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Research Article

LATEST RESEARCH

European Integrated Structural Biology Infrastructure launching

Feb 23, 2012 - 5:00:00 AM

Instruct will allow laboratories throughout Europe to gain ready access to the most advanced facilities, technologies and methodologies. Israeli scientists and their European counterparts will now have access to facilities they could only have dreamed of before, says Weizmann Institute's Prof. Gideon Schreiber, Deputy Director of Israel's Instruct Core Centre, as well as of the ISPC. We hope this core centre will stimulate new collaborative research projects between laboratories throughout Europe with the Weizmann Institute and with other Israeli institutions, and also attract more graduate students, postdoctoral fellows and visiting scientists from all over the world.

By Weizmann Institute of Science, [RxPG] Major transformations in biomedical science are on the horizon with the establishment of the world-class Integrated Structural Biology Infrastructure (Instruct) in support of European biomedical research.

The European Strategy Forum of Research Infrastructures (ESFRI) is involved in establishing about 40 such infrastructures, seven of them in biomedical sciences. Instruct is one such biomedical project, whose aim is to provide pan-European user access to state-of-the-art equipment, technologies and manpower in cellular structural biology. This will allow Europe to maintain a competitive edge and play a leading role in this vital research area.

The Weizmann Institute of Science, together with Tel Aviv University, has been chosen as one of the seven Core Centres, joining prestigious institutions in the UK, Italy, France and Germany.

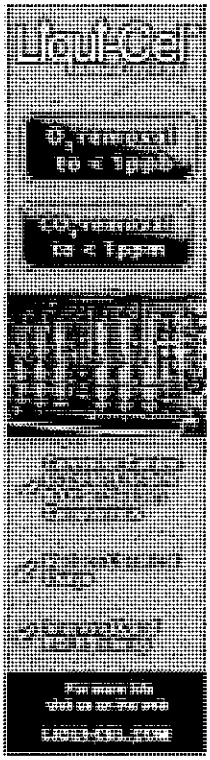
Structural Biology is a scientific area in which Israeli scientists have been leading for many years, as evidenced by Weizmann Institute's Prof. Ada Yonath, who won a Nobel Prize in 2009 for her pioneering work on solving the structure of ribosomes, says the Institute's Prof. Joel Sussman, Director of Israel's Instruct Core Centre.

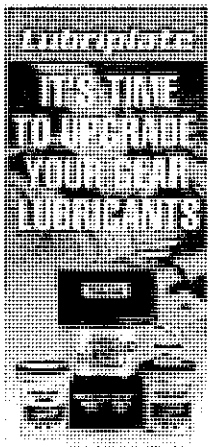
Crucial to understanding how the living cell functions is knowledge of the three-dimensional structures of its proteins and nucleic acids, how these interact with one another, and their arrangement and dynamics within the cell. But no single discipline alone is able to decipher this. In addition to the Weizmann Institute having developed world-class research programs in several of the disciplines relevant to Instruct, including electron microscopy, mass spectroscopy, X-ray crystallography, NMR, bioinformatics and structural proteomics, the Israel Structural Proteomics Center (ISPC) has played a synergistic role in integrating and coordinating all these various disciplines, says Sussman. The ISPC was established by scientists from the Weizmann Institute, with Sussman as its director, in order to increase the efficiency of protein structure determination.

Mirroring the philosophy of the ISPC, Instruct will merge the information obtained by the various structural biology methods and techniques in order to provide a dynamic picture of key cellular processes, both in vivo and in vitro, on all scales from individual macromolecules, through complexes and organelles to the whole cell. This knowledge will permit major advances in understanding and treating diseases.

Instruct will allow laboratories throughout Europe to gain ready access to the most advanced facilities, technologies and methodologies. Israeli scientists and their European counterparts will now have access to facilities they could only have dreamed of before, says Weizmann Institute's Prof. Gideon Schreiber, Deputy Director of Israel's Instruct Core Centre, as well as of the ISPC. We hope this core centre will stimulate new collaborative research projects between laboratories throughout Europe with the Weizmann Institute and with other Israeli institutions, and also attract more graduate students, postdoctoral fellows and visiting scientists from all over the world.

Instruct will formally be launched at a signing ceremony in Brussels on 23rd February, 2012, and Weizmann Institute Vice President Prof. Haim Garty will be signing on behalf of the Weizmann Institute, Tel Aviv University and the State of Israel.





Improving Security In The Cloud

Cloud Computing Will Keep Increasing As The Demand For Computing Power Increases.

Greg Hale, ISSSource.com

01/30/2012

Cloud computing will keep increasing as the demand for computing power increases.

That increase also raises some crucial questions about security like can a user perform computations on data stored in "the cloud" without letting anyone else see the information?

There will soon be the capability to work on data while it is still undergoing encryption, giving an encrypted result that a user can later securely decipher, according to research at the Weizmann Institute and MIT.

Cloud computing is simply an operation carried out on a network of shared, remote servers and the idea of securing the cloud has been an issue in the industry for quite a while.

Attempting computation on sensitive data stored on shared servers leaves that data exposed in ways that traditional encryption techniques can't protect against.

The main problem is that to manipulate the data, you first have to decode it. "Until a few years ago, no one knew if the encryption needed for this sort of online security was even possible," said Dr. Zvika Brakerski, who just completed his PhD in the group of Professor Shafi Goldwasser of the Computer Science and Applied Mathematics Dept. at Weizmann.

In 2009, however, Craig Gentry, a PhD student at Stanford University, provided the first demonstration of fully homomorphic encryption (FHE). But the original method was extraordinarily time consuming and unwieldy, making it highly impractical. Gentry constructed his FHE system by using fairly sophisticated math, based on ideal lattices, and this required him to make new and unfamiliar complexity assumptions to prove security.

Gentry's use of ideal lattices seemed inherent to fully homomorphic encryption; researchers assumed they were necessary for the server to perform such basic operations as addition and multiplication on encrypted data.

Brakerski, together with Dr. Vinod Vaikuntanathan (who was a student of Goldwasser's at MIT), surprised the computer security world earlier this year with two papers describing several new ways of making fully homomorphic encryption more efficient.

For one, they managed to make FHE work with much simpler arithmetic, which speeds up processing time. And a surprise discovery showed a mathematical construct used to generate the encryption keys could be more simple without compromising security. Gentry's original ideal lattices are theoretical collections of points that can add together – as in an ordinary lattice structure – but also multiplied. But the new research shows the lattice does not have to be ideal, which simplifies the construction immensely. "The fact that it worked was something like magic, and it has challenged our assumptions about the function of the ideal lattices in homomorphic encryption," Brakerski said.

Their result promises to pave a path to applying FHE in practice. Optimized versions of the new system could be hundreds – or even thousands of times faster than Gentry's original construction.

Indeed, Brakerski and Vaikuntanathan have managed to advance the theory behind fully homomorphic encryption to the point that computer engineers can begin to work on applications.

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MONDAY, MARCH 12, 2012

Why Do We See The Man In The Moon?

There's something poetic about gazing up at the night sky, seeing the familiar face of the "Man in the Moon" who faithfully accompanies us through life. The synchronous rotation of the Moon - it takes the same amount of time to spin around its own axis as it does to revolve around Earth - is what causes the Moon to "lock eyes" with Earth. This results in one of its hemispheres constantly facing us. But is there a reason why this particular half of the Moon locked with Earth, or was it pure coincidence that it didn't "turn its back" on us?

Through careful analysis and computer-generated simulations, Prof. Oded Aharonson of the Weizmann Institute's Center for Planetary Science (he began this research while still at the California Institute of Technology), together with Prof. Peter Goldreich of the California Institute of Technology and Prof. Re'em Sari of the Hebrew University of Jerusalem have shown that it is not coincidence but the Moon's geophysical properties that determine its orientation. Their findings have recently been published in Icarus.

The near side of the Moon is low-lying and covered by craters filled with dense, dark volcanic material, giving us the Man in the Moon. In contrast, the far side is predominately made up of higher mountainous regions. "Intuitively, we might actually have expected the far side to be facing us as the high mountains would have brought the Moon closer to Earth, putting the system in a lower energy state," says Aharonson. Nature usually prefers lower energy states, so why isn't this the case?

The motion of the Moon is a bit like the motion of toy train circling around a track with two hills and two valleys. The hills and valleys represent the different energy levels of the orientation of the geophysically asymmetric Moon. Friction causes the train to slow down until it doesn't have enough energy to climb over the hill, and settles into one of the valleys. The choice of valleys is governed not by the depth of valleys, but rather by the height of the hill it crossed for the last time. Similarly for the Moon, its maxima energy (the hills in our analogy) governs the ultimate state of the Moon, not its minima energy (the valleys).

According to the scientists' simulations, the energy values calculated for the current geophysical characteristics of the Moon favor locking it in the current orientation. "In fact, by designing different models of the Moon – moving its mass around, and altering various other parameters that affect its gravitational properties – we are able to have complete control over which 'valley' the Moon settles into," says Aharonson.

Some might argue that the Moon would have locked with Earth very early in its existence, when its properties were much different to those of today's moon, and so these findings might not explain the actual events. The scientists, and indeed some evidence, suggest that the other side of the Moon could have been facing Earth at some point, but was hit out of sync and then later relocked into the current orientation in the way described by the new findings.

Aharonson: "For me, what is most interesting is not seeing the Man in the Moon, but the elegance of how the system works."

Prof. Oded Aharonson would like to acknowledge support from the Lunar Reconnaissance Project.

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WEDNESDAY, DECEMBER 14, 2011 ▪ 18 KISLEV, 5772

Weizmann scientists have had leading role in global search for 'God particle'

• By JUDY SIEGEL

Weizmann Institute of Science astrophysicists have been prominent in the experiments that have shown "promising signs" of the existence of the Higgs boson – the "God particle" – that provides a framework for all of the subatomic particles in nature and has been sought for decades.

Scientists at the Large Hadron Collider (LHC) and the CERN research center in Switzerland said in an excited announcement on Tuesday that it found some evidence in its experiments of the existence of the elementary particle.

It was suggested in 1964 by six physicists, including University of Edinburgh physicist Peter Higgs whom it was named after, as a way to explain mass.

The sub-atomic particle called Higgs is the one piece of the Standard Model of Particle Physics that has not been proven to exist, and some scientists believe that the model will have to be rethought if the Higgs is not found.

Prof. Giora Mikenberg of the Rehovot institute was the ATLAS Muon Project leader for many years and now heads the Israeli LHC team. Prof. Ehud Duchovni heads the Weizmann Atlas group, as well as a small group looking for SUSY signals. Prof Eilam Gross is currently the ATLAS Higgs physics group convener.

All are members of the Weizmann Institute's Particle Physics and Astrophysics Department, and they have been part of the effort to find the Higgs since 1987.

ATLAS and its sister experiment in the LHC, CMS, have been searching for the Higgs boson together.

"In 2011, the LHC particle accelerator in Geneva collided over 300 trillion protons," said Gross. "All of that enormous energy – seven-trillion electron volts – went into the effort to produce the Higgs boson.

But in each collision, other similar particles are created, and there is no way to foresee what we will find. The chances of a collision producing a Higgs boson are so small that only about 100 are expected to be observed over the course of a year."

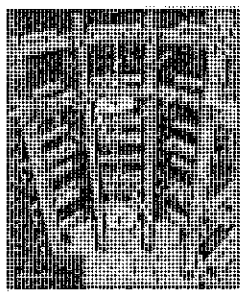
Finding possible signs of a Higgs involved looking for statistical anomalies in the data (compared to what the results would look like if there were no Higgs) in the expected mass range.

The problem is that once these anomalies appear, the scientists had to rule out statistical flukes. But several weeks ago, it was noticed that "extra" events in the probable Higgs range had accumulated in the experimental results during 2011.

"We couldn't believe our eyes – we looked at the screen for ages before we started to digest what we were seeing," Gross continued. "In the past three weeks, the entire Higgs search team in the ATLAS experiment have checked and rechecked the results from every possible angle. We checked for errors... for bugs in the program."

The ATLAS results suggest that there could be a Higgs boson with a mass of around 126 GeV, and that there is just a 1 in 5,000 chance that the extra events they observed in this particular mass are the result of a statistical fluke, and not the creation of a Higgs boson.

Such fluctuations might still disappear, so the proof is still not at all conclusive, but scientists believe that it bodes well for the next round of LHC collisions, which are due to begin in April 2012.



THIS ILLUSTRATION shows the results of a collision that could represent a Higgs boson from the Atlas experiment. (Weizmann Institute of Science)

A Quantum Diaries Survivor

Eilam Gross: Higgs - The Best There Is, For Now

By Tommaso Dorigo | December 2011 | 10 comments | Print | E-mail | Track Comments

Tommaso Dorigo

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Weizmann Institute of Science of Rehovot, Israel, and a distinguished member of the ATLAS collaboration. That makes him a competitor, since I work for the other experiment around the ring, CMS. But Eilam is also a colleague, especially since we are members of the Statistics Committees of our respective experiments and we cooperate in a joint group to try and converge on common practices for statistical procedures in data analysis at the LHC. Ah, and- I forgot to mention he is the convener of the ATLAS Higgs group! So I am very pleased to feature his own take on the LHC results on Higgs searches...

A Quantum Diaries Survivor

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ABOUT TOMMASO

I am an experimental particle physicist working with the CMS experiment at CERN and the CDF experiment at Fermilab. In my spare time I play chess...

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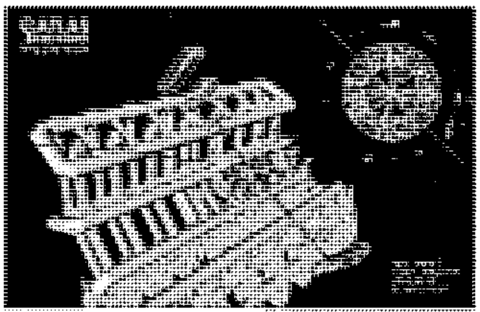
"The God Particle," as the Higgs boson is often called, comes from the title of the book by Nobel laureate Leon Lederman that deals with the search for the elusive particle. This particle, according to the Standard Model of Particle Physics, is responsible for giving mass to all of the elementary particles in nature.

The mass of an electron determines the size of a hydrogen atom; ultimately the size of atoms ensures, amazingly enough, our existence. Maybe this is the reason the Higgs has been treated with almost mystical reverence in the mass media.

The Higgs boson is the only one of the elementary particles making up the Standard Model of Particle Physics that has not yet been discovered. Its importance can't be denied. Many scientists believe that the Standard Model will stand or fall on the discovery of Higgs boson particles orproof that they don't exist.

Three weeks ago, I attended a conference in Paris. Nearly everyone who is involved in the search for this particle was there. I was the guest of my friend Marumi Kado. At some point after a wonderful, wine-filled dinner, Marumi suggested a glass of grappa. "You must," he said. "It is Prime Uva, the best there is." A few hours later, in the wee hours of the morning, Marumi nudged me awake from a deep sleep and said: "Eilam, do you want to see a Higgs?" Of course, I jumped up immediately: "What? Where?" "The computer has stopped running; here are the results," he said. On his computer screen were images from ATLAS. We were all in shock. Something was out of the ordinary at a mass of 126 GeV (a unit of mass close to that of a proton). Definitely significant ~ 3.6 standard deviations. We couldn't believe our eyes - we looked at the screen for ages before we started to digest what we were seeing. For the past three weeks, the entire Higgs search team in the ATLAS experiment have checked and rechecked the results from every possible angle. We checked for errors... for bugs in the program.

In 2011 the LHC particle accelerator in Geneva collided over 300 trillion (a million million) protons in two opposing beams. All of that enormous energy (7 trillion electron volts) went into the effort to produce the Higgs boson. In each collision, other similar particles are created and there is no way to foresee what will be found. Quantum field theory enables us to predict the chances of a certain particle being created. The calculations show that the likelihood of getting a Higgs out of a particular collision is so small that over the course of a year we can't see the signs of more than a hundred or so (with a mass of 126 GeV).



In the figure above we see the result of a collision that looks like a Higgs. But is this a Higgs particle? The problem is that we don't know enough to conclusively identify it. It could look like hundreds or thousands of other particles produced in the collisions. How can we tell?

We don't know for sure! What we can do is count how many of the collisions outcome look similar to a Higgs, and we can calculate how many of these we expect to see in the Standard Model without the Higgs. On the basis of observation, we can compute the probability that the number of collisions that result in particles similar to a Higgs boson will fit the Standard Model (without the Higgs). The numerical value of that probability is called p0.

If there is no Higgs, we would expect that value to bearound 0.5 (50%), i.e., the same as the

Weizmann Institute Scientists Make Significant Contributions to LHC Findings

Published: December 13, 2011, Weizmann Institute of Science

Today's announcement from the Large Hadron Collider (LHC) at CERN points to promising signs for the existence of the Higgs boson. Weizmann Institute scientists have been prominent participants in ATLAS, one of the two experiments to produce results in the search for this elementary particle. Prof. Giora Mikenberg was the ATLAS Muon Project leader for many years and now heads the Israeli LHC team. Prof. Ehud Duchovni heads the Weizmann Atlas group as well as a small group looking for SUSY signals. Prof Eilam Gross is currently the ATLAS Higgs physics group convener. All are members of the Weizmann Institute's Particle Physics and Astrophysics Department, and they have been part of the effort to find the Higgs since 1987.

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ATLAS and its sister experiment in the LHC, CMS, have been searching for the Higgs boson, thought to be the particle that gives all the other elementary particles their mass. The Higgs is predicted by the Standard Model of Particle Physics, which provides a framework for all of the subatomic particles in nature. The Higgs is the one piece of the Standard Model that has not been proven to exist, and some scientists believe that the model will have to be rethought if the Higgs is not found.

Gross: 'In 2011 the LHC particle accelerator in Geneva collided over 300 trillion (a million million) protons. All of that enormous energy (7 trillion electron volts) went into the effort to produce the Higgs boson. But in each collision, other similar particles are created and there is no way to foresee what we will find. The chances of a collision producing a Higgs boson are so small that only about a hundred are expected to be observed over the course of a year.'

Finding possible signs of a Higgs involved looking for statistical anomalies in the data (compared to what the results would look like if there were no Higgs) in the expected mass range. The problem is that once these anomalies appear, the scientists had to rule out statistical flukes. But several weeks ago, it was noticed that 'extra' events in the probable Higgs range had accumulated in the experimental results during 2011. Gross: 'We couldn't believe our eyes -- we looked at the screen for ages before we started to digest what we were seeing. In the past three weeks, the entire Higgs search team in the ATLAS experiment have checked and rechecked the results from every possible angle. We checked for errors... for bugs in the program.'

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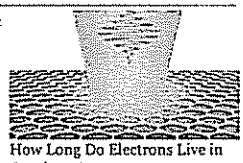

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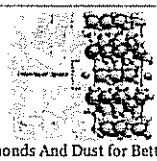

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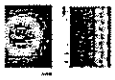

CERN Experiment Traps Antimatter Atoms for 1000 Seconds
CERN
Geneva, 5 June 2011 -- In a paper published online by the journal Nature Physics today, the ALPHA experiment at CERN1 reports that it has succeeded in trapping antimatter atoms for over 16 minutes: long enough to begin to study their properties in detail. ALPHA is part of a broad programme at CERN's antiproton decelerator (AD)[2] investigating the mysteries of one of nature's most elusive substances.

Electron Is Surprisingly Round, Say Imperial Scientists Following 10 Year Study
Imperial College London
Scientists at Imperial College London have made the most accurate measurement yet of the shape of the humble electron, finding that it is almost a perfect sphere, in a study published in the journal Nature today.

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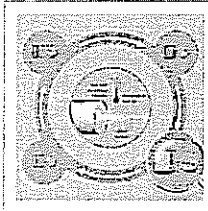

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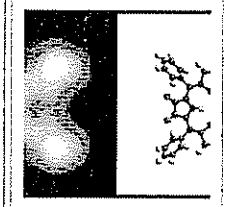

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THURSDAY, JANUARY 12, 2012

Tracking Human Evolutionary History

A new element is being brought in to the already well-developed and multifaceted cooperation between the Max Planck Society and Israel's Weizmann Institute: on 11 January 2012, Max Planck President Peter Gruss and Weizmann President Daniel Zajfman signed the foundation treaty for the new Max Planck Weizmann Center for Integrative Archaeology and Anthropology in Rehovot.

Jean-Jacques Hublin from the Max Planck Institute for Evolutionary Anthropology studies the interactions between Neanderthals and modern humans in the Levant region - on the border between Africa and Eurasia.

Credit: © Volker Steger

"In founding the joint Max Planck Center, we are intensifying the historically evolved cooperation between the Max Planck Society and the Weizmann Institute that has so far spanned more than fifty years," emphasised Max Planck President Peter Gruss. "This is a coming together of two research institutions that are excellently positioned in basic research, in a bid to gain new, ground-breaking knowledge both in the field of archaeology and anthropology."

The new Center will be headed by Professor Jean-Jacques Hublin, Director at the Max Planck Institute for Evolutionary Anthropology in Leipzig, and Professor Steve Weiner from the Kimmel Center for Archaeological Science at the Weizmann Institute in Rehovot, Israel.

How do ideas spread? Why and how do lifestyles change? How can we explain the different stages of development in different parts of the world? Why do groups migrate from one geographical location to another? These are the key questions that will form the first of the new Center's research focuses: "The Timing of Cultural Change". The researchers are interested above all in the time at which cultural change takes place, but also in the spread of cultural traditions in a region. High-resolution radiocarbon dating can offer answers to these questions. Mass spectrometry can help to date findings with a precision of +/- 20 to 40 years. And the radiocarbon calibration curve makes it possible to delve up to 50,000 years into the past, thus enabling researchers to document cultural change over this vast period.

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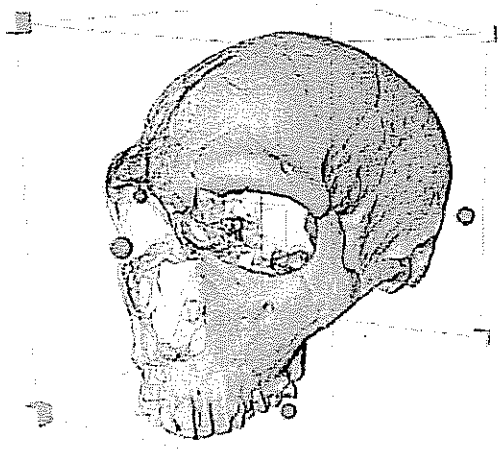

Credit: Max Planck Weizmann Center

The Max Planck Weizmann Center plans to combine work at archaeological digs with lab work and analysis based on radiocarbon dating to obtain reliable results.

The second area of research at the Max Planck Weizmann Center will be concerned with bone and tooth structures and their functional significance.

The Levantine region at the border between Africa and Eurasia is one of the key locations in the history of human evolution. The researchers are particularly interested in the coexistence of Neanderthals and early modern man. Normally, traditional research of fossils is based on the descriptive morphology of bones and teeth. However, for some time now 3D computer reconstructions based on CT scans have been seeing increased use. The Max Planck Institute for Evolutionary Anthropology is world leading in this area. A new high-resolution µCT machine at the Weizmann Institute is able to provide additional detailed information on tooth and bone structures. In the Biomaterials Department, headed by Professor Peter Fratzl, Director at the Max Planck Institute for Colloids and Interfaces in Potsdam-Golm, scientists are investigating the relationship between structure and function in modern bones and teeth. Professor Steve Weiner from the Weizmann Institute is also working on this topic.

Research findings on the relationship between structure, morphology and function in modern bones and teeth can serve as a basis for studying this relationship in fossilised humans, of who hardly anything is known at this point in time. Scientists are hopeful that the new approach will deliver new findings which could mark a radical change in anthropology.

"The Kimmel Center in Rehovot, Israel, and the Max Planck Institute for Evolutionary Anthropology in Leipzig are two of the world's most innovative research centres in the field of archaeological science and the study of bone development. Furthermore, the two sides complement each other marvellously, thanks to their two different areas of expertise," reported Professor Hublin from the Max Planck Institute for Evolutionary Anthropology in Leipzig. He goes on to say, "I am very excited to be sharing in the experience of these two institutions as they begin their new, collaborative scientific project."

The Max Planck Weizmann Center for Integrative Archaeology and Anthropology is the first Center to be established by the Max Planck Society in conjunction with Israel's Weizmann Institute. Ten Max Planck Centers are currently being planned or established at nine locations across the globe.

Contacts and sources:
Angelika Lange-Gao , Managing Director Minerva Foundation GmbH
Administrative Headquarters of the Max Planck Society, München

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The Cause of Type Ia Supernovae

Type Ia supernovae are intensely valuable to astronomy because they're the best and brightest "standard candles" for telling the distances of far galaxies without relying on redshifts. Type Ia's explode with a narrow range of luminosities, and each one's place in this range can be told accurately by its rate of fading. Clearly, almost exactly the same process is happening in them everywhere. So it would be nice to know exactly what that is.

The general picture is clear: a Type Ia happens when a carbon-oxygen white dwarf star collects just enough mass from a binary companion to approach 1.4 solar masses (the Chandrasekhar limit), where it starts to collapse in on itself. In just seconds, the growing pressure at its center sets off a runaway thermonuclear reaction that fuses almost all of the 1.4 solar masses of carbon and oxygen into heavier elements, releasing a well-calibrated amount of energy.

A competing theory is that the tip-over happens when *two* white dwarfs spiral together and merge. This scenario would add troubling uncertainty to how much mass is involved and how much energy these explosions release.

Score one for the standard model. A team led by Assaf Sternberg and Avishay Gal-Yam (Weizmann Institute of Science, Israel) finds that an ordinary mass-donor star must indeed be present in the system, at least some of the time.

The ordinary star, up until the white dwarf explodes, would be blowing off at least a thin stellar wind. A pair of white dwarfs would not do this. Examining spectra of 35 Type Ia supernovae in relatively nearby galaxies, the team found sodium (which has strong, easily detectable spectral lines) in the expanding debris of some of the blasts. Sodium should not exist in a white dwarf, nor should it be created in the explosion itself. It's apparently in the swept-up stellar wind from a normal star that was in the system beforehand.

Not all supernova specialists are convinced. "I suspect the results are also marginally consistent with zero," says Robert Kirshner (Harvard-Smithsonian Center for Astrophysics). "This is not the fault of the observers — they have a sound approach. Basically, they need to build up the statistics."

The *quite* nearby Type Ia that exploded in M101 on August 24th should help.

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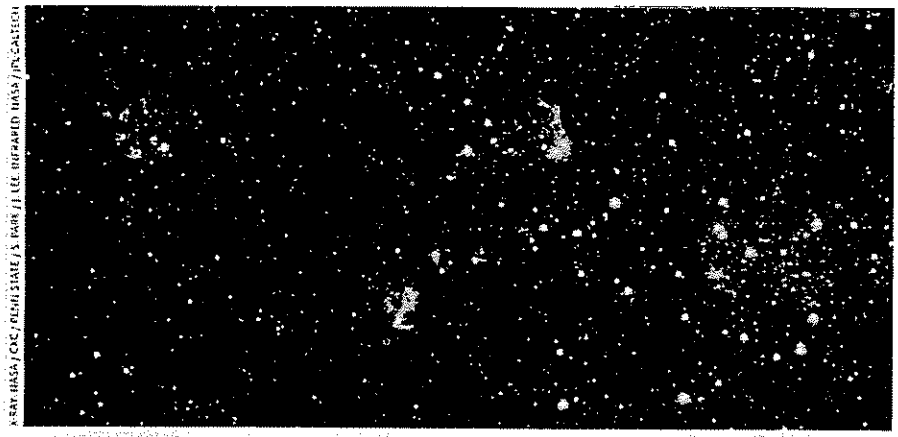

The supernova remnant SNR 0104 in the Small Magellanic Cloud is thought to be the debris from a Type Ia blast. The expanding remnant emits strongly in X-rays, shown purple here. Red and green represent two infrared wavelengths from unrelated stars and nebulae.

