מכון ויצמן למדע
WEIZMANN INSTITUTE OF SCIENCE

Science Tips

Media Relations Department
http://wis-wander.weizmann.ac.il news@weizmann.ac.il

Tel: 972-8-934-3852 / 56 Fax: 972-8-934-4132

January 2016

Israeli Instrument Bound for Jupiter

Weizmann Institute scientists are planning an experiment for a mission to the giant planet

NASA/JPL/University of Arizona

Sometime in the year 2030, if all goes according to plan, some dozen groups around the world will begin receiving unique data streams sent from just above the planet Jupiter. Their instruments, which will include a device designed and constructed in Israel, will arrive there aboard the JUICE (JUpiter ICy satellite Explorer) spacecraft, a mission planned by the European Space Agency (ESA) to investigate the properties of the Solar System's largest planet and several of its moons. Among other things, the research groups participating in JUICE hope to discover whether the conditions for life exist anywhere in the vicinity of the planet.

"This is the first time that an Israeli-built device will be carried beyond Earth's orbit," says Dr. Yohai Kaspi of the Weizmann Institute's Earth and Planetary Sciences Department, who is the principal investigator on this effort. The project, conducted in collaboration with an Italian team from the University of Rome, is called 3GM (Gravity & Geophysics of Jupiter and Galilean Moons).

The Israeli contribution to the project is an atomic clock that will measure tiny vacillations in a radio beam provided by the Italian team. This clock must be so accurate it would lose less than a second in 100,000 years, so Kaspi has turned to the Israeli firm AccuBeat, which manufactures clocks that are used in high-tech aircraft, among other things. Its engineers, together with Kaspi and his team, including Dr. Eli Galanti and Dr. Marzia Parisi, have spent the last two years in research and development to design a device that should not only meet the strict demands of the experiment but survive the eight-year trip and function in the conditions of space. Their design was recently approved for flight by the European Space Agency. Israel's Ministry of Science and Technology will fund the research, building and assembly of the device.

For around two and a half years as JUICE orbits Jupiter, the 3GM team will investigate the planet's atmosphere by intercepting radio waves traveling through the gas, timing them and measuring the angle at which the waves are deflected. This will enable them to decipher the atmosphere's makeup.

During flybys of three of the planet's moons – Europa, Ganymede and Callisto – the 3GM instruments will help search for tides. Researchers observing these moons have noted fluctuations in the gravity of these moons, suggesting the large mass of Jupiter is creating tides in liquid oceans beneath their hard, icy exteriors. By measuring the variations in gravity, the researchers hope to learn how large these oceans are, what they are made of, and even whether their conditions might harbor life.

The JUICE teams are preparing for a launch in 2022. That gives them three years to get the various instruments ready and another three to assemble and test the craft. In the long wait – eight years – from launch to arrival, Kaspi intends to work on building theoretical models that can be tested against the data they will receive from their instruments.

Dr. Yohai Kaspi's research is supported by the Helen Kimmel Center for Planetary Science.

http://sci.esa.int/juice/

Tiny “Flasks” Speed Up Chemical Reactions

Self-assembling nanosphere clusters might improve processes from drug synthesis to drug delivery

Miniature self-assembling “flasks” created at the Weizmann Institute may prove a useful tool in research and industry. The nanoflasks, which have a span of several nanometers, or millionths of a millimeter, can accelerate chemical reactions for research. In the future, they might facilitate the manufacture of various industrial materials and perhaps even serve as vehicles for drug delivery.

Dr. Rafal Klajn of the Weizmann Institute’s Organic Chemistry Department and his team were originally studying the light-induced self-assembly of nanoparticles. They were employing a method earlier developed by Klajn in which inorganic nanoparticles are coated in a single layer of organic molecules that change their configuration when exposed to light; these alter the properties of the nanoparticles such that they self-assemble into crystalline clusters. When spherical nanoparticles of gold or other materials self-assembled into a cluster, empty spaces formed between them, like those between oranges packed in a case. Klajn and his team members realized that the empty spaces sometimes trapped water molecules, which led them to suggest that they could also trap “guest” molecules of other materials and function as tiny flasks for chemical reactions. A cluster of a million nanoparticles would contain a million such nanoflasks.

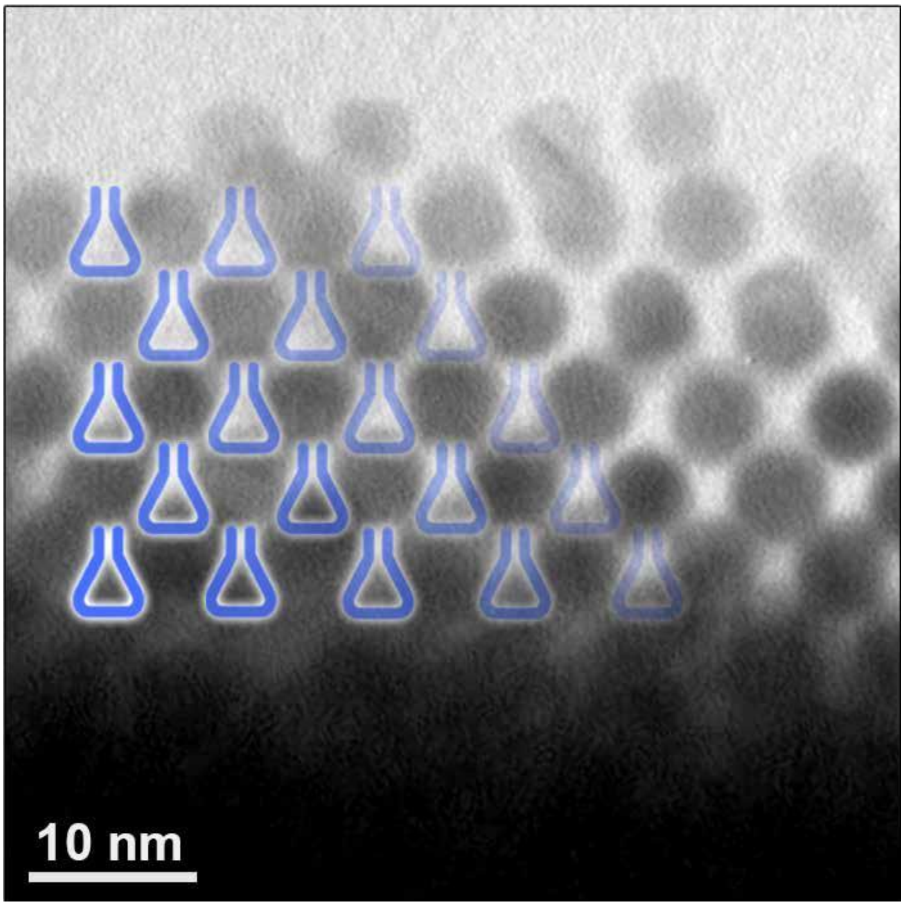
As reported in *Nature Nanotechnology*, when the scientists trapped molecules that tend to react with one another inside the nanoflasks, they found that the chemical reaction ran a hundred times faster than the same reaction taking place in solution. Being confined inside the nanoflasks greatly increased the concentration of the molecules and organized them in a way that caused them to react more readily. Enzymes speed up chemical reactions in a similar manner – by confining the reacting molecules within a pocket.

Although clusters of nanoparticles containing empty spaces have been created before, the advantage of the Weizmann Institute method is that the clusters are dynamic and reversible, so molecules can be inserted and released on demand. The clusters self-assemble when nanoparticles are exposed to ultra- violet light, but exposure to regular light causes them to disassemble, so that the same nanoparticles can be reused in nu- merous cycles. Moreover, the scientists found that by decorating their nanopar- ticles with a mixture of different chemi- cals, they could trap molecules inside the nanoflasks in a highly selective manner. For example, from a mixture of spiral-shaped molecules, they could cause left- or right-handed spirals to be trapped, a skill that can be particularly important for drug synthesis.

For future industrial use, the nanoflasks may prove useful in speeding up numerous chemical reactions, such as polymerization reactions needed for the manufacture of plastics. The method might also be applied one day in drug delivery. The drug would be delivered inside nanoflasks to the target organ and released at the required time when the nanoflasks would disassemble upon exposure to light.

Dr. Klajn’s team included Dr. Hui Zhao, Dr. T. Udayabhaskararao, Michal Sawczyk, Kristina Kucanda, Dr. Debasish Manna, Dr. Pintu K. Kundu and Dr. Ji-Woong Lee. They worked in collaboration with Dr. Petr Kral and his group in the University of Illinois at Chicago.

Dr. Rafal Klajn's research is supported by the Abramson Family Center for Young Scientists; the Rothschild Caesarea Foundation; the Mel and Joyce Eisenberg-Keefer Fund for New Scientists; the estate of Olga Klein Astrachan; and the European Research Council.



A cluster of gold nanoparticles under a transmission electron microscope. Empty spaces between the nanoparticles can serve as nanoflasks, as suggested by the drawing

http://www.nature.com/nnano/journal/vaop/ncurrent/full/nnano.2015.256.html

Your Symptoms? Evolution's Way of Telling You to Stay Home

Research suggests that our selfish genes are behind the aches and fever

When you have a fever, your nose is stuffed and your headache is spreading to your toes, your body is telling you to stay home in bed. Feeling sick is an evolutionary adaptation according to a hypothesis put forward by Prof. Guy Shakhar of the Weizmann Institute's Immunology Department and Dr. Keren Shakhar of the Psychology Department of the College of Management Academic Studies, in a recent paper published in *PLoS Biology*.

We tend to take it for granted that infection is what causes the symptoms of illness, assuming that the microbial invasion directly impinges on our well-being. In truth, many of our body's systems are involved in being sick: the immune system and endocrine systems, as well as our nervous system. Moreover, the behavior we associate with sickness is not limited to humans. Anyone who has a pet knows that animals act differ- ently when they are ill. Some of the most extreme "sickness behavior" is found in such social insects as bees, which typically abandon the hive to die elsewhere when they are sick. In other words, such behavