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HUMANITY - It is what the Hebrew University is built on

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SIMPLE METHOD MEASURES HOW LONG BACTERIA CAN WAIT OUT ANTIBIOTICS

The efficient classification of bacterial strains as tolerant, resistant, or persistent could help to guide treatment decisions, and could ultimately reduce the ever-growing risk of resistance

Prof. Nathalie Balaban at the Hebrew University of Jerusalem. (Photo: Bruno Charbit for Hebrew University)

A growing number of pathogens are developing resistance to one or more antibiotics, threatening our ability to treat infectious diseases. Now, according to a study published in Biophysical Journal, a simple new method for measuring the time it takes to kill a bacterial population could improve the ability of clinicians to effectively treat antimicrobial-tolerant strains that are on the path to becoming resistant.

"These findings allow measurement of tolerance, which has previously been largely overlooked in the clinical setting," says senior study author Prof. Nathalie Balaban, the Joseph and Sadie Danciger Professor of Physics at the Hebrew University of Jerusalem. "Routinely measuring tolerance could supply valuable information about the duration of antibiotic treatments, reducing the chance of both under and over-treatment. Furthermore, data compiled from such measurements could give an estimate of how widespread the phenomenon of tolerance really is, which is currently a complete unknown."

According to the World Health Organisation, antibiotic resistance is one of the biggest threats to global health and is putting the achievements of modern medicine at risk.

"The lack of a quantitative measure means that this aspect of the treatment relies largely on the experience of the individual, physician or the community," says first author Asher Brauner, a PhD student in Balaban's lab at the Hebrew University's Racah Institute of Physics. "This can lead to treatment being either too short, increasing the risk of relapse and evolution of resistance, or much too long, unnecessarily causing side effects, release of antibiotic waste into the environment and additional costs."

To address this problem, Balaban and her team developed a tolerance metric called the minimum duration for killing 99% of the population (MDK99). The protocol, which can be performed manually or using an automated robotic system, involves exposing populations of approximately 100 bacteria in separate microwell plates to different concentrations of antibiotics for varied time periods, while determining the presence or lack of survivors.

The researchers applied MDK99 to six *Escherichia coli* strains, which showed tolerance levels ranging from 2 to 23 hr under ampicillin treatment. MDK99 also facilitates measurements of a special case of tolerance known as time-dependent persistence—the presence of transiently dormant subpopulations of bacteria that are killed more slowly than the majority of the fast-growing population. Like other forms of tolerance, time-dependent persistence can lead to recurrent infections because the few surviving bacteria can quickly grow to replenish the entire population once antibiotic treatment stops.

"A take-home message from this is that it is important to complete a course of antibiotic treatment as prescribed, even after the disappearance of the symptoms," Balaban says. "Partial treatment gives tolerance and persistence mutations a selective advantage, and these, in turn, hasten the development of resistance."

HEBREW UNIVERSITY'S CENTER FOR JEWISH ART LAUNCHES THE WORLD'S LARGEST INDEX OF JEWISH ART

The online Bezalel Narkiss Index of Jewish Art preserves the rich artistic heritage of the Jewish people throughout time and across the globe

The Center for Jewish Art at the Hebrew University of Jerusalem launched the world's largest online database of Jewish art today at the World Congress of Jewish Studies in Jerusalem.

The Bezalel Narkiss Index of Jewish Art is a collection of digitised images and information about Jewish artefacts from all over the world. The online collection includes more than 260,000 images of objects and artefacts from 700 museums, synagogues and private collections in 41 different countries, as well as architectural drawings of 1,500 synagogues and Jewish ritual buildings from antiquity to the modern day.

The public can access the Bezalel Index of Jewish Art and start exploring the world of Jewish art at **http://cja.huji.ac.il/browser.php**. Amateur or professional researchers easily access more than a quarter of a million images, with accompanying details and descriptions, either by simple keyword search, or according to such categories as Iconographical Subject, Origin, Artist, Object, Community, Collection or Location.

The Center for Jewish Art (http://cja.huji.ac.il) is the world's foremost institution dedicated to the preservation of the Jewish artistic heritage. The Center's activities include documentation, research, education and publishing. Under the direction of Dr. Vladimir Levin, the Center has in recent years worked steadily toward completing the Index by photographing, measuring and painstakingly describing and categorising each piece to be made available online to the public.

Left: Avi Biran, "Chicken" Kiddush Cup, 2007
This Kiddush cup presents a contemporary design for a traditional Jewish object. The Center for Jewish Art is undertaking documentation of Judaica, produced by Bezalel Academy graduates.
Right: Tombstone In Jewish Cemetery in Yabluniv, Ukraine, 18th Century
This baroque carved tombstone features a unicorn fighting with a lion; the scene probably has Messianic connotations.
(Photos: Center for Jewish Art / Hebrew University)

"Jewish culture is largely perceived as a culture of texts and ideas, not of images. As the largest virtual Jewish museum in the world, the Index of Jewish Art is a sophisticated tool for studying visual aspects of Jewish heritage. We hope that making this Index available will lead to further in-depth study of primary sources, and serve as an enduring launching pad for the study of the historical and cultural significance of Jewish art for many years to come," said Dr. Levin.