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The Most Distant and Ancient Supernovae in the Young Universe

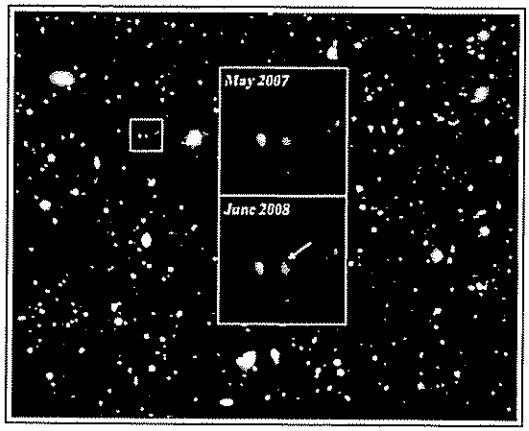

Figure 1: The type Ia supernova in the inset above, one of 150 in the full sample, exploded some 10 billion years ago and is one of the oldest and farthest type Ia supernovae observed to date. Except for a handful of stars, all of the objects in the above image are galaxies. (Click image to enlarge.)

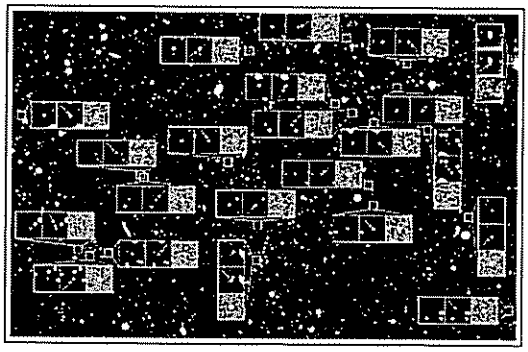

Figure 2: This image shows 22 out of 150 supernovae, only 10% of the Subaru Deep Field. With the exception of a few nearby Milky Way stars, each point of light in the image is a galaxy, which consists of tens of billions of stars. Every triplet of frames focuses on different aspects of one event: the galaxy before the explosion; with the supernova in progress; and isolation of light from the supernova, as shown in a digital "difference image."

Full-size image with supernovae - Full-size image without supernovae

A team of Japanese, Israeli, and U.S. astronomers used the Subaru Telescope to assemble the largest sample ever found of the most distant exploding stars called supernovae, which emitted their light about ten billion years ago, long before the Earth was formed. The researchers used this sample of ancient supernovae to determine how frequently such explosions of stars occurred in the young universe.

Supernovae have substantial importance in astrophysics. They are nature's element factories: essentially all of the elements in the periodic table that are heavier than oxygen were formed through nuclear reactions immediately preceding and during these colossal explosions. The explosions fling these elements into interstellar space, where they serve as raw materials for new generations of stars and planets. Thus, the atoms in our bodies, like the calcium atoms in our bones or the iron atoms in our blood, were created in supernovae. By tracking the frequency and types of supernova explosions back through cosmic time, astronomers can reconstruct the universe's history of element creation, from the plain mix of hydrogen and helium that existed for the first billion years or so after

the Big Bang, up to the elemental richness we see today.

However, looking back in time requires looking out to great distances, which means that even these bright explosions are exceedingly faint and difficult to spot. To overcome this obstacle, the team took advantage of a combination of the Subaru Telescope's assets: the huge light-collecting power of its large 8.2 meter primary mirror; the sharpness of its images, and the wide field of view of its prime focus camera (Suprime-Cam). On four separate occasions, they pointed the telescope toward one single field called the Subaru Deep Field, which spans an area of the sky similar to that covered by the full moon and had previously been studied in great detail by Subaru scientists. By "staring" with the telescope at this single field, they let the faint light from the most distant galaxies and supernovae accumulate over several nights at a time, thus forming a very long and deep exposure of the field. Each of the four observations caught about 40 supernovae in the act of exploding among the 150,000 galaxies in the field. Altogether, the team discovered 150 explosions, including a dozen that rank among the most distant and ancient ever seen.

The team's analysis of the data showed that supernovae of the so-called "thermonuclear" type were exploding about five times more frequently in the young universe, about ten billion years ago, than they do today. Thermonuclear supernovae, often called Type-Ia supernovae, are one of the main sources of the element iron in the universe. Equally important, these explosions have served as cosmic distance markers for astronomers. Over the past decade, they have revealed that the expansion of the universe, in which all galaxies are receding from each other, is actually accelerating under the influence of mysterious dark energy. However, the nature of the thermonuclear supernovae themselves is poorly understood, and there has been fierce debate about the identity of the pre-explosion stars or stellar systems. By revealing the range of the ages of the stars that explode in this way, the team's new findings provide some important clues to solving this mystery. The results correspond closely to a scenario in which a thermonuclear supernovae is the outcome of the merger of a pair of compact stellar remnants called white dwarfs. Future observations with the next-generation Subaru imaging camera, Hyper Suprime-Cam, will permit the discovery of even larger and more distant supernova samples, and allow for further testing of this conclusion.

The results are described in a paper by Graur et al. in the October 2011 issue of the Monthly Notices of the Royal Astronomical Society. The title is "Supernovae in the Subaru Deep Field: the rate and delay-time distribution of type Ia supernovae out to redshift 2".

Team members:

O. Graur (Tel-Aviv University,Israel)
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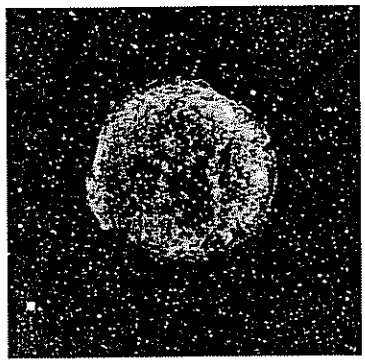
Double checking our cosmic tape measure

By Kelly Oakes | August 18, 2011 | 1

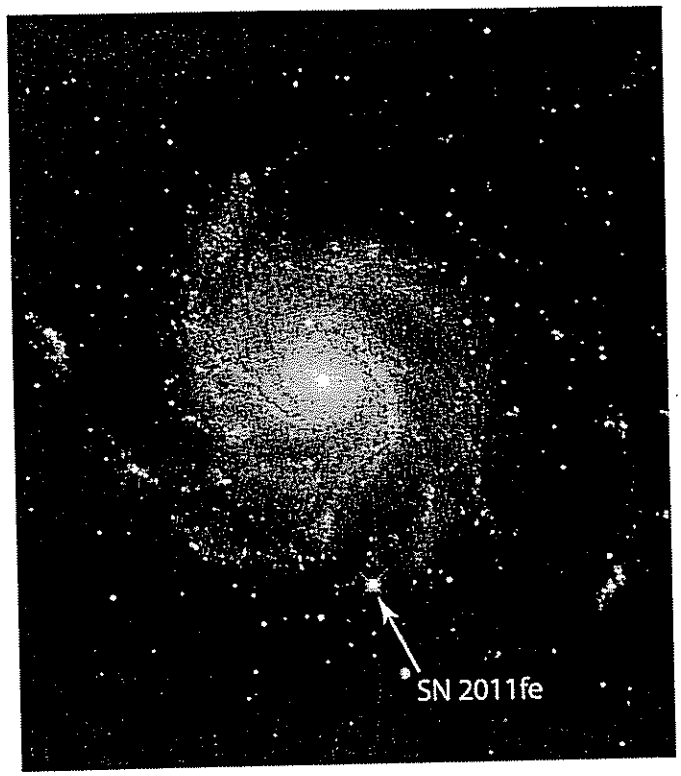


A composite infrared and x-ray image of the remnant of a type 1a supernova. Credit: NASA/MPIA/Calar Alto Observatory, Oliver Krause et al.

In the late 90s there was a race going on between two astronomy collaborations. Both were on the verge of making a discovery that would change the field of cosmology forever, though they may not have realised it at the time. The High-z Supernova Search Team and the Supernova Cosmology Project were both studying a peculiar sort of exploding star, known as a type 1a supernova, and trying to figure out the ultimate fate of the universe — would it expand forever, or eventually slow to a stop and reverse in on itself in a "big crunch"? The answer: neither. Both teams reported, in separate papers, one published in 1998 and the other in 1999, that the expansion of the universe was actually *accelerating*. That is, it is expanding faster today than it was yesterday, and tomorrow it will be moving apart even faster than it is today. This was a rather unexpected result.

Astronomers think that the type of supernova used to make this discovery, type 1a, occurs when a white dwarf — an old, dense star that was once similar to our own Sun — with a binary companion begins to drag material from its companion star on to itself, growing bigger and bigger until, eventually, it can no longer sustain itself. At this

SN 2011fe in the Pinwheel Galaxy (M101) at maximum brightness, a composite of optical data from the Las Cumbres Observatory Global Telescope Network 0.8-meter Byrne Observatory Telescope at the Sedgwick Reserve and (purple) hydrogen emission data from the Palomar Transient Factory.



