czjzek, Rostock, France Yingang Feng,
Ya-Jun Liu and Qiu Cui, Qingdao, China Yannick Bomble, Martin Keller and Michael
Himmel, NREL, Golden CO Victor De Lorenzo, Madrid Mariano CarriÃ­n-VÃ¡zquez,
Spanish National Research Council Carlos Fonts, University of Lisbon Marek Cieplak,
Polish Academy of Sciences Damien Thompson, University of Limerick Henri-Pierre
Fierobe, CNRS, Marseille Harry Flint, University of Aberdeen Harry Gilbert, Newcastle
University Gideon Davies, York University Dimitris Hatzinikolaou, University of Athens

**Prof. Eitan Bibi**

**Collaboration with:** Gert Bange, Marburg University, Marburg, Germany.

**Prof. Rivka Dikstein**

**Collaboration with:** Yuki Yamaguchi, Idit Shachar, Nahum Sonenberg, Yuri Svitkin,
Franck Martin, Katsura Asano, Igor Ulitsky, Michael Walker, Neta Regev-Rudsky

**Prof. Michael Eisenbach**

**Prof. Zvulun Elazar**

**Prof. Michael Fainzilber**

**Dr. Sarel-Jacob Fleishman**

**Collaboration with:** Dan Tawfik Deborah Fass Gilad Haran Eitan Bibi

**Dr. Nir Fluman**

**Prof. Anthony H. Futerman**
Prof. Steven J. d Karlish

Prof. Zvi Livneh

Prof. David Mirelman

Collaboration with: Rivka Bracha
Collaboration with: Aharon Rabinkov, Elena Appel

Dr. Neta Regev-Rudzki

Prof. Ziv Reich

Dr. Ruth Scherz-Shouval

Prof. Yehezkel Shai

Prof. Michal Sharon

Prof. Yoram Shechter

Dr. Ofer Shoshani

Prof. Michael Walker

Prof. David Wallach

Prof. Meir Wilchek

Collaboration with: retired, Dr. Talia Miron.

Prof. Avraham Yaron

Department of Molecular Genetics
The molecular basis of genetic and related biological processes are under investigation in our Department. The investigators approach these processes from the most reduced and reconstructed systems up to more systemic and computational analysis. Different organisms are employed including virus, yeast, Drosophila, mouse and human. These animal models and cell culture systems are used to study the mechanisms of:

a. Basic processes in gene expression, such as transcription, translation and protein degradation.

b. Cellular responses to various stimuli, such as cytokines, growth factors and exposure to DNA-damage.

c. Regulation of cell growth, senescence, differentiation and death.

d. Development; Mechanistic view of zygote to embryo transition and development of various organs, such as brain, muscles, bones and pancreas.

e. Genetic and acquired diseases such as cancer and virus infection. Embryonic stem cell biology, early development and advance human disease modeling.

f. Study of pluripotent stem cell biology and epigenetic reprogramming.

g. Computational and system biology. The function/evolution of genes and their diversification.

Research activities

Dr. Yaron Antebi

Prof. Eli Arama

Prof. Naama Barkai

Prof. Ari Elson

Prof. Jeffrey Gerst

Collaboration with: Prof. Robert Singer (Albert Einstein College of Medicine) Prof. Markus Landthaler (Max Delbruck Center for Molecule Medicine) Prof. Andre Levchenko (Yale University) Prof. Yitzhak Pilpel (Weizmann Institute of Science)

Dr. David Gokhman

Prof. Yoram Groner

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Collaboration with: Amos Tanay Department of Computer Science & Applied Mathematics Eli Zelzer department of Molecular Genetics

Dr. Dvir Gur
Dr. Jacob (Yaqub) Hanna

Prof. Eran Hornstein

Prof. Chaim Kahana

Prof. Adi Kimchi

Prof. Doron Lancet

Collaboration with: Prof. Rafi Zidovetzki, University of California Riverside Prof. Philippe Schmitt-Kopplin, Helmholtz Center Munich Prof. Daniel Segre, Boston University

Dr. Orly Laufman

Prof. Shmuel Pietrokovski

Prof. Yitzhak Pilpel

Prof. Orly Reiner

Prof. Michel Revel

Collaboration with: J. Chebath

Prof. Menachem Rubinstein

Collaboration with: Gideon Schreiber

Prof. Maya Schuldiner

Collaboration with: Dr. Einat Zalckvar

Dr. Schraga Schwartz
Plants offer the world its only renewable resource of foods, alternative energy and biotherapeutic compounds. Plants have highly sophisticated short and long-term adaptive mechanisms to the environment as a result of the simple fact that they cannot alter their location during environmental change. Basic understanding of how plants react to the environment and why they grow the way they do are central to devising a rational approach to address three important global challenges, namely to secure more and healthier food, to develop novel plant-based products associated with biotherapeutics and to produce alternative energy resources in the form of biofuels. Research activities in the Department of Plant Sciences are associated with all of the above-mentioned global challenges and range from studies on the function and regulation of isolated genes to their interactive behavior in the context of the whole plant. We have developed extensive in-house genomic, bioinformatics and transgenic infrastructure that enables us to isolate novel genes by gene trapping, knockout or map-based cloning. Cloned genes are manipulated and studied by transgenic analysis to establish their potential in the whole plant. Our research as listed below integrates methodologies of molecular biology, protein modeling, genomics, metabolomics, bioinformatics, system biology, genetics, biochemistry and physiology.

Harnessing light energy and energy transduction in the plant cell: Research is carried out on the basic biophysical phenomenon of photon absorption by chlorophyll through transduction of this energy to ATP and the regulation of energy flux by the plant redox state.

Adaptive response in the plant to the biotic and abiotic environment: Molecular mechanisms that drive the cellular response are investigated under environmental perturbation. Research is directed in understanding the elements that play a role in the recognition of pathogens and the subsequent mounting of plant defense responses as
well as in the response of plants to abiotic stresses, such as salt stress.

Plant metabolism and growth: Research is centered around elucidating regulatory metabolic networks for production of essential primary and secondary metabolites as well as understanding gene expression and hormonal networks that control plant metabolism, growth, reproduction and productivity.

Plant genome organization: Molecular tools have been developed to examine the fluidity of the plant genome, as described by transposon element, and the evolution of polyploid plants.

Research activities

Prof. Asaph Aharoni

Prof. Marvin Edelman

Collaboration with: Barak Cohen, Ron Vunsh

Prof. Moshe Feldman

Collaboration with: Prof. Avi Levy

Prof. Robert Fluhr

Dr. Assaf Gal

Prof. Gad Galili

Collaboration with: Zevulun Elazar, Aviah Zilberstein, Rachel Amir, Yoram Kapulnik, Alisaider Fernie

Prof. Jonathan Gressel

Collaboration with: Michael Burnet

Dr. Tamir Klein

Prof. Ron Milo

Prof. Avigdor Scherz

Prof. Assaf Vardi
Faculty of Chemistry

Department of Chemical and Biological Physics

The Chemical and Biological Physics Department provides an interdisciplinary home to a broad range of topics spanning Physics, Chemistry, and Biology. The Department is composed by over 20 tenured and tenure-track physicists and chemists, evenly split between theorists and experimentalists, and working on the following broad areas:

Fundamental quantum frontiers are explored with advanced theoretical tools (Ilya Averbukh, Eli Pollak, David Tannor); light-matter interactions (Ilya Averbukh, Gershon Kurizki, David Tannor, Efi Shahmoon); fundamental issues in quantum information, control and thermodynamics (Gershon Kurizki, David Tannor, Efi Shahmoon); ab-initio quantum chemistry and surface scattering (Eli Pollak); and real-time quantum dynamics methods (Eli Pollak, David Tannor). The department has a strong program at the interface between classical physics, chemistry, and biology.

Eran Bouchbinder studies the plasticity of disordered systems, glassy phenomena, dynamic fracture, frictional interfaces, and biophysics. Itamar Procaccia studies turbulence, as well as the physics of fractals, glass formation, and mechanical properties of amorphous systems. Theoretical biological physics is the main thrust of research of Nir Gov, who models with predictive power emerging phenomena ranging from cellular shapes to the collective behavior of insects.

Samuel Safran employs statistical thermodynamics to study the structure, phase behavior, and dynamics of soft matter in biology. The chemistry/biology interface is also studied experimentally by Roy Bar-Ziv, who develops and explores living-like systems in cell-free environments, and by Michael Elbaum, who employs advanced microscopic tools to elucidate the complex behavior of cells and biomolecules. Experimental atomic and molecular spectroscopies are also mainstays of the Department.

Quantum optics is the focus of Barak Dayan’s experiments on atom-mediated photon-photon interactions. Light matter interaction, nonlinear laser spectroscopy, and plasmonics are the focus of the experimental research of Yehiam Prior. Edvardas Narevicius is a leader in using magnetic field control and the slowing down of molecular beams to study quantum effects in sympathetically cooled systems.

Oren Tal has developed unique methods for the study of single molecule conductors, including electronic, spintronic, and thermal conductivity effects. Molecular electronics and spin-chemistry are also main themes of research for Ron Naaman, who investigates these using organic-inorganic interfaces via self-assembled monolayers. Single molecule spectroscopy and its application to a broad range of topics, from protein dynamics to nanoplasmonics, are at the center of the experimental program of Gilad Haran. Baran Eren exploits new forms of microscopy and spectroscopy, to understand the chemistry and electronic behavior of solid surfaces under relevant conditions with unprecedented accuracy.

A centerpiece of the combined experimental/theoretical program in the Department rests on Magnetic Resonance research. Amit Finkler bridges this topic with optics, in a program relying on optically-detected magnetic resonance as an emerging form of quantum sensing. Lucio Frydman and his group focus on developing and utilizing new concepts and techniques in NMR and MRI, with applications ranging from Physics to Biology and Medicine. Assaf Tal's group focuses on developing new spectroscopy and imaging tools for understanding the brain's physiology in vivo. Shimon Vega and Daniella Goldfarb are developing and utilizing dynamic nuclear polarization methods for NMR and EPR research, with the Vega group also deeply involved in solid state NMR, and the Goldfarb research also focused on...
multiple-resonance high-field EPR techniques applied to biophysics and materials science. The diverse interests as represented above have created an atmosphere of outstanding scientific creativity. Members of the Department have overlapping interests and collaborations among themselves, with other scientists throughout the Weizmann Institute, and with scientists throughout the world. New training opportunities for students and postdocs are always emerging, at whose conclusion participating scientists will have been exposed to a broad spectrum of challenges and acquired state-of-the-art knowledge. If you are interested in joining this elite group of researchers as a M.Sc., Ph.D or postdoctoral trainee, do not hesitate to contact the expert(s) of your choice.

**Research activities**

Prof. Ilya Averbukh

Prof. Roy Bar-Ziv

Prof. Eran Bouchbinder

**Collaboration with:** Prof. Alain Karma (Northeastern University, USA) Prof. Jay Fineberg (Hebrew University, Israel)

**Collaboration with:** Dr. Efim Brener (Forschungszentrum Juelich, Germany) Prof. Jean-François Molinari (EPFL, Switzerland)

**Collaboration with:** Prof. Edan Lerner (University of Amsterdam, Netherlands)

**Collaboration with:** Prof. Chris Rycroft (Harvard University, USA) Prof. Edan Lerner (University of Amsterdam, Netherlands) Prof. Jan Schroers (Yale University, USA)

**Collaboration with:** Prof. Haguy Wolfenson (Technion, Israel)

Prof. Barak Dayan

Prof. Michael Elbaum

Dr. Baran Eren

Dr. Amit Finkler

**Collaboration with:** Durga Dasari, University of Stuttgart

**Collaboration with:** Danna Freedman, Northwestern University

**Collaboration with:** Michael Stern, Bar-Ilan University Eyal Buks, Technion

Prof. Lucio Frydman
Prof. Nir Gov

Prof. Gilad Haran

Collaboration with: Amnon Horovitz, Weizmann, Ron Naaman, Weizmann, Axel Mogk, University of Heidelberg, George Stan, University of Cincinnati
Collaboration with: Ronen Alon, Weizmann, Frank Brown, UCSB, Andres Alcover, Pasteur Institute
Collaboration with: Ora Bitton, Weizmann, Lothar Houben, Weizmann, Lev Chuntonov, Technion, Javier Aizpurua, San Sebastian

Prof. Gershon Kurizki

Prof. Ron Naaman

Collaboration with: Yossi Paltiel, Hebrew University David H. Waldeck, University of Pittsburghm USA Claudio Fontanessi, Modena University, Italy E. W. Meijer, Eindhoven, Netherland Michael Therien, Duke University, USA Moh El Naggar, USC, USA Jonas Fransson, Uppsala, Sweden

Prof. Yehiam Prior

Collaboration with: Ilya Averbukh

Prof. Itamar Procaccia

Collaboration with: George Hentschel, Bhanu Bhowmik, Harish Charan
Collaboration with: Valery Ilyin, George Hentschel, Prasenjit Das, Chandana Mondal, Saikat Roy, Avanish Kumar
Collaboration with: Eviatar B. Procaccia, Arik Yochelis
Collaboration with: Avanish Kumar, Prasenjit Das
Collaboration with: Victor L'vov, Anna Pomyalov

Prof. Samuel Safran

Dr. Ephraim Shahmoon

Prof. David Tannor

Prof. Shimon Vega

Collaboration with: Akiva Feintuch

Department of Structural Biology

The functions of biological systems emerge from the structures of macromolecules, their conformational dynamics, and their higher order assembly. Determination of biomolecular structures and an understanding of their conformational changes and assembly properties provide great insights into biological mechanisms. Much of the research in structural biology at the Weizmann Institute is carried out in the Faculty of Chemistry, using a diverse set of cutting-edge research tools and methods. Investigators in the Structural Biology Department rely on the primary techniques for experimental structure determination, namely X-ray crystallography, NMR, and electron microscopy, but they also employ a variety of other specialized and emerging spectroscopic methods combined with creative molecular engineering to explore macromolecular structures, energetics, and dynamics. Experimental strategies are complemented by computational and theoretical approaches. Among the specific subjects of research in the department are ribosomes, protein chaperones, viruses, extracellular matrices, and biominerals. Processes being investigated include protein aggregation in cells, conformational dynamics of enzymes, formation of skeletal tissues, cell penetration by viruses, DNA recognition by proteins, and protein folding. Efforts are also directed towards the design of potential drugs. The wide variety of research activities in the department are based on a shared appreciation for the physical and chemical foundations of biological activities.

Research activities

Prof. Lia Addadi

Collaboration with: S. Weiner
Collaboration with: B. Geiger

Prof. Jacob Anglister

Collaboration with: F. Naider
Collaboration with: F. Naider
Collaboration with: J. Piehler
Collaboration with: M. Gurevitz, D. Gordon

Prof. Ron Diskin
Prof. Deborah Fass

Prof. Amnon Horovitz

Collaboration with: Ron Unger (Bar Ilan University)
Collaboration with: Keith Willison (Imperial College, London); Michal Sharon;
Collaboration with: Gilad Haran

Dr. Emmanuel Levy

Collaboration with: Jonathan Doye (Oxford) Samuel Safran (WIS)

Prof. Koby Levy

Dr. Rina Rosenzweig

Prof. Zippora Shakked

Collaboration with: Donald Crothers (Yale University)

Dr. Moran Shalev-Benami

Collaboration with: Peter McCormick; Ofer Yizhar
Collaboration with: Schraga Schwartz;

Prof. Joel Sussman

Collaboration with: Israel Silman
Collaboration with: Dan Tawfik & Israel Silman
Collaboration with: Israel Silman
Collaboration with: Israel Silman
Collaboration with: Tony Futerman & Israel Silman
Collaboration with: Jaime Prilusky & Israel Silman

Prof. Stephen Weiner

Collaboration with: Ron Shahar, Hebrew University of Jerusalem
Collaboration with: Elisabetta Boaretto,
Collaboration with: L. Addadi, Leeor Kronick, Dan Oron
The research in this department is dedicated to understanding the complex inter-relationships among the major Earth Systems and on the human impact on the Earth's environment and climate. In addition, research is conducted on planetary atmospheres and planetary geomorphologies. The Department's research activities have several general areas of activities. One focuses on water and includes hydrology, geochemistry, land-plant-atmosphere interactions, and oceanography. A second activity is in the use of stable isotopes for reconstructions of paleoclimatic and of biosphere-atmosphere dynamics, and a third is in the area of atmospheric chemistry and dynamics, and cloud physics. The fourth area of research is in planetary sciences.

Our research requires knowledge of the interdependent components that together constitute the "environment", as well as a commitment to protect this environment by improving the manner in which air, water, land, and energy are utilized by humans. The Department is distinguished by the interactions among scientists from different backgrounds and expertise, which is critical for achieving a comprehensive understanding of the global environment and planetary sciences. The department promotes international collaborations based on short- and long-term visits for research and training by scientists who complement existing expertise in the Department. The interdisciplinary nature of the Department is well reflected in the academic training of the research students. Their backgrounds vary from physics, chemistry, and mathematics through geology to biology. We encourage the participation of students who are interested in not only investigating in depth a specific subject but who are also interested in a broader and integrative approach to science.

**Research activities**

Prof. Oded Aharonson

Prof. Brian Berkowitz

Dr. Rei Chemke

Dr. Itay Halevy

Prof. Yohai Kaspi

Dr. Yael Kiro

Prof. Ilan Koren
Collaboration with: Dr. Graham Feingold - NOAA Prof. Alex Kostinski - MTU Prof. Alexander Khain - HUJI Prof. Vanderlei Martins - UMBC Prof. Zev Levin - TAU Dr. Lorraine Remer - NASA Prof. Yoav Schechner - Technion Dr. Eitan Hirsch - IIBR Dr. Eyal Agassi - IIBR

Collaboration with: Prof. Eli Tziperman - Harvard Dr. Graham Feingold - NOAA Prof. Alex Kostinski - MTU Dr. Mickael Chekroun - Weizmann

Collaboration with: Prof. Assaf Vardi - Weizmann Prof. Emmanuel Boss - University of Maine Prof. Yinon Rudich - Weizmann

Collaboration with: Prof. Alex Kostinski - MTU Prof. Vanderlei Martins - UMBC Dr. Lorraine Remer - NASA Prof. Yoav Schechner - Technion Dr. Eitan Hirsch - IIBR Dr. Eyal Agassi - IIBR

Dr. Shira Raveh-Rubin

Collaboration with: Philippe Drobinski, CNRS

Prof. Yinon Rudich

Collaboration with: Prof. Ralf Zimmermann - Helmholtz Center Munich and University of Rostock, Germany Prof. Astrid Kiendler-Scharr - Hemholtz Ceter Juelich, Germany

Collaboration with: Prof. Ido Braslvski - Hebrew University

Collaboration with: Dr. Steve Brown - NOAA, Boulder CO Prof. Alexander Laskin - Purdue University

Prof. Dan Yakir

Department of Organic Chemistry

The areas of research in the Department of Organic Chemistry include synthetic and mechanistic organic and organometallic chemistry, novel reactions for organic synthesis, bond activation by metal complexes, polymeric reagents and catalysis. Bioorganic chemistry includes the studies of plant antiviral agents, the molecular mechanism of action of rhodopsin, artificial ion carriers and molecular sensors. Biological chemistry includes studies on structure, function, and mode of action of biologically active peptides and proteins; thermophilic enzymes; enzymes involved in DNA repair, DNA and RNA processing; studies of ordered, compact states of nucleic acids; and biomedical applications of EPR and NMR. Computational chemistry deals with the prediction of molecular properties by first principles (ab initio) and semiempirical quantum mechanical calculations..

Research activities

Prof. Mario D. Bachi

Prof. Yigal Burstein
Activities in the Department span a wide range of topics from soft, composite and hard materials to energy research, nanoscience, and biological materials. A unifying theme is the study of material functionality and its relation to fundamental properties at multiple scales. These properties may be mechanical, structural, chemical, electronic, magnetic, optical, and more. Some examples are: How do shapes and sizes of nm-sized particles affect their properties? How can we tune the properties of solar cells by manipulating their material interfaces? How does friction in knee and hip joints depend on polyelectrolytes that lubricate them? How can we design self-assembling (bio)chemical systems? THE RESEARCH IS BASED ON AN INTERDISCIPLINARY APPROACH, and indeed the scientists bring complementary experience in chemistry and physics, including both theory and experiment.
Research activities

**Prof. David Cahen**

**Collaboration with:** @WIS: S. Cohen, G. Hodes, L. Kronik, L Houben, D. Oron; A. Kahn (Princeton); M. Bär (Helmholtz Centre Berlin, HZB and Erlangen); H. Bolink (Valencia); P. Nayak (TIFR-H); S Avashti (IISc); H. Ishii (Chiba); P. Schultz, JF. Guillemoles (IPVF-CNRS); T. Kirchartz (Duisburg-Jülich).

**Collaboration with:** @WIS: M. Sheves, I. Pecht M. Tornow (TU-Munich); G. Vattya (Budapest); J. Blumberger (Imp. College); L. Zotti (Sevilla); JC Cuevas (Madrid); H. Chen (Zhejiang U);

**Prof. Gary Hodes**

**Collaboration with:** D. Cahen (WIS)

**Prof. Ernesto Joselevich**

**Prof. Jacob Klein**

**Collaboration with:** Sam Safran

**Prof. Leeor Kronik**

**Prof. Meir Lahav**

**Collaboration with:** Prof Igor Lubomirsky Dr.David Ehre

**Prof. Leslie Leiserowitz**

**Dr. Michal Leskes**

**Prof. Igor Lubomirsky**

**Collaboration with:** Prof. Meir Lahav

**Dr. Sivan Refaely-Abramson**

**Collaboration with:** Sara Barja, Centro de Física de Materiales, CSIC-UPV/EHU and DIPC

**Prof. Jacob Sagiv**
Prof. Reshef Tenne

Collaboration with: Dr. R. Arenal, Laboratorio de Microscopías Avanzadas, Instituto de Nanociencia de Aragon, Universidad de Zaragoza, 50018 Zaragoza, Spain Dr. Luc Lajaunie, Departamento de Ciencia de los Materiales e Ingeniería Orgánica y Química, Facultad de Ciencias, Universidad de Cádiz, Campus Río San Pedro S/N, Puerto Real 11510, Cádiz, Spain Prof. Ernesto Joselevich, Department of Materials and Interfaces, Weizmann Institute, Rehovot 76100, Israel Dr. Lothar Houben, Chemical Research Support Department, Weizmann Institute, Rehovot 76100, Israel Prof. Alla Zak, Holon Institute of Technology, Israel Prof. Shmuel Kenig and Prof. Hanna Dodiuk, Shenkar College, Israel Prof. Yoshihiro Iwasa, University of Tokyo and the Riken Institute, Japan Prof. Janina Maultzsch, Department of Physics, FAU Erlangen-Nürnberg, 91058 Erlangen, Germany Dr. Iddo Pinkas, Chemical Research Support Department, Weizmann Institute, Rehovot 76100, Israel
The principal interests of the department lie in the areas of computer science and applied mathematics. Research areas include (but are not limited to) algorithms, their design and analysis; biological applications, bioinformatics, system biology, biological modeling; computational complexity, probabilistic proof systems, hardness of approximation, circuit complexity, combinatorial games; computer vision, image processing; cryptography; differential equations; distributed and parallel computing; dynamical systems; fluid dynamics; logic of programs, specification methodologies; machine learning and mathematical statistics; numerical analysis; randomness and its relation to computation; robotics and motion control; visual perception and brain modeling.

The departmental computer facilities include multiple PCs, multiple unix servers, two Linux clusters with multiple nodes, and large data storage systems. In addition, the vision laboratories, robotics laboratories and computational biology laboratories have a combination of experimental equipment and large-scale computing clusters.

Research activities

Prof. Achi Brandt

Prof. Irit Dinur

Prof. Yonina Eldar

Prof. Uriel Feige

Prof. Tamar Flash

Prof. Aviezri S. Fraenkel

Collaboration with: David Klein, Jamie Simpson


Collaboration with: George Andrews, James Sellers

Prof. Oded Goldreich

Prof. Shafrira Goldwasser
Department of Mathematics

The principal research interests of the department lie in the broadly understood areas of analysis, probability, algebra, and geometry.

Topics covered in **Analysis** include operator and matrix theory, spectral theory, linear and nonlinear ordinary and partial differential equations, functional and harmonic analysis, ergodic theory and dynamical systems, control theory in its various manifestations, optimization, game theory, approximation and complexity of functions, numerical analysis, singularity theory and robotics. Research in **Probability** theory covers random walks and graphs, motion in random media, percolation, random matrices, Gaussian fields and other probabilistic models in mathematical physics.

Areas of **Geometric** research include the structure of finite and infinite dimensional spaces, analytic, real algebraic and semi-algebraic geometry, typology of foliations and complex vector fields.

The **Algebraic** direction includes some aspects of algebraic geometry, geometric group theory, Lie Theory, representation theory, quantum groups, number theory, automorphic forms, ring theory, statistics of Young diagrams, algebraic combinatorics and enveloping algebras, invariants and crystals.

For the research done at our sister department, the Department of Scomputer Science and Applied Mathematics, see [here](#).

**Research activities**

**Prof. Avraham Rami Aizenbud**

**Collaboration with:** Nir Avni, Raf Cluckers, Dmitry Gourevitch

**Collaboration with:** Nir Avni, Dmitry Gourevitch, Shachar Carmeli, Eitan Sayag.

**Collaboration with:** Dmitry Gourevitch, Shachar Carmeli, Raf Cluckers

**Prof. Zvi Artstein**

**Prof. Itai Benjamini**

**Prof. Vladimir Berkovich**

**Prof. Harry Dym**

**Collaboration with:** Damir Z. Arov, Vladimir Derkach
Collaboration with: Damir Z. Arov

Dr. Ronen Eldan

Prof. Ehud Friedgut

Prof. Stephen Gelbart

Prof. Maria Gorelik

Collaboration with: Dimitar Grantcharov, Victor Kac, Vera Serganova.

Dr. Dmitry Gourevitch

Collaboration with: Avraham Aizenbud, Eitan Sayag, Siddhartha Sahi, Eyal Kaplan

Collaboration with: Avraham Aizenbud, Eitan Sayag, Siddhartha Sahi, Eyal Kaplan

Collaboration with: Henrik P. A. Gustafssonb; Axel Kleinschmidt; Daniel Persson; Siddhartha Sahi

Prof. Anthony Joseph

Collaboration with: Yasmine Fittouhi

Prof. Yakar Kannai

Prof. Victor Katsnelson

Prof. Boaz Klartag

Prof. Gady Kozma

Prof. Erez Lapid

Prof. Dmitry Novikov

Prof. Amitai Regev
Collaboration with: Allan Berele, Doron Zeilberger

Prof. Gideon Schechtman

Dr. Ran Tessler

Collaboration with: Dr. Chaim Even Zohar Mr. Tsviqa Lakrec Dr. Xavier Blot Dr. Sybille Rosset Dr. Yizhen Zhao Mr. Elad Tzalik. Prof. Tali Kaufman

Prof. Sergei Yakovenko

Prof. Yosef Yomdin

Prof. Ofer Zeitouni
The scientific activity of the department is mainly concentrated around the experimental and theoretical research in quantum solid state physics. It includes experimental research of mesoscopic physics, quantum Hall physics, topological states of matter, high temperature superconductors, two and one dimensional superconductors, metal-insulator transition, carbon nanotubes, semiconductor nanowires, and study of material growth. The theoretical efforts concentrate on similar subjects with added work on disordered materials, cold atoms, and quantum optics.

The Braun Center for sub micron research is an integral part of the department. It is a modern and well equipped center, with growth (three MBE's) and characterization systems, which allows to conduct experiments on sub micron semiconductor structures under high magnetic fields, conventional and high temperature superconductors, and nanowires made of carbon nanotubes and semiconductor nanowires.

Research activities

Prof. Israel Bar-Joseph

Dr. Haim Beidenkopf

Prof. Erez Berg

Prof. Alexander Finkelstein

Prof. Yuval Gefen

Prof. Moty Heiblum

Prof. Shahal Ilani

Prof. Shimon Levit

Dr. Karen Michaeli
The Department of Particle Physics and Astrophysics is engaged in both experimental and theoretical research, in various directions. These include elementary particle physics, field theory, string theory, theoretical astrophysics, observational astrophysics, particle astrophysics, relativistic heavy ion physics, molecular physics, nuclear physics, plasma physics, and radiation detection physics.

Research activities

**Prof. Ofer Aharony**

**Collaboration with:** D. Kutasov, A. Giveon, N. Itzhaki, S. Dubovsky, N. Barel

**Collaboration with:** F. Benini, O. Mamroud, P. Milan

**Collaboration with:** S. Chester, E. Urbach, T. Solberg, T. Sheaffer

**Collaboration with:** L. Yung, T. Sheaffer

**Collaboration with:** E. Palti, Y. Breitstein

**Dr. Sagi Ben-Ami**

**Collaboration with:** Yossi Shvartzvald

**Prof. Micha Berkooz**
Dr. Kfir Blum

Prof. Amos Breskin

Dr. Shikma Bressler

Collaboration with: RD51 collaboration

Dr. Ran Budnik

Prof. Ehud Duchovni

Prof. Yitzhak Frishman

Collaboration with: Prof Jacob Sonnenschein
Collaboration with: Prof Marek Karliner

Prof. Avishay Gal-Yam

Prof. Doron Gepner

Prof. Eilam Gross

Collaboration with: Students: Michael Pitt and Jonathan Shlomi

Prof. Shmuel Gurvitz

Collaboration with: Xin-Qi Li, D. Sokolovski
Collaboration with: A. Aharony, O. Entin-Wohlman, Xin-Qi Li, Wei-Min Zhang

Prof. Haim Harari

Prof. Uri Karshon

Collaboration with: ZEUS Collaboration, DESY, Hamburg
Collaboration with: ZEUS Collaboration, DESY, Hamburg
Collaboration with: ZEUS Collaboration, DESY, Hamburg
Collaboration with: NIKHEF, The University of Michigan, University of Wuppertal