Prof. Bezalel Narkiss was an Israel Prize laureate who established the Hebrew University's Department of Art History in 1966 with his colleague Prof. Moshe Barasch. In 1979

Mosaic Floor, Synagogue in Hammath Tiberias, Israel, 286-337 CE – Throughout the Byzantine period the floors of synagogues in the Land of Israel were covered with mosaics. This mosaic includes symbolic representation of the Temple and zodiac signs surrounding Helios, the sun god. (Photo: Center for Jewish Art / Hebrew University)

Left: Torah Ark Curtain, Lower Silesia, Prussia, 1792 (The Emanuel Ringelblum Jewish Historical Institute In Warsaw)
This Torah ark curtain is one of the few from the eighteenth century with Biblical scenes. The Sacrifice of Isaac is depicted in its center, and the circumcision of Isaac underneath.
Right: Torah Finials, Afghanistan, 1918
The Jewish community of Afghanistan developed a very special type of silver flat Torah finials, adorned with bells. (Photos: Center for Jewish Art / Hebrew University)

Narkiss established the Center for Jewish Art with the goal of creating a research centre that focuses on investigating and preserving Jewish visual art. Since then, the Center has employed a small but dedicated group of professionals and graduate students who routinely go on documentation expeditions all over the world.

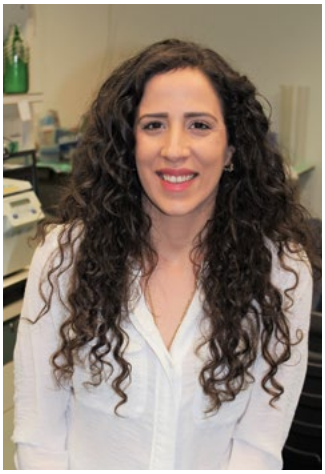
On these trips abroad, researchers document six categories of Jewish art: Hebrew Illuminated Manuscripts, Sacred and Ritual Objects, Jewish Cemeteries, Ancient Jewish Art, Modern Jewish Art, and Jewish Ritual Architecture. Some of the pieces documented are no longer in existence, but have a permanent place in the vast index that has taken more than thirty years to collect and six years to digitise. In some cases, the researchers were able to document an object just in time, such as right before a crumbling East European synagogue collapsed to its foundation, or a ritual object disappeared into obscurity at an auction.

While the expedition team worked tirelessly at documenting the objects that they could find, they also attempted to raise awareness among the locals of the importance of preserving Jewish heritage sites, not just for Jewish communities, but also as a significant part of their own history and culture.

NEW TOOL COULD LEAD TO EARLIER DIAGNOSIS, BETTER TREATMENT OF PARKINSON'S DISEASE

Suaad Abd-Elhadi wins a Kaye Innovation Award for a new diagnostic tool that could pave the way for early diagnosis and improved treatment of one of the most common and debilitating neurodegenerative disorders

Parkinson's disease is the second most common neurodegenerative disorder in humans, after Alzheimer's disease. It is typically characterised by changes in motor control such as tremors and shaking, but can also include non-motor symptoms, from the cognitive to the behavioural. An estimated seven to 10 million people worldwide are living with Parkinson's disease, with medication costing approximately $2,500 a year, and therapeutic surgery costing up to $100,000 dollars, per patient.



Suaad Abd-Elhadi
(Photo: Hebrew University)

Making an accurate diagnosis of Parkinson's, particularly in early stages and mild cases, is difficult, and there are currently no standard diagnostic tests other than clinical information provided by the patient and the findings of a neurological exam. One of the best hopes for improving diagnosis is to develop a reliable test for identifying a biomarker, i.e. a substance whose presence would indicate the presence of the disease.

Now, Suaad Abd-Elhadi, a PhD student at the Institute for Medical Research Israel-Canada (IMRIC) in the Hebrew University of Jerusalem's Faculty of Medicine, has developed the lipid ELISA ("enzyme-linked immunosorbent assay."). This novel diagnostic tool could lead to earlier detection of Parkinson's, along with better tracking of the disease's progression and a patient's response to therapy.

As a simple and highly sensitive diagnostic tool that can detect Parkinson's biomarkers, the lipid ELISA could lead to a minimally invasive and cost-effective way to improve the lives of Parkinson's patients. Recently, Abd-Elhadi has demonstrated a proof of concept to the high potential of this lipid-ELISA assay in differentiating healthy and Parkinson's affected subjects. She is now in the process of analysing a large cohort of samples, including moderate and severe Parkinson's, and control cases, as part of a clinical study.

Through Yissum, its technology transfer company, the Hebrew University holds granted patents on the technology, and has signed an agreement with Integra Holdings for further development and commercialisation.

In recognition of her work, Suaad Abd-Elhadi was awarded the Kaye Innovation Award for 2017.

COMPREHENSIVE STUDY SHOWS A SIGNIFICANT ONGOING DECLINE IN SPERM COUNTS OF WESTERN MEN, POINTING TO IMPAIRED MALE HEALTH AND DECREASING FERTILITY

Meta-analysis finds that among men from North America, Europe and Australia, sperm concentration has declined more than 50% in less than 40 years

SUMMARY: A rigorous and comprehensive meta-analysis of data collected between 1973 and 2011 finds that among men from Western countries who were not selected on the basis of their fertility status, sperm concentration declined by more than 50%, with no evidence of a "levelling off" in recent years. These findings strongly suggest a significant decline in male reproductive health that has serious implications beyond fertility and reproduction, given recent evidence linking poor semen quality with higher risk of hospitalisation and death. Research on causes of this ongoing decline and their prevention is urgently needed.

In the first systematic review and meta-analysis of trends in sperm count, researchers from the Hebrew University

Dr. Hagai Levine (Photo credit: Hebrew University)

of Jerusalem's Faculty of Medicine and the Icahn School of Medicine at Mount Sinai report a significant decline in sperm concentration and total sperm count among men from Western countries. The study is published today in Human Reproduction Update, the leading journal in the fields of Reproductive Biology and Obstetrics & Gynaecology.

By screening 7,500 studies and conducting a meta-regression analysis on 185 studies between 1973 and 2011, the researchers found a 52.4 percent decline in sperm concentration, and a 59.3 percent decline in total sperm count, among men from North America, Europe, Australia and New Zealand who were not selected based on their fertility status. In contrast, no significant decline was seen in South America, Asia and Africa, where far fewer studies have been conducted.

The study also indicates the rate of decline among Western men is not decreasing: the slope was steep and significant even when analysis was restricted to studies with sample collection between 1996 and 2011.

The research was led by Dr. Hagai Levine, Head of the Environmental Health Track at the Hebrew University-Hadassah Braun School of Public Health and Community Medicine, Jerusalem, with Dr. Shanna H Swan, Professor in the Department of Environmental Medicine and Public Health at the Icahn School of Medicine at Mount Sinai, New York, and an international team of researchers from Brazil, Denmark, Israel, Spain and the United States.

"Given the importance of sperm counts for male fertility and human health, this study is an urgent wake-up call for researchers and health authorities around the world to investigate the causes of the sharp ongoing drop in sperm count, with the goal of prevention," said Dr. Hagai Levine, the lead author and Head of the Environmental Health Track at the Hebrew University-Hadassah Braun School of Public Health and Community Medicine, in the Hebrew University of Jerusalem's Faculty of Medicine.

The findings have important public health implications. While the current study did not examine causes of the observed declines, sperm count has previously been plausibly associated with environmental and lifestyle influences, including prenatal chemical exposure, adult pesticide exposure, smoking, stress and obesity. Therefore, sperm count may sensitively reflect the impact of the modern environment on male health across the lifespan and serve as a "canary in the coal mine" signalling broader risks to male health.

Watch the video at https://youtu.be/rb98liTzSgA

FIRST 'HAPLOID' HUMAN STEM CELLS COULD CHANGE THE FACE OF MEDICAL RESEARCH

Potential for regenerative medicine and cancer research earns doctoral student Ido Sagi a Kaye Innovation Award

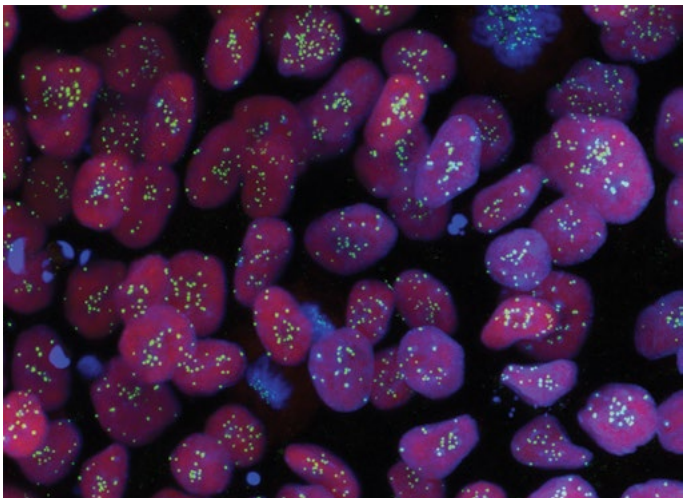
Stem cell research holds huge potential for medicine and human health. In particular, human embryonic stem cells (ESCs), with their ability to turn into any cell in the human body, are essential to the future prevention and treatment of disease.

One set or two? Diploid versus haploid cells

Most of the cells in our body are diploid, which means they carry two sets of chromosomes — one from each parent. Until now, scientists have only succeeded in creating haploid embryonic stem cells — which contain a single set of chromosomes — in non-human mammals such as mice, rats and monkeys. However, scientists have long sought to isolate and replicate these haploid ESCs in humans, which would allow them to work with one set of human chromosomes as opposed to a mixture from both parents.

This milestone was finally reached when Ido Sagi, working as a PhD student at the Hebrew University of Jerusalem's Azrieli Center for Stem Cells and Genetic Research, led research that yielded the first successful isolation and maintenance of haploid embryonic stem cells in humans. Unlike in mice, these haploid stem cells were able to differentiate into many other cell types, such as brain, heart and pancreas, while retaining a single set of chromosomes.

With Prof. Nissim Benvenisty, Director of the Azrieli Center, Sagi showed that this new human stem cell type will play an important role in human genetic and medical research. It will aid our understanding of human development – for example, why we reproduce sexually instead of from a single parent.



Haploid human embryonic stem cells (Credit: Azrieli Center for Stem Cells and Genetic Research at Hebrew University)

Summer is a time for barbecues, fresh produce, and outdoor dining. While we all enjoy the warm summer days – and maybe some time off – researchers at the Hebrew University of Jerusalem are making significant advancements in sustainable agriculture.

HU researchers are …

- Restoring old-time "heirloom" flavour back to tomatoes, without losing disease resistance, enhanced shelf life, or other traits of modern commercial tomatoes.
- Unravelling the mysteries of plant regeneration to help increase global food supplies.
- Delivering a method to protect vegetables like peppers, tomatoes, and eggplants from spoilage during shipment – a discovery that could save billions of dollars.
- Working daily to develop sustainable solutions that will help feed the world's growing population.

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It will make genetic screening easier and more precise, by allowing the examination of single sets of chromosomes. And it is already enabling the study of resistance to chemotherapy drugs, with implications for cancer therapy.

Diagnostic kits for personalised medicine

Based on this research, Yissum, the Technology Transfer arm of the Hebrew University, launched the company New Stem, which is developing a diagnostic kit for predicting resistance to chemotherapy treatments. By amassing a broad library of human pluripotent stem cells with different mutations and genetic makeups, NewStem plans to develop diagnostic kits for personalised medication and future therapeutic and reproductive products.