Credit: B.J. Fulton (LCOGT) / PTF

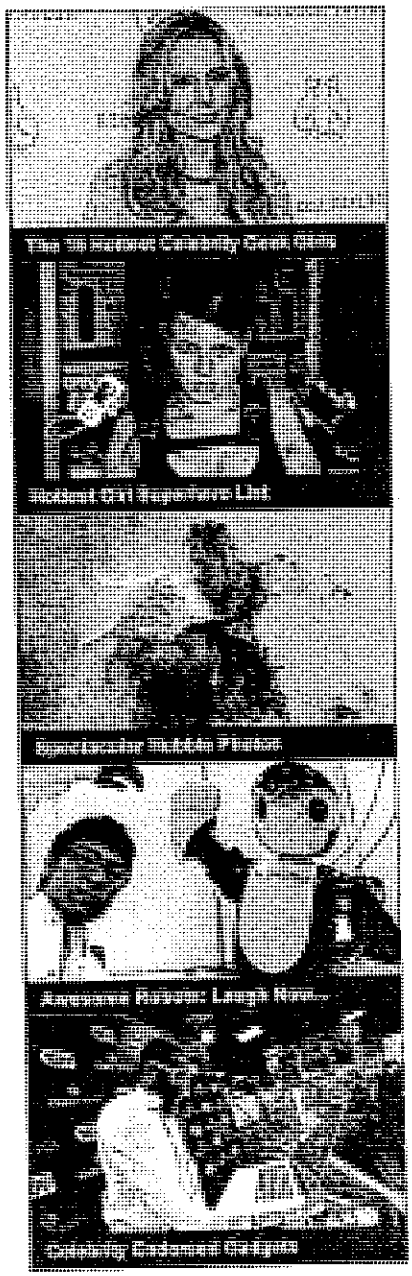
The new "type Ia" thermonuclear supernova, known as PTF 11kly, exploded on August 24th in the Pinwheel galaxy, located in the "Big Dipper," also known as Ursa Major. These supernovae are used to measure dark energy, which scientists believe is related to the expansion of the universe. The discovery of the supernova was made by an international team of astronomers known as the Palomar Transient Factory.

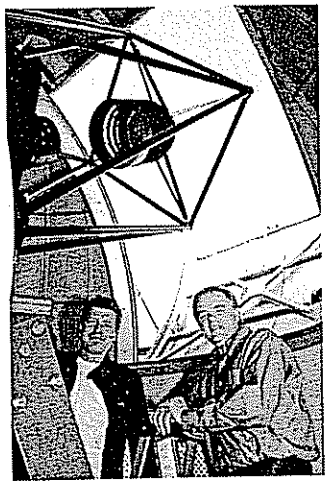
Located 21 million light-years away, this supernova was practically next door, in cosmic terms, and could be seen in early September with binoculars. The explosion gave scientists their best chance yet to study a thermonuclear supernova up close, with modern instruments.

Over the past 50 years, astrophysicists have discovered that type Ia supernovae are part of binary systems — two stars orbiting each other. The one that exploded was theorized to be a white dwarf star. "That's what our sun will be at the end of its life," said Andy Howell, a member of the UCSB team. "It will have the mass of the sun crammed into the size of the Earth." Howell is a staff scientist at the UCSB-affiliated Las Cumbres Observatory Global Telescope Network LCOGT, an assistant adjunct professor of physics at UCSB, and co-author of both papers.

Scientists are upbeat about the finding that the supernova is a white dwarf. "It's been nearly 50 years since the original theoretical suggestions were made that these supernovae were caused by white dwarfs," said co-author Lars Bildsten. "The observational proof is very satisfying to see!" Bildsten is a permanent member of UCSB's Kavli Institute of Theoretical Physics (KITP) and is UCSB's Wayne Rosing, Simon and Diana Raab Chair in Theoretical Astrophysics.

Bottom image: Andy Howell (left) and Lars Bildsten with LCOGT's prototype 1-meter telescope at headquarters in Goleta.





Credit: Rod Rolle

Such white dwarf stars would normally be dead forever, slowly cooling and freezing solid over cosmic time. However, if it has a companion star, then the white dwarf can steal its matter, and return to life. If they steal too much matter, the carbon atoms will fuse so rapidly that the burning cannot be stopped, leading to an explosion as a Type Ia supernova.

That has long been the leading theory, although proof has remained elusive for decades. One of the papers shows that the exploding star had to be smaller than a tenth of the radius of the sun. That rules out normal stars, and for the first time provides direct evidence that white dwarfs are responsible for Type Ia supernovae. The lead author is Peter Nugent, who discovered the supernova, and is a senior staff scientist at Lawrence Berkeley National Laboratory, and an adjunct professor at UC Berkeley.

Scientists have not yet ascertained the type of the companion star to the white-dwarf-turned supernova. However, they have ruled out the type of star they expected — a red giant. Previous studies of RS Ophiuci, a binary star system in our own Milky Way galaxy that is similar to the one being studied, has a white dwarf near the limit that will cause it to explode. And, it is being fed by a companion red giant star. So scientists were somewhat surprised that they did not find a red giant next to the supernova that exploded in August.

A second paper regarding the companion star to the white dwarf was led by Weidong Li, a research scientist at the University of California, Berkeley. He explained: "This is the first time through direct imaging of the explosion site, we were able to rule out certain types of stars as the companion to a Type Ia supernova. The second star couldn't have been a massive red giant."

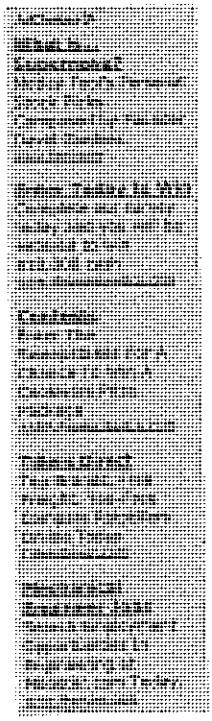
After decades of hunting the origins of Type Ia supernovae, scientists were finally able to make progress in this case for two reasons. In the case of the Li paper, it is because this was the closest thermonuclear supernova since sensitive modern instruments, like those on the Hubble Space Telescope, have been available.

In the Nugent paper, while closeness was necessary, another factor was even more important -- -- the speed of the discovery. The team discovered the supernova only 11 hours after it exploded, allowing for the first estimate of the size of the star when it blew up. "Not only is this the closest Type Ia supernova in the last 25 years, it is the youngest and brightest ever discovered in the digital age," said Nugent. "Observations with ground- and space-based telescopes from the radio through X-ray wavelengths have provided unprecedented constraints on how the supernova exploded."

The scientists noted that these rapid observations were not due to luck; they were possible because the Palomar 48-inch telescope, which was used to discover the supernova, is effectively a robot. Given regions of the sky to scan, Palomar 48 observes all night long without a human driving it. The data are then automatically processed by computers, and new potential supernovae are presented to the discovery team when they wake up.

In fact, LCOGT is building a global network of telescopes to take this idea to the next level. "If you have telescopes spread out in longitude, it is always dark somewhere, so you can observe targets around the clock," said Howell. "We like to say that the sun will never rise on the LCOGT empire."

LCOGT already has telescopes in Haleakala, Hawaii, and Siding Spring, Australia, as well as at the Sedgwick reserve near Santa Ynez, Calif. In 2012 it will expand to Texas, Chile, and South Africa. Last August, astronomers at LCOGT were able to use the fledgling network to monitor



A Supernova with a View: The Closest Supernova in 25 Years Yields New Insights into Its Formation

Published: December 16, 2011. Weizmann Institute of Science

Type 1a supernovae are such regular features of the Universe that astrophysicists use them to measure cosmic distances. But we still don't know exactly what makes these giant explosions occur. Now, scientists at the Weizmann Institute of Science, as part of an international effort to study supernovae, are beginning to clear up the mystery of why certain stars explode in a brilliant display at the ends of their lives.

New research began last August, when the automatic telescopes at the Palomar Transient Factory (PTF) in California that search for signs of developing supernova spotted one just a half a day into the explosion process. Not only was this a very early observation, but the supernova was in the Pinwheel Galaxy a mere 6.4 Megaparsecs away – the closest one in the last 25 years.

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The scientists participating in PTF, including Drs. Eran Ofek and Avishay Gal-Yam of the Particle Physics and Astrophysics Department, have recently published three new papers based on their initial observations and analysis, two of them appearing in *Nature* and one in the *Astrophysical Journal.*

Data on the new supernova came from X-ray and radio wave telescopes, both Earth- and satellite-based. In addition, the researchers went over images of the Pinwheel Galaxy taken by the Hubble Space Telescope over the years to see if they could detect pre-explosion signs of the system that gave rise to the supernova.

To the scientist's surprise, the X-ray and radio observations yielded no significant data, and the archival study did not reveal what was there beforehand. But, like the dog in the Sherlock Holmes story that didn't bark, this lack turned out to be a significant clue: It allowed them to eliminate some of the various scenarios proposed for the type of setup causing the explosion.

These scenarios fall into two broad categories, both of them involving ancient, dense stars called white dwarfs. In one, two white dwarfs merge, and their combined mass becomes unstable, ending in a thermonuclear blast. In the other, the heavy white dwarf siphons off material from a companion star until it exceeds its stable weight limit, again causing an explosion. Proposed companion stars run the gamut from huge, gaseous red giants to smaller, sun-like stars.

The team's results, including an analysis of the material thrown off in the blast and of the 'shock breakout' that takes place as the light released in the shockwave passes through the mass of erupting material (conducted by Itay Rabinak, a student of Prof. Eli Waxman of the same department), showed that the exploding star was, as predicted, a white dwarf: an extremely compact star with a diameter much smaller than that of our sun. And while the team didn't manage to discount either category, they set an upper limit on the size of a possible companion, showing it could not have been a particularly large star, such as a red giant.

'Although we can't rule out a white dwarf merger,' says Ofek, 'our results point to another likely scenario in which a medium range star – close to our sun's size – supplied the white dwarf with the extra material needed to turn it into a supernova.'

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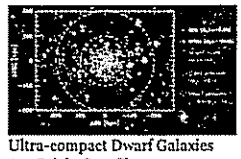
stars 
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The white blood cells that fight disease and help our bodies heal are directed to sites of infection or injury by 'exit signs' - chemical signals that tell them where to pass through the blood vessel walls and into the underlying tissue. New research at the Weizmann Institute, which appeared in *Nature Immunology* online, shows how the cells lining blood vessel walls may act as 'selectors' by hiding the signals where only certain 'educated' white blood cells will find them.

In previous studies, Prof. Ronen Alon and his team in the Immunology Department had found that near sites of inflammation, white blood cells rapidly crawl along the inner lining of the blood vessels with tens of tiny legs that grip the surface tightly, feeling for the exit sign. Such signs consist of migration-promoting molecules called chemokines, which the cells lining the blood vessels - endothelial cells - display on their outer surfaces like flashing lights.

In the new study, Alon and his team, including Drs. Ziv Shulman and Shmuel Cohen, found that not all chemokine signals produced by endothelial cells are on display. They observed the recruitment of subsets of immune cells called effector cells that are the 'special forces' of the immune system: They receive training in the lymph nodes, where they learn to identify a particular newly-invading pathogen and then return to the bloodstream on a search and destroy mission. Like the other white blood cells, effector cells crawled on tiny appendages along the lining of inflamed blood vessels near the site of pathogen entry, but rather than sensing surface chemokines, they used their legs to reach into the endothelial cells in search of the migration-promoting chemokines.

As opposed to the external exit signs, these chemokines were held in tiny containers - vesicles - inside the inflamed endothelial cell walls. The effector cells paused in the joins where several cells met, inserting their legs through the walls of several endothelial cells at once to trap chemokines as they were released from vesicles at the endothelial cell membrane. Once they obtained the right chemokine directives, the immune cells were quickly ushered out through the blood vessel walls toward their final destination.

The researchers think that keeping the chemokines inside the endothelial cells ensures, on the one hand, that these vital signals will be safe from getting washed away in the blood or eaten by various enzymes. On the other hand, it guarantees that only those effector cells with special training - that can make the extra effort to find the signals - will pass through.

Alon: 'We are now seeing that the blood vessel endothelium is much more than just a passive, sticky barrier - it actively selects which recruited cells actually cross the barrier and which will not. The endothelial cells seem to play an active role in showing the immune cells the right way out, though we're not sure exactly how. Moreover, we think that tumors near blood vessels might exploit these trafficking rules for their benefit by putting the endothelial cells in a quiescent state or making the endothelium produce the 'wrong' chemokines. Thus, immune cells capable of destroying these tumors will not be able to exit the blood and navigate to the tumor site, while other immune cells that aid in cancer growth will.'

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12033 - מכון ויצמן למדע

HEALTH SCAN

• By JUDY SIEGEL-ITZKOVICH

WHITE CELL 'SELECTORS'

The white blood cells that fight disease and help our bodies heal are sent to sites of infection or injury by "exit signs" – chemical signals that tell them where to pass through the blood vessel walls and into the underlying tissue. New research at the Weizmann Institute of Science that appeared online recently in *Nature Immunology* shows how cells lining blood vessel walls may act as "selectors" by hiding signals where only certain "educated" white blood cells find them.

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"We are now seeing that the blood vessel endothelium is much more than just a passive, sticky barrier; it actively selects which recruited cells actually cross the barrier and which will not," says Alon. The endothelial cells seem to play an active role in showing the immune cells the right way out, though we're not sure exactly how. Moreover, we think that tumors near blood vessels might exploit these trafficking rules for their benefit by putting the endothelial cells in a quiescent state or making the endothelium produce the "wrong" chemokines. Thus, immune cells capable of destroying these tumors will not be able to exit the blood and navigate to the tumor site, while other immune cells that aid in cancer growth will."

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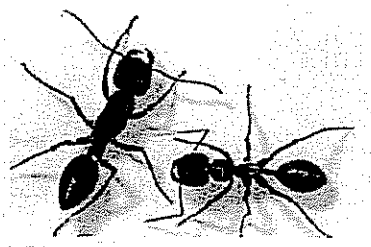
SUNDAY, DECEMBER 4, 2011

Divine Secrets Of The Ant Sisterhood: No Leaders Needed In Empire Of The Ants

"In the long history of humankind (and animal kind, too) those who learned to collaborate and improvise most effectively have prevailed," wrote Darwin. Ants, a family that has inhabited the earth for about 100 million years, must be one of the most magnificent manifestations of such biological cooperation. Thousands of female ants pull together in a coordinated effort to ensure that all the needs are met for the proper functioning of the entire colony. (The males' only role is to mate with the queen, and once this is completed, they die).

Ants communicating

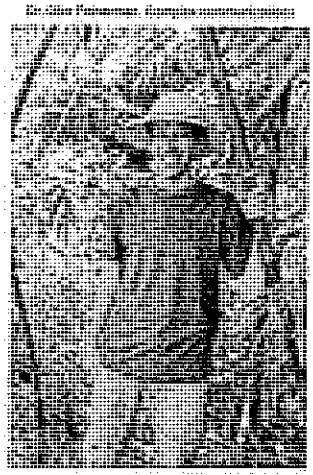


Credit: Weizmann Institute

While some ants forage, others stay behind to tend the brood, or to build, maintain or defend the colony's living quarters; and there are even those whose task it is to bury the dead. But the thing that makes their behavior so remarkable is that they have no leader – no boss or governing body to allocate and manage their activities. How exactly do ants collaborate and divide the labor among themselves so successfully and altruistically?

In his new lab in the Physics of Complex Systems Department, Dr. Ofer Feinerman and his team are hoping to reveal some of the ants' secrets in a collaborative effort of their own, using tools from such fields as information theory, statistical and theoretical physics, computer science, systems biology, neuroscience and, of course biology.

"Biology is rife with complex systems consisting of individual components – proteins, cells, organisms – organizing themselves into networks to coordinate their activity. While biology is able to identify and describe the individual components, the interactions between them can get very messy and analyzing such data can become overwhelming. By borrowing tools from physics and math, more quantitative measurements can be used to discern the rules that govern such complex collective behaviors," says Feinerman.



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BLOG ARCHIVE

Ants primarily "speak" to one another in the language of chemicals: If an ant finds a rich food source, for example, it will deposit a trail of pheromones that tells the other ants where to find it. Social networks are formed between the ants during such communication, and it is these networks that Feinerman wants to understand.

In a setup reminiscent of Big Brother,Feinerman has handpicked a number of native Israeli ants to enter an artificial, nest-like structure that has cameras dotted around, enabling his team to eavesdrop on the ants' "conversations." Each ant is identified by a barcode glued to its back, enabling the scientists to track and record its activities.

The scientists are hoping to answer such questions as: Who "speaks" to whom? Do ants form cliques and only interact with those in the same group, or are they indiscriminate? Do they employ far-reaching social networking tools akin to, say, Twitter or Facebook, relying on others to "retweet" and "share" their messages? Do messages get passed down a line of ants, or would an ant prefer to wander far and wide to make sure the message is relayed accurately?

Feinerman: "Ants use different communication strategies, ranging from one extreme to the other, depending on the setting. For example, in 'piggybacking,' one ant rides on top of another; though slow, this is a very reliable and direct method of communication, appropriate, for example, for ensuring the second ant arrives at the exact food location without getting lost along the way. Other situations may warrant less focused, but faster, forms of communication. For example, if a colony comes under attack, the ants spray pheromones into the air. This alarm system rapidly warns other, distant colonies of potentially imminent danger."

Slow and reliable or fast with some compromise: Understanding ant communication and social networking strategies will do more than help reveal the intricate workings of an ant colony; they also assist in the long term goal of using this rich cooperative system to develop a theory of collective information processing. Ultimately, the researchers would like to develop the tools needed to answer fundamental questions about other complex biological systems: for instance, how immune system cells work together to fight infection. Such tools could also have practical applications in the design of so-called distributed systems, including cellular communication antennae, wireless sensor networks or even groups of robots engaged in rescue operations.

Empire of the Ants

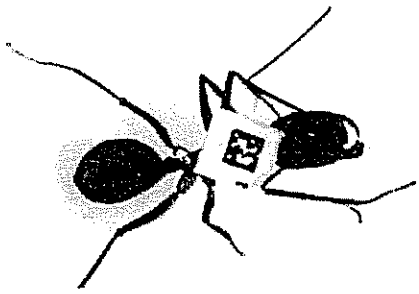
At the head of each ant colony is a queen; but, though "royalty," she does not possess any sovereign power over the worker ants – her sole duty is to lay eggs. With no ruler, how do ants divide labor? Do some ants belong to "elite" units, with others relegated to more "lower-class" duties? Or are they all equal?