Collaboration with: Multiple institutions (mostly from Canada, Chile, Russia, China and the USA)

Collaboration with: DESY, Albert-Ludwig Universitaet Freiburg, Max-Planck Institute of Structure and Matter, Helmholtz-Zentrum Jena, Friedrich-Schiller Universitaet Jena, Queens University Belfast, University College London, University of Plymouth, Tel Aviv University, Technion

Prof. Igal Talmi

Collaboration with: Shalom Shlomo, Texas A & M University

Prof. Itzhak Tserruya

Collaboration with: I. Ravinovich
Collaboration with: I. Ravinovich
Collaboration with: I. Ravinovich

Prof. Vladimir Usov

Collaboration with: G.Z. Machabeli
Collaboration with: A.E. Shabad
Collaboration with: K.S. Cheng, T. Harko, M. Milgrom, F. Weber
Collaboration with: N.N. Pilyugin

Prof. Eli Waxman

Collaboration with: Avishay Gal-Yam, Boaz Katz, Doron Kushnir, Eran Ofek, Yossi Shvartzvald
Collaboration with: Sagi Ben-Ami, Avishay Gal-Yam, Eran Ofek, Yossi Shvratzvald

Dr. Barak Zackay

Collaboration with: Matias Zaldarriaga - IAS princeton Tejaswi Venumadhav - UCSB
Collaboration with: Tsevi Mazeh - Tel Aviv University
Collaboration with: Thomas Prince - Caltech Victoria Kaspi - McGill university

Prof. Daniel Zajfman

Collaboration with: Oded Heber

Department of Physics Core Facilities
The Department of Particle Physics and Astrophysics is engaged in both experimental and theoretical research, in various directions. These include elementary particle physics, field theory, string theory, theoretical astrophysics, observational astrophysics, particle astrophysics, relativistic heavy ion physics, molecular physics, nuclear physics, plasma physics, and radiation detection physics.

Department of Physics of Complex Systems

The Department of Physics of Complex Systems pursues two main directions, Atomic, Molecular and Optical (AMO) physics and the physics of Soft and Biological Matter. Contemporary topics in AMO physics range from atto-second pulses and intense lasers, through precision spectroscopy of ultracold atoms, molecules or ions, to quantum information and quantum optics. Soft and biological physics are characterized by wide ranging complexity that can often be simplified by considering fundamental physical concepts and principles. The Department consists of slightly under 20 groups, of which about two thirds are experimentalists and one third are theoreticians.

Atomic, Molecular and Optical Physics

The AMO groups in the Department of Physics of Complex Systems study a wide variety of topics in nonlinear and quantum optics, atomic and molecular physics. Of interest are the properties of atoms and ions at ultra-cold temperatures where full control of individual atoms and photons is possible and quantum phenomena are manifested. These unique properties can be applied for quantum sensing, simulations and computing and study of new physics. Both theoretical and experimental aspects of Quantum Computation comprise an important and very significant goal of the research. A particularly rich field of study is that of the interaction of ultrashort optical pulses with atoms, molecules, electrons and solids, which enables the measurement of ultrafast dynamics, allows the acceleration of electrons and protons, and generates new radiation sources for bio-medical applications. In addition, investigations of the geometrical quantum nature of light are conducted, along with its use for simulating general relativity in the lab.

Soft Matter and Biological Physics

The theoretical issues in soft matter cover non-equilibrium processes and aspects of emergent properties, of frustration and of material structure, all of which can be approached using the tools of statistical mechanics coupled with a deep mathematical description of organization in matter. Structures in liquid and organic crystals, as well as in viscoelastic material yield insight on the underlying physical processes and mechanisms. In biological systems, mechanisms that determine the size of cells can be obtained using physics modeling and theoretical concepts. In considering the statistical physics of turbulence, special emphasis is made on broken and emerging symmetries, with important implications for conformal invariance in inverse turbulent cascades and recently for the kinetic and hydrodynamic theory of emerging viscous electronics. The experimental labs treat such diverse systems as ants, single molecules, neuronal cultures, one dimensional organisms, and even human groups. A unifying theme lies in relating the properties of the constituent parts to those of the emerging whole. Biological computation is treated in social contexts such as ant colonies and in devices comprised of living neurons. Emergent properties such as synchronization of activity, decision making and resource sharing are among the novel phenomena that have been discovered in these systems. Turbulence in viscoelastic media is studied in microfluidic environments.

Research activities

Dr. Hillel Aharoni
Dr. Rotem Arnon-Friedman

Prof. Nir Davidson

Collaboration with: Ofer Firstenberg, Ephi Sachmoon and Yaov Sagi
Collaboration with: Roee Ozeri
Collaboration with: Asher Friesem, Hui Cao, Oren Raz
Collaboration with: Ofer Firstenberg
Collaboration with: Ofer Firstenberg

Prof. Eytan Domany

Collaboration with: A. P. Young (UCSC)
Collaboration with: Several research groups at Weizmann, in the USA and in Europe; see below.