A HEBREW UNIVERSITY INNOVATION FEEDS THE WORLD WITH MORE FISH PROTEIN

A new way to grow larger fish and feed the expanding world population earns Prof. Berta Levavi-Sivan a 2017 Kaye innovation Award

As the world faces a projected population increase from today's 7.5 billion people to 9 billion people by 2050, the demand for sustainable food sources is on the rise. The answer to this looming dilemma may well reside within the booming field of aquaculture. While wild fisheries have been on the decline for the last 20 years, aquaculture, or fish farming, is the fastest growing food-producing sector in the world, and will play an increasingly vital role in our planet's food resources in the years to come.

One of the challenges to aquaculture is that reproduction, as an energy intensive endeavour, makes fish grow more slowly. To solve this problem, Prof. Berta Levavi-Sivan at the Hebrew University of Jerusalem identified tiny molecules named Neurokinin B (NKB) and Neurokinin F (NKF) that are secreted by the brains of fish and play a crucial role in their reproduction. Prof. Levavi-Sivan, a specialist in aquaculture at the Hebrew University's Robert H. Smith Faculty of Agriculture, Food and Environment, then developed molecules that neutralise the effect of NKB and NKF. The molecules inhibited fish reproduction and consequently led to increased growth rates.

Better Fish Growth, More Aquaculture Jobs

These inhibitors can now be included in fish feed to ensure better growth rates. For example, young tilapia fed the inhibitors in their food supply for two months gained 25% more weight versus fish that did not receive the supplement. So far, NKB has been found in 20 different species of fish, indicating that this discovery could be effective in a wide variety of species.

The technology developed by Prof. Levavi-Sivan and her team was licensed by Yissum, the Technology Transfer company of the Hebrew University, to start-up AquiNovo Ltd., established and operating within the framework of The Trendlines Group. AquiNovo is further developing the technology to generate growth enhancers for farmed fish.

In recognition of her work, Prof. Berta Levavi-Sivan was awarded the Kaye Innovation Award for 2017.

Prof. Berta Levavi-Sivan on the job in Uganda. (Photo: Hebrew University)

SCIENTISTS MAKE FIRST DIRECT OBSERVATION OF ULTRA-FAST VORTEX DYNAMICS IN SUPERCONDUCTORS

Vortices observed travelling much faster than previously thought possible — up to 72,000 km/hr (45,000 mph)

New technique can be used to test designs for reducing vortex motion and improving superconductors' properties

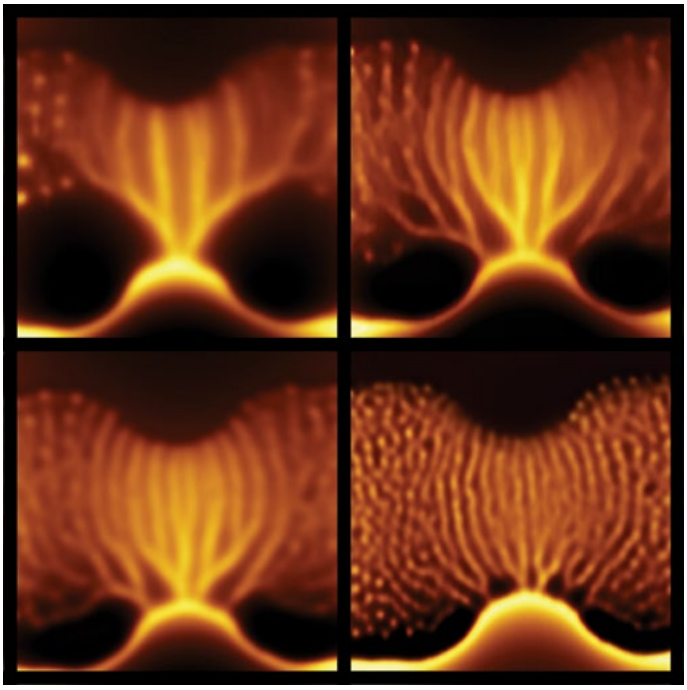
Researchers have made the first direct visual observation and measurement of ultra-fast vortex dynamics in superconductors. Their technique, detailed in the journal Nature Communications, could contribute to the development of novel practical applications by optimising superconductor properties for use in electronics.

Superconductivity is a state of matter in which an electric current can flow with absolutely no resistance. This occurs when certain materials are cooled below a critical temperature. The effect is useful for various applications, from magnetically levitating trains to MRI machines and particle accelerators. It also sparks the imagination with thoughts of lossless power transfer and much faster computation.

However, superconductivity is, generally speaking, suppressed in the presence of magnetic fields, limiting the ability to use these materials in real life applications.

Motion of vortices allows for electrical resistance, which, again, poses an obstacle for applications. Understanding when and how vortices will move or remain localised is the focus of much scientific research. Until now, addressing the physics of fast moving vortices experimentally has proven extremely challenging, mainly because of the lack of adequate tools.

Now an international team of researchers, led by Prof. Eli Zeldov from the Weizmann Institute of Science and Dr. Yonathan Anahory, senior lecturer at the Hebrew University of Jerusalem's Racah Institute of Physics, has shown for the first time how these vortices move in superconducting materials and how fast they may travel.



Four different images of vortices penetrating into a superconducting lead film at rates of tens of GHz, and travelling at velocities up to about 20 km/s. The vortex trajectories, appearing as smeared lines, show a tree-like structure with a single stem that undergoes a series of bifurcations into branches. Each image is done at a different magnetic field and each image is 12 x 12 μm2. (Photo:Yonathan Anahory / Hebrew University)

They observed vortices flowing through a thin superconducting film at rates of tens of GHz, and travelling at velocities much faster than previously thought possible — up to about 72 000 km/hr (45 000 mph). This is not only much faster than the speed of sound, but also exceeds the pair-breaking speed limit of superconducting condensate — meaning that a vortex can travel 50 times faster than the speed limit of the supercurrent that drives it. This would be like driving an object to travel around the earth in just over 30 minutes.

In photos and videos shown for the first time, the vortex trajectories appear as smeared lines crossing from one side of the film to another. This is similar to the blurring of images in photographs of fast-moving objects.

"This work offers an insight into the fundamental physics of vortex dynamics in superconductors, crucial for many applications," said Dr. Lior Embon, who was, at the time, the student in charge of this study. "These findings can be essential for further development of superconducting electronics, opening new challenges for theories and experiments in the yet unexplored range of very high electromagnetic fields and currents."

Furthermore, simulation results obtained by Ph.D. student Željko Jelić from Belgium suggest that by proper sample design and improved heat removal it should be possible to reach even higher velocities. In that regime, the calculated frequencies of penetration of vortices may be pushed to the much technologically desired THz frequency gap.

The research uncovers the rich physics of ultrafast vortices in superconducting films, and offers a broad outlook for further experimental and theoretical investigations. In the future, this technology could allow researchers to test designs that aim to reduce vortex motion and improve the properties of superconductors.

Watch the video at http://media.huji.ac.il/new/photos/hu170720_ya1.mp4

MYSTERIOUS CHILDREN'S NEUROLOGICAL DISEASE IS TRACED TO A SINGLE ERROR IN ONE GENE

Scientists find that affected children's cells are flooded with ribosomal RNA and are poisoned by it; the first time that an excess of ribosomal RNA has been linked to a disease in humans

In a new study published today in The American Journal of Human Genetics, a multinational team of researchers describes, for the first time, the biological basis of a severe neurological disorder in children.

The extremely rare disorder is characterised by developmental regression and neurodegeneration. At first the children lead normal lives and seem identical to their age-matched peers. However, beginning at around 3 to 6 years of age, they present with neurological deterioration, gradually losing motor, cognitive and speech functions. Although the condition progresses slowly, most patients are completely dependent on their caretakers by 15-20 years of age.

Prof. Orly Elpeleg
(Photo: Hebrew University)

Researchers from the Hadassah Medical Center and the Hebrew University of Jerusalem's Faculty of Medicine, working with colleagues from the Pennsylvania State University College of Medicine and a multinational research team, have now identified and studied 7 children — from Canada, France, Israel, Russia and the United States — who suffer from the disorder.

The researchers found in all patients the same spontaneously occurring, non-inherited genetic change in a gene (named "UBTF") responsible for ribosomal RNA formation. Because of this small change, the patients' cells are flooded with ribosomal RNA and are poisoned by it. (Ribosomes are responsible for the translation and production of cell proteins; themselves, they are made up of ribosomal proteins and of ribosomal RNA in a precise ratio).

The researchers found an identical error in the same gene in all the patients tested, representing a difference of one letter among the roughly 3 billion letters that make up human DNA. By finding the identical change in children who suffer from the identical clinical disease, the researchers determined that the altered gene is indeed the cause of the disease.

Prof. Orly Elpeleg, head of the Department of Genetics at Hadassah Medical Center in Jerusalem and a professor of Paediatrics at the Hebrew University's Faculty of Medicine, led the multinational research. Prof. Elpeleg credits the discovery to deep sequencing technology that Hadassah and the Hebrew University were among the first to introduce into clinical practice in the world, and the first in Israel.

"Our study links neuronal degeneration in childhood with altered rDNA chromatin status and rRNA metabolism. It is the first time that an excess of ribosomal RNA has been linked to a genetic disease in humans," said Prof. Elpeleg.

While there is currently no cure for genetic diseases of this kind, the identification of the exact mutation may allow for the planning of therapies designed to silence the mutant gene. "Science may not be able to repair the gene, but now that our findings are published, it may be possible to make early identification of the disease and in the future find ways to prevent such a serious deterioration," said Prof. Elpeleg.

RAPID 3D PRINTING IN WATER USING NOVEL HYBRID NANOPARTICLES HOLDS PROMISE FOR OLD AND NEW INDUSTRIES

A new type of nano-photoinitiator could lead to advanced biomedical and industrial materials, along with more environmentally friendly printing processes

Researchers at the Hebrew University of Jerusalem's Center for Nanoscience and Nanotechnology have developed a new type of photoinitiator for three-dimensional (3D) printing in water. These novel nanoparticles could allow for the creation of bio-friendly 3D printed structures, further the development of biomedical accessories, and drive progress in traditional industries such as plastics.

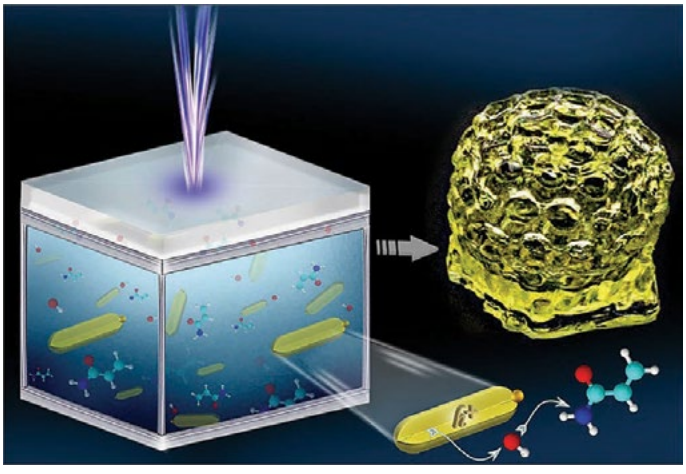
3D printing has become an important tool for fabricating different organic based materials for a variety of industries. However, printing structures in water has always been challenging due to a lack of water soluble molecules known as photoinitiators -- the molecules that induce chemical reactions necessary to form solid printed material by light.

Now, writing in Nano Letters, Prof. Uri Banin and Prof. Shlomo Magdassi at the Hebrew University's Institute of Chemistry describe an efficient means of 3D printing in water using semiconductor-metal hybrid nanoparticles (HNPs) as the photoinitiators.

3D printing in water opens exciting opportunities in the biomedical arena for tailored fabrication of medical devices and for printing scaffolds for tissue engineering. For example, the researchers envision personalised fabrication of joint replacements, bone plates, heart valves, artificial tendons and ligaments, and other artificial organ replacements.

3D printing in water also offers an environmentally friendly approach to additive manufacturing, which could replace the current technology of printing in organic based inks.

Unlike regular photoinitiators, the novel hybrid nanoparticles developed by Prof. Banin and Prof. Magdassi present tuneable properties, wide excitation window in the UV and visible range, high light sensitivity, and function by a unique photocatalytic mechanism that increases printing efficiency while reducing the amount of materials required to create the final product. The whole process can also be used in advanced polymerisation modalities, such as two photon printers, which allows it to produce high resolution features.



Hybrid nanoparticles as photoinitiators

NANOSCALE CHIP SYSTEM MEASURES LIGHT FROM A SINGLE BACTERIAL CELL TO ENABLE PORTABLE CHEMICAL DETECTION

Further development could open door to on-chip biological and chemical sensing applications, e.g. detecting chemicals in real-time continuous flow systems and even in an open-air environment

Researchers at the Hebrew University of Jerusalem have created a nanophotonic chip system using lasers and bacteria to observe fluorescence emitted from a single bacterial cell. To fix the bacteria in place and to route light toward individual bacterial cells, they used V-groove-shaped plasmonic waveguides, tiny aluminium-coated rods only tens of nanometers in diameter. The novel system, described in the journal Nano Letters, paves the way for an efficient and portable on-chip system for diverse cell-based sensing applications, such as detecting chemicals in real-time.

The field of on-chip photonic devices for biological and chemical sensing applications presents many powerful alternatives to conventional analytical techniques for applications ranging from "lab on a chip" to environmental monitoring. However, these sensing schemes rely mainly on off-chip detection and require a cumbersome apparatus, even when measuring only single cells.

The Hebrew University team looked for ways to integrate all system components, including light sources and detectors, on-chip at the nanoscale. This would result in a lab-on-chip system that is small, portable and can perform sensing in real-time.

To achieve this, they molecularly engineered live bacteria that emit a fluorescent signal in the presence of target compounds. They paired these on-chip with a nanoscale waveguide, which not only served the purpose of guiding light, but also allowed mechanical trapping of individual bacteria within the V-groove.

In three different illumination conditions, they experimentally demonstrated the interrogation of an individual Escherichia coli bacterial cell using a nanoscale plasmonic V-groove waveguide. First, they measured the light emitted from a bacterium flowing on top of the nanocoupler in a liquid environment by allowing the fluorescence from the bacterium to be coupled directly into the waveguide through the nanocoupler. Next, a bacterium was mechanically trapped within the V groove waveguide and was excited by laser directly either from the top or through the nanocoupler. In all cases, significant fluorescence was collected from the output nano coupler into the detector.

The system worked well both in wet environments, where the bacteria are flowing on top of the waveguide, and in dry conditions, where the bacteria are trapped within the waveguide.

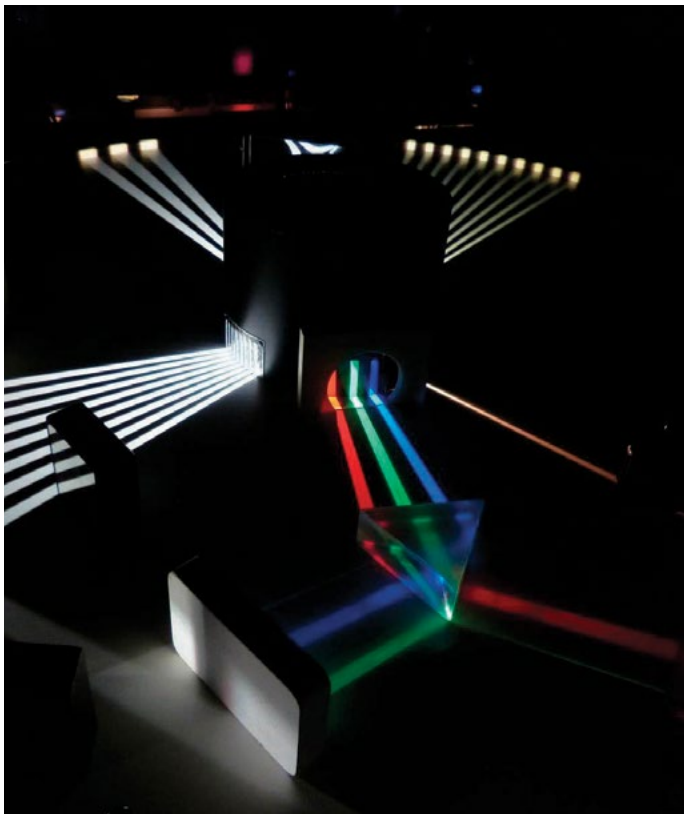
The research was led by Prof. Uriel Levy, Director of The Harvey M. Krueger Family Center for Nanoscience and Nanotechnology at the Hebrew University in collaboration with Prof. Shimshon Belkin, at the Hebrew University's Alexander Silberman Institute of Life Sciences, who genetically engineered the bacterial sensors, and Prof. Anders Kristensen from the Danish Technical University, who was in charge of fabricating the V-groove waveguides. Prof. Levy is the Eric Samson Chair in Applied Science and Technology, and Prof. Belkin is the Ministry of Labor and Social Welfare Chair in Industrial Hygiene, at the Hebrew University.