In previous research, Dr. Feinerman investigated whether certain factors – previous experience, age, body weight, spatial location – determine how tasks are allocated. One way to test this is to see how ants respond to increased demands in certain tasks. For example, when food stores are running low, which ants take it upon themselves to aid in the foraging effort? Or offer a helping hand to nurse an extra brood in the colony?

The ants were placed in an artificial, two-chambered nest, and the scientists manipulated the task load by withholding food or adding new members to a brood. Again, the ants were individually tagged – this time using radio-frequency identification (RFID) – to identify individuals that responded.

This study revealed that it is the leaner ants that are usually on the frontline: They are the first to respond to increased foraging needs, even when other factors (age, experience and spatial location) are taken into account. They also seem to be the ones who engage in transporting the newly planted brood members to the main brood pile. However, lean ants do not seem to actually help in tending the brood. In fact, Feinerman found that brood care seems to be random, not dependent on by age, experience or weight, but rather, by whoever happens to be passing by.

Barcoded ant in the lab of Dr. Ofer Feinerman



Credit: Weizmann Institute

"With regard to foraging, sending out the leaner ants could boost colony survival, as they would be more expendable in the risky task of foraging, may attract fewer predators, and might even be more mobile than their heavier counterparts. Likewise, the fact that brood care seems to be open to all suggests that flexibility in general task allocation, and collaboration on the whole, is more valuable than, say, expertise or experience, as it allows for a rapid response to a changing environment, thereby ensuring the survival of the colony," says Feinerman.

ANT-thropologist

Dr. Ofer Feinerman was born in Rehovot, Israel, and he earned a B.Sc. in physics and mathematics summa cum laude (1998) and an M.Sc. in physics (1999), both from the Hebrew University of Jerusalem. As a Ph.D. student at the Weizmann Institute of Science, under the guidance of Prof. Elisha Moses, he grew the first artificial logic circuits made of nerve cells, earning his doctorate in 2006. He then conducted postdoctoral research for three years at the Memorial Sloan-Kettering Cancer Center in New York, investigating how the immune system's T-regulation cells work together to fight infection. Feinerman spent one year studying ants at Rockefeller University before joining the Department of Physics of Complex Systems at the Weizmann Institute of Science as a Senior Scientist in October 2010. "Coming back to the Weizmann Institute was a dream – not only did it give me the opportunity to return to Israel, but it also gave me the freedom to study ants – a somewhat unconventional subject. For this I am

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eternally grateful to and proud of the Weizmann Institute."

Feinerman is married to Micka, a mosaic artist, and has three children: Matan (9), Shai (7) and Nomi (4).

Dr. Ofer Feinerman's research is supported by the Clore Foundation.

Contacts and sources:
Dr. Ofer Feinerman
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Posted by Alton Parrish at 3:09 AM

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Clear vision summary

NEW WORLDS

• By JUDY SIEGEL-ITZKOVICH

The average person with a digital camera and a computer is used to cropping or scaling down photos and clipping video segments. But these processes can result in the loss of important information; scaling down an image, for example, sacrifices resolution. Now the YEDA Research and Development Company Ltd. – the commercial arm of the Weizmann Institute of Science in Rehovot – has entered into a license agreement with the well-known Adobe Systems Inc. on a "bidirectional similarity measure" to summarize visual data.

The new method produces a complete and coherent visual summary – a smaller or shorter version of the original that retains the most relevant information. The bidirectionality of the method ensures that the resulting image is visually coherent, YEDA says. In addition to telling the same "story," it is as visually pleasing as the original. As opposed to cropping or clipping or scaling down, the summarizing technique manages to maintain both relevant information and resolution details, despite the decrease in size.

In addition to summarizing images and videos, the method may have a number of other applications, including completing missing parts in images and videos; creating montages out of separate images; photo reshuffling (in which elements may be moved around the image/video); automatic cropping; image synthesis (in which an image might be expanded, rather than summarized); and image morphing (generating a video sequence displaying a smooth transition from one image to another, possibly unrelated image).

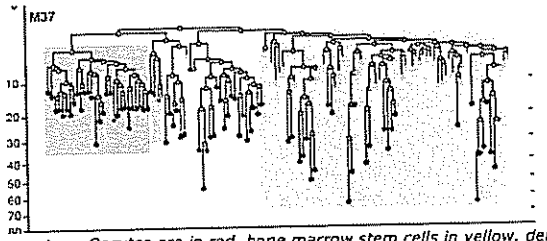
The bidirectional similarity method was developed by Prof. Michal Irani and Drs. Denis Simakov, Yaron Caspi and Eli Shechtman of the Rehovot institute's computer science and applied mathematics department. It is based on eliminating redundant information from the image/video. Video summarization works in a similar way, only the program exploits redundancy in space-time. Gradual resizing and rechecking ensures that the final result is seamless and coherent, the Weizmann team says.

Lineage Trees Reveal Cells' Histories

Thu, 02/23/2012 - 16:00

In recent years, a number of controversial claims have been made about the female mammal's egg supply – that it is renewed over her adult lifetime (as opposed to the conventional understanding that she is born with all of her eggs), and that the source of these eggs is stem cells that originate in the bone marrow. Now, Weizmann Institute scientists have disproved one of those claims and pointed in new directions toward resolving the other. Their findings, based on an original method for reconstructing lineage trees for cells, were published online today in PLoS Genetics.

The method, developed over several years in the lab of Prof. Ehud Shapiro of the Institute's Biological Chemistry, and Computer Science and Applied Mathematics Departments, uses mutations in specific genetic markers to determine which cells are most closely related and how far back they share a common parent cell, to create a sort of family tree for cells. Shapiro and members of his lab, including Drs. Shalev Itzkovitz and Rivka Adar, together with Prof. Nava Dekel and research student Yitzhak Reizel of the Biological Regulation Department, used their method to see if ova could be descended from bone-marrow stem cells. Their findings indicated that any relationship between the two types was too distant for one to be an ancestor of the other.



Mouse cell lineage tree. Oocytes are in red, bone marrow stem cells in yellow, demonstrating that the two form separate clusters with only a distant relationship

These scientists also found, surprisingly, that the ova of older mice had undergone more cell divisions than those of younger mice. This could be the result of replenishment during adulthood, but an alternate theory holds that all eggs are created before birth, and those that undergo fewer divisions are simply selected earlier on for ovulation. Further experimentation, says Shapiro, will resolve the issue.

Cell lineage trees are similar to modern evolutionary and taxonomic trees based on genome comparisons between organisms. Shapiro and his team used mutations in cells that are passed on to daughter cells over an organism's lifetime (though not on to the next generation). By comparing a number of genetic sequences called microsatellites – areas where mutations occur like clockwork – they can place cells on trees to reveal their developmental history.

A number of papers published by Shapiro, his team and collaborators in recent months have demonstrated the power and versatility of this method. One study, for instance, lent support to the notion that the adult stem cells residing in tiny crypts in the lining of the colon do not harbor, as thought, "immortal DNA strands." Immortal strands may be retained by dividing stem cells if they always relegate the newly-synthesized DNA to the differentiating daughter cell and

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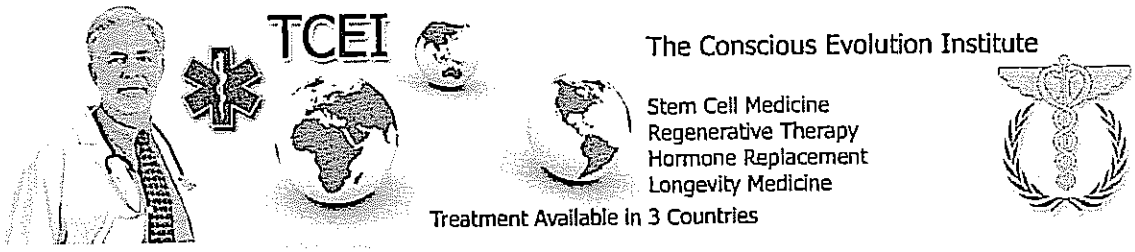

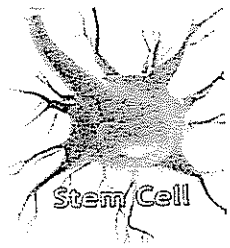

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Lineage trees reveal cells' histories

Posted on February 24th, 2012 in Stem Cells

The method, developed over several years in the lab of Prof. Ehud Shapiro of the Institute's Biological Chemistry, and Computer Science and Applied Mathematics Departments, uses mutations in specific genetic markers to determine which cells are most closely related and how far back they share a common parent cell, to create a sort of family tree for cells. Shapiro and members of his lab, including Drs. Shalev Itzkovitz and Rivka Adar, together with Prof. Nava Dekel and research student Yitzhak Reizel of the Biological Regulation Department, used their method to see if ova could be descended from bone-marrow stem cells. Their findings indicated that any relationship between the two types was too distant for one to be an ancestor of the other.

These scientists also found, surprisingly, that the ova of older mice had undergone more cell divisions than those of younger mice. This could be the result of replenishment during adulthood, but an alternate theory holds that all eggs are created before birth, and those that undergo fewer divisions are simply selected earlier on for ovulation. Further experimentation, says Shapiro, will resolve the issue.

Cell lineage trees are similar to modern evolutionary and taxonomic trees based on genome comparisons between organisms. Shapiro and his team used mutations in cells that are passed on to daughter cells over an organism's lifetime (though not on to the next generation). By comparing a number of genetic sequences called microsatellites – areas where mutations occur like clockwork – they can place cells on trees to reveal their developmental history.

A number of papers published by Shapiro, his team and collaborators in recent months have demonstrated the power and versatility of this method. One study, for instance, lent support to the notion that the adult stem cells residing in tiny crypts in the lining of the colon do not harbor, as thought, "immortal DNA strands." Immortal strands may be retained by dividing stem cells if they always relegate the newly-synthesized DNA to the differentiating daughter cell and keep the original stand in the one that remains a stem cell.

A second study addressed an open question about developing muscle cells. Here they found that two kinds of progenitor cell – myogenic cells, which eventually give rise to muscle fiber, and non-myogenic cells – found within the same muscle are more closely related than similar cells in different muscles.

One immediate advantage of the cell lineage analysis method developed by Shapiro's team is that it is non-invasive and retrospective, and as such can be applied to the

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'Hormone Of Love' Ensures Its Future

Main Category: Neurology / Neuroscience
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Article Date: 04 Nov 2011 - 0:00 PDT

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Much of the body's chemistry is controlled by the brain - from blood pressure to appetite to food metabolism. In a study published recently in *Developmental Cell*, a team of scientists led by Dr. Gil Levkowitz of the Weizmann Institute has revealed the exact structure of one crucial brain area in which biochemical commands are passed from the brain cells to the bloodstream and from there to the body. In the process, they discovered a surprising new role for the "hormone of love," showing that it helps to direct the development of this brain structure.

The area in question, the neurohypophysis, is an interface between nerve fibers and blood vessels located at the base of the brain. Here, some of the major brain-body interactions take place: Hormones released from nerves into the blood vessels regulate a series of vital body processes, including the balance of fluids and uterine contractions in childbirth.

Although the neurohypophysis has been studied for more than a century, the scientists in the Weizmann Institute-led study developed new genetic tools that enabled them to examine the exact three-dimensional arrangement of this brain structure and clarify the cellular and molecular processes leading to its formation. Since the human neurohypophysis is exceedingly complex, the scientists performed the research on live embryos of zebrafish. These fully transparent embryos offer a unique model for studying the vertebrate brain, lending themselves to genetic manipulation with relative ease and enabling researchers to observe the actual formation of a neurohypophysis under a microscope.

The study revealed a surprising new function for the hormonal messenger oxytocin, dubbed the "hormone of love" because, in addition to controlling appetite and such female reproductive behaviors as breastfeeding, it is also involved in mother-child and mate bonding. The scientists showed that oxytocin, one of the two major hormones secreted in the adult neurohypophysis, is involved in the development of this brain area already in the embryo. At this stage, the oxytocin governs the formation of new blood vessels. "The messenger helps to build the road for transmitting its own future messages," says Levkowitz . Developmental Cell highlighted the study's findings in a preview headlined, "The Hormone of Love Attracts a Partner for Life."

These findings provide an important advance in basic research because they shed light on fundamental brain processes, but in the future they might also be relevant to the treatment of disease. Since the neurohypophysis is one of only a few portions of the brain able to regenerate after injury, an understanding of how it is formed may one day help achieve such regeneration in other parts of the central nervous system.

Additional References Citations

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Scientists Discover New Role for Hormone of Love

Rockville, Maryland, November 09 (QNA) - Scientists have recently discovered a new role for the "hormone of love" oxytocin that of helping the development of a crucial area of brain. In a study published recently in Developmental Cell, a team of scientists led by Dr. Gil Levkowitz of the Weizmann Institute has revealed the exact structure of one crucial brain area in which biochemical commands are passed from the brain cells to the bloodstream and from there to the body. In the process, they discovered a surprising new role for the "hormone of love," showing that it helps to direct the development of this brain structure, Science Daily reported Wednesday. The area in question, the neurohypophysis, is an interface between nerve fibers and blood vessels located at the base of the brain. Here, some of the major brain-body interactions take place: Hormones released from nerves into the blood vessels regulate a series of vital body processes, including the balance of fluids and uterine contractions in childbirth. The scientists developed new genetic tools that enabled them to examine the exact three-dimensional arrangement of this brain structure and clarify the cellular and molecular processes leading to its formation. Since the human neurohypophysis is exceedingly complex, the scientists performed the research on live embryos of zebrafish. These fully transparent embryos offer a unique model for studying the vertebrate brain, lending themselves to genetic manipulation with relative ease and enabling researchers to observe the actual formation of a neurohypophysis under a microscope. The study revealed a surprising new function for the hormonal messenger oxytocin, dubbed the "hormone of love" because, in addition to controlling appetite and such female reproductive behaviours as breastfeeding, it is also involved in mother-child and mate bonding. The scientists showed that oxytocin, one of the two major hormones secreted in the adult neurohypophysis, is involved in the development of this brain area already in the embryo. At this stage, the oxytocin governs the formation of new blood vessels. "The messenger helps to build the road for transmitting its own future messages," said Levkowitz . Developmental Cell highlighted the study"s findings in a preview headlined, "The Hormone of Love Attracts a Partner for Life." These findings provide an important advance in basic research because they shed light on fundamental brain processes, but in the future they might also be relevant to the treatment of disease. Since the neurohypophysis is one of only a few portions of the brain able to regenerate after injury, an understanding of how it is formed may one day help achieve such regeneration in other parts of the central nervous system.

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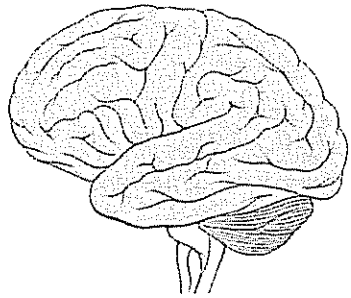

Scientists now have a better understanding of the way that stress impacts the brain. New research, published by Cell Press in the January 26 issue of the journal *Neuron*, reveals pioneering evidence for a new mechanism of stress adaptation and may eventually lead to a better understanding of why prolonged and repeated exposure to stress can lead to anxiety disorders and depression.

Most stressful stimuli cause the release of corticotropin-releasing hormone (CRH) from neurons in the brain. This is typically followed by rapid changes in CRH gene expression.

In more practical terms, as soon as the CRH-containing neurons run out of CRH, they are already receiving directions to make more. CRH controls various reactions to stress, including immediate "fight-or-flight" responses as well as more delayed adaptive responses in the brain. Regulation of CRH activity is critical for adaptation to stress, and abnormal regulation of CRH is linked with multiple human psychiatric disorders.

"Despite the wealth of information regarding the physiological role of CRH in mediating the response to stress, the molecular mechanisms that regulate expression of the CRH gene, and thereby CRH synthesis, have remained largely elusive," explains senior study author, Dr. Gil Levkowitz, from the Weizmann Institute of Science in Israel. "In our study, we used mouse and zebrafish model systems to identify a novel intracellular signaling pathway that controls stress-induced CRH gene expression."

Dr. Levkowitz and colleagues discovered that the protein Orthopedia (Otp), which is expressed in parts of the brain associated with stress adaptation, modulated CRH gene expression and was required for stress adaptation. The researchers went on to show that Otp regulates production of two different receptors on the neurons' surface. The receptors, which receive and relay CRH production instructions, essentially function as "ON" and "OFF" switches.

"This regulation of the CRH gene is critical for neuronal adaptation to stress. Failure to activate or terminate the CRH response can lead to chronic over- or under-activation of stress-related brain circuits, leading to pathological conditions," concludes Dr. Levkowitz. "Taken together, our findings identify an evolutionarily conserved biochemical pathway that modulates adaptation to stress."

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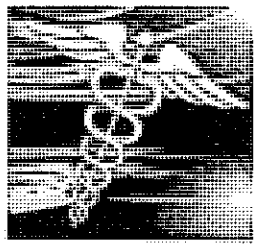
Vaccination for Rheumatoid Arthritis and Crohn's



Recently, scientists of Weizmann Institute have claimed of having found a vaccine which could prove helpful in treating autoimmune diseases like as rheumatoid arthritis and Crohn's. The treatment thus claimed has proved successful on animal. A trial on human is yet to begin.

For the research, the scientists blocked the activities of notorious enzyme called MMP9, which is famous for getting out of control and trigger autoimmune diseases. The findings of the scientists have been published in the renowned pages of journal Nature Medicine.

It has been informed that generally, MMP9 are kept under check by inhibitor molecules called TIMPs. However, if MMP9 gets out of control then it may cause cancer metastasis and autoimmune diseases. Previously, many researchers, scientists and medical experts have tried to target MMP9 but they all had severe side effects.

Therefore, this time the scientists played smartly and found a way by which controlled MMP9 could be produced. The vaccine thus created though does target MMP9 but not directly. The scientists tested the vaccine over mice with a rodent version of Crohn's. It was found that inflammation of the disease reduced significantly with the introduction of the vaccine.

Professor Irit Sagi from the Weizmann Institute said, "We are excited not only by the potential of this method to treat Crohn's, but by the potential of using this approach to explore novel treatments for many other diseases".