Prof. Nirit Dudovich

Prof. Efi Efrati

Prof. Gregory Falkovich

Collaboration with: Natalia Vladimirova, Michal Shavit, Vladimir Lebedev
Collaboration with: Anna Frishman, Vladimir Lebedev, Natalia Vladimirova, Bjorn Hof.
Collaboration with: Michal Shavit, Natalia Vladimirova
Collaboration with: Leonid Levitov, Andrey Shytov, Andre Geim.

Dr. Ofer Feinerman

Prof. Ofer Firstenberg

Prof. Asher Friesem

Prof. Ulf Leonhardt

Prof. Victor Malka
Collaboration with: HZDR in Germany, Ecole Polytechnique in France, and UM from US

Dr. Ziv Meir

Prof. Elisha Moses

Prof. David Mukamel

Collaboration with: S. Ruffo A. Campa

Collaboration with: S. Majumdar G. Schehr M. Barma A. Kundu

Prof. Roee Ozeri

Dr. Oren Raz

Dr. Osip Schwartz

Prof. Adam Schwimmer

Prof. Uzy Smilansky

Prof. Joel Stavans

Prof. Victor Steinberg

Collaboration with: Prof. G. Falkovich, Prof. V. Lebedev, Prof. Y. Dubief, Prof. H. Stark
The Department of Science Teaching’s main interrelated missions are to advance the academic discipline of science and mathematics education, to enhance the quality and effectiveness of mathematics and science education in Israel, and to develop academic and practical leadership in science and mathematics education in Israel and overseas. The Department carries out educational research and development primarily for grades 7-12 in mathematics, physics, chemistry, computer science, earth sciences and life sciences, and in science and technology for junior high school. The Department targets both the general student population and those who are majoring in one or more of these disciplines. The Department carries out interrelated and continuous long-term academic activities, including research, development and implementation of innovative learning materials, pedagogical models, and teachers’ professional development (PD). The Department has many avenues of collaboration with other departments on campus and with the educational system in Israel; it has a significant impact on science education research, practice, and policy in Israel and overseas. As the Department is currently shifting from mainly textual teaching and learning materials developed in the Department to primarily digital platforms, the demand for techno-pedagogical support has increased tremendously in recent years. This shift allows the incorporation of new methodologies for both teaching and learning, as well as in the way research is carried out in the Department. The large amount of data on teachers’ and students’ performance accumulating in databases promote the development and use of new research methodologies. AI tools are currently being developed to improve both the teaching and learning that take place on these platforms, as well as to expand the Department’s research possibilities. These days Department is establishing a core facilities unit, entitled EduCore, that is expected to provide the needed services (e.g., software development, technological design, data science services, etc.) and to support both research and development in the various research groups, as well as other units and faculties at the Weizmann Institute that are in need of techno-pedagogical services.

**Research activities**

**Prof. Abraham Arcavi**

**Collaboration with:** Dr. Ronnie Karsenty  
**Collaboration with:** Dr. Sue Magidson  
**Collaboration with:** Dr. Nurit Hadas

**Prof. Michal Armoni**

**Prof. Mordechai Ben-Ari**

**Collaboration with:** Francesco Mondada, Ecole Polytechnique Federale de Lausanne

**Prof. Ron Blonder**
Prof. Ruhama Even

Prof. Bat Sheva Eylon

Collaboration with: U. Ganiel
Collaboration with: U. Ganiel
Collaboration with: E. Bagno, U. Ganiel
Collaboration with: Z. Scherz, I. Hopfeld, N. Orion, O. Kedem, Y. Ben-Hur
Collaboration with: Z. Scherz, N. Orion, S. Rosenfeld, U. Ganiel

Prof. David Fortus

Collaboration with: Yoni Yeshayahu, Head of Pediatrics and Juvenile Endocrinology, Samson Assuta Hospital
Collaboration with: Joe Krajcik - Michigan State University Knut Neumann - Leibniz Institute for Science and Mathematics Education (IPN), Germany Jeff Nordine - University of Iowa Bob Geier - Michigan State University
Collaboration with: Itai Berger - Head of Pediatric Neurology - Samson Assuta Hospital
Collaboration with: Troy Sadler - University of North Carolina at Chapel Hill

Prof. Avi Hofstein

Collaboration with: R. Mamlok
Collaboration with: Rachel mamlok-Naaman,

Prof. Nir Orion

Prof. Anat Yarden

Collaboration with: Prof. Zohar Livnat, Bar-Ilan University
Collaboration with: Prof. Ute Harms, IPN, Kiel, Germany
Collaboration with: Dr. Irit Sadeh, Ministry of Education
Collaboration with: Prof. Baruch Schwarz, Hebrew University; Prof. Boris Koichu, WIS; Prof. Michal Tabach, Tel-Aviv University; Dr. Einat Heyd-Metzuyanim, Technion
Collaboration with: Prof. Ruhama Even, Prof. Vered Rom-Kedar
Collaboration with: Dr. Giora Alexandron, Dr. Yael Shwartz, Prof. Ron Blonder

Prof. Edit Yerushalmi

Collaboration with: C. Singh, E. Cohen, E. Bagno, B. Eylon
Collaboration with: R. Safadi, E. Bagno, A. Rozen
Collaboration with: C. Henderson, K. Heller, P. Heller, V. Quo, E. Cohen