Unlike the more traditional plasmonic waveguides consisting of either silver or gold, the choice of aluminium was instrumental for being able to guide the fluorescent light emitted from the bacteria all the way to the output nanocoupler. Furthermore, the waveguide dimensions allow for efficient mechanical trapping of the bacteria and the multimode characteristics may become instrumental in gathering more information, e.g., on the specific position and orientation of the bacteria.

The results provide a clear indication of the feasibility of constructing a hybrid bioplasmonic system using live cells. Future work will include the construction of waveguide network, diversifying the system to incorporate different types of bacterial sensors for the detection of various biological or chemical analytes.

The research is a collaboration between scientists at the Department of Applied Physics, the Rachel and Selim Benin School of Engineering and Computer Science, the Harvey M. Krueger Family Center for Nanoscience and Nanotechnology, and the Alexander Silberman Institute of Life Sciences, at the Hebrew University of Jerusalem, Israel; and the Department of Micro- and Nanotechnology, Technical University of Denmark, Kongens Lyngby, Denmark. Additional researchers include Oren Lotan, Jonathan Bar-David, Cameron L.C. Smith, and Sharon Yagur-Kroll.

Watch the videos at
http://media.huji.ac.il/new/multimedia/hu170816_nano1.mp4
http://media.huji.ac.il/new/multimedia/hu170816_nano2.mp4



A laser beam excites fluorescent bacteria swimming in a micro-fluidic device. The fluorescent light emitted by these bacteria radiates in all directions, and some of it couples into a plasmonic waveguide and is directed toward the waveguide's end. The direct fluorescence from the bacteria is seen most clearly on the right-hand side, while light which was coupled and propagated in the waveguide appears as a bright spot blinking on the left-hand side. The blinking is a result of the bacteria's changing position, and is correlated to the location of the bacteria relative to the nano-mirror in the waveguide's right side. (Photo: Hebrew University)

NEWS FROM AROUND AUSTRALIA

ALUMNI SPOTLIGHT

Welcome to our new segment, Spotlight on Alumni. In each edition of Hebrew University – The Innovative Way, we will profile a Hebrew University alumnus/alumna, now residing in Australia.

SHAHAR BURLA

Dr Shahar Burla is a Sydney-based researcher, lecturer and a Contributing Editor to the Australian online publication, Plus61J. Shahar graduated with Honours from a Master's degree in political science from the Hebrew University and a PhD in political science from Bar-Ilan University. He is the author of Political Imagination in the Diaspora: The Construction of a Pro-Israeli Narrative (2013) and co-editor of Australia and Israel: A Diasporic, Cultural and Political Relationship (2015). He has received several awards, including a President's Fellowship for outstanding PhD student and the Menahem Begin Foundation Academic Award for his Master dissertation from the Hebrew University titled "The Imaginary Impulse: The Political Imagination in Zeev Jabotinsky's Writing".

Shahar has worked extensively in the Not-For-Profit sector and is currently employed as Philanthropy Executive for Autism Spectrum Australia (Aspect), with prior positions at The Sydney Children's Hospital Network and the Sydney Jewish Museum. He has taught in various positions at UNSW and the Hebrew University and currently tutors at Mosman Community College in subjects such as "Israel through Films" and "The Middle East through Films" and at Melton Jewish Culture Courses at the University of Sydney in "Israeli Literature as a Window to Israeli Society". He has presented at many conferences and seminars and has published multiple books, articles, book chapters and papers.

When asked how his studies at the Hebrew University of Jerusalem have affected his career and life today, Shahar attributed the very high quality of education and lecturers in the Department of Political Science. He feels very fortunate to have studied under Professors Shlomo Avineri and Zeev Sternhell, who were both very influential on his academic writings. During the first two years of study at the University, Shahar lived in student dormitories and one of his roommates is still a close friend today. During his time on campus, Shahar witnessed political tension due to the second Intifada and was at Mount Scopus the day that the Frank Sinatra café was bombed by Hamas on 31 July 2002.

Shahar feels that the Hebrew University taught him to reach his full potential and that this has been a message that he has carried with him throughout his life, expressed in his ability to create close friendships and understand the needs of society. During his time on campus and in the days before laptops, Shahar spent a lot of time in the Computer Centres on campus, generously funded by Agnes Ginges and the Late Berel Ginges, and was very grateful to have this facility to use.

In his career today, Shahar feels very privileged to be able to help people on the autistic spectrum and to be part of cutting-edge research in to this disability. He has a lot of satisfaction in witnessing the zedakah that the Jewish community contributes to this cause.

As Editor at Plus61J, Shahar is able to focus on his expertise in the Jewish Diaspora and its connection to Israel, the prospect for peace, the situation in the Middle East and assist people to understand Israel through culture and art. He incorporates his academic skills and knowledge honed at the Hebrew University to "broaden the conversation" and show another perspective to the situation in Israel.

Shahar is married to Limor Fayena and they have two children, a 10 year old girl and 6 year old boy and reside in Sydney.

NEW SOUTH WALES

THANK YOU PRINT35

When the NSW Division of the Friends needed to send out our newsletter recently to a very large database and were short-staffed, there was only one place we would go to for assistance with sorting, stuffing and sending…Print35! In addition to providing their wonderful supported employees with a work opportunity, they and all at Jewish Care are a true pleasure to work with. Thank you Print35!!

COMMITTEE FOR STUDENT SUPPORT

Our August Sunday luncheon was addressed by Eddie Jaku, who shared his life story, including his personal experiences during the Holocaust. Growing up, Eddie identified as "German first and Jewish at home". Yet with the rise of Nazism, he was subjected to discrimination, including his expulsion from school in 1933. Though his mother, father and sister were all murdered in Auschwitz, Eddie's motto is not to propagate hatred, which he considers to be a debilitating emotion.

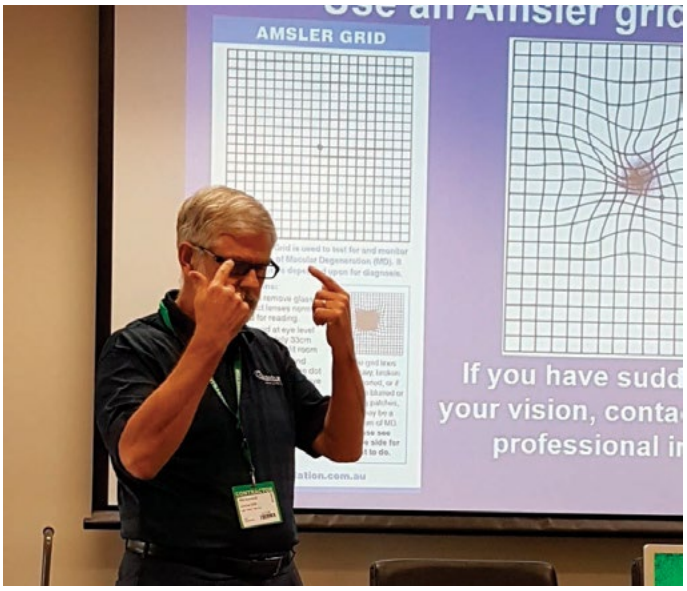
Our next meeting is set for Tuesday, 5 September and our next function is to be held on Sunday 26 November, where the Beersheba 100th Anniversary will be the topic.

HONOURS CLUB

We were indeed privileged to have the President of the Hebrew University, Professor Menahem Ben-Sasson, address our group during his brief visit to Sydney in July. He Spoke of "The Hebrew University and Jerusalem: Building a Bridge to a Better Tomorrow".

Our August speaker was ANU Law Student, Sam Taylor. Sam became fascinated with Israel, after having read the book "Start-up Nation" He took part in the Hebrew University's Mishpatim Law Seminar and now back in Australia, his intention is to continue fostering Israel-Australia relations, particularly in the innovation space.

Our North Shore Honours Club held its second meeting in August, where Rob Drummond addressed our group on "Living with Low Vision", featuring ORCAM – the Hebrew University of Jerusalem technology, founded by Professor Amnon Shashua.



Rob Drummond

VICTORIA

MISSION TO ISRAEL – JUNE 2017

From 6 to 14 June, Eitan Drori, Executive Director of the Australian Friends – Victorian Division led a mission of 32 people the length and breadth of Israel. Among the highlights of the mission were; visits to various Hebrew University scientific and innovative research labs such as the Water-Use Efficiency glass house at the Faculty of Agriculture and Environment in Rehovot, meeting with Israeli combat soldiers on the Israeli-Syrian border on the Golan Heights and at the Gaza-Israel border in the south and a visit to the Peres Centre for Peace and Innovation.

The mission also incorporated the Hebrew University Board of Governors meeting held every year which saw mission participants attending the opening session of the 80th meeting of the Board of Governors at the Hebrew University amphitheatre, attending a plenary session and a gala event.

With the success of this year's mission there is an expectation for an even more spectacular mission for next year, planning for which is already in the works. If you might be interested in joining us, please feel free to contact our Melbourne office on (03) 9272 5510.

WESTERN AUSTRALIA

NANOTECHNOLOGY IS THE TECHNOLOGY OF THE 21ST CENTURY – VISIT BY PROFESSOR URI BANIN

The Australian Friends of the Hebrew University, WA Division, were delighted to host visiting Professor Uri Banin, a leading Nano-scientist at the Hebrew University of Jerusalem's School of Nanotechnology. Prof Banin was in Australia as part of a larger delegation of scientists who attended a symposium at the University of Sydney under the banner of the Sir Zelman Cowan Fund. The lectures and material covered at this symposium were truly breath taking.

Prof Banin took the opportunity to visit Perth to showcase the research in Nanotechnology at the HUJ and to promote the joint UWA-HUJ Student Exchange Scholarship. This scholarship fund - which is seeking sponsorship - allows students from UWA and HUJ to visit each other's university with support. All donations to this fund are fully tax-deductible in Australia.

Prof Banin outlined what the HUJ is doing in this area of technology. It must be remembered that we are talking about technology at the scale of one billionth of a meter. The "next size down" is inside the atom. Prof Banin illustrated applications across the spectrum for this technology. There was a strong emphasis in the biological sciences; drugs used for ovarian cancer are already being delivered in nanotechnology form. Television sets with ultra-high definition use nanotechnology to achieve their clarity of picture. The production of hydrogen as a fuel, from water, is Prof. Banin's special interest. This would provide "clean recyclable, non-polluting energy on almost limitless scale" he said. It would also reduce Israel and the world's dependence on fossil fuels; leading to significant environmental and geopolitical changes.

The application of nano-technology is limitless, with applications in computer science, materials e.g. super light and super strong, already a game changer in aircraft such as the Boeing Dreamliner 787 that will fly Perth to London beginning March 2018.

We were indeed privileged to have a scientist of Prof Banin's calibre lecture us. He is a prolific author, winner of numerous awards and involved at the very frontier of this area of science. One would hope that in the future further exchange in ideas and technology would occur between HUJ and UWA. This can only be achieved by the free exchange of students between both institutions. Supporting the UWA-HUJ scholarship will allow this valuable initiative to prosper.

Assoc. Prof Peter Winterton AM with Prof Uri Banin

Barbara Brezger and Hilary Winterton

Prof Uri & Mrs Yael Banin, Geoff & Valmae Morris and Aviva Freilich

CONTACT US

- Do you want to know more about the activities of the Friends?
- Interested in upcoming events?
- Going to Israel soon and keen to visit the Hebrew University?
- Interested in studying at the University, or do you know someone who is?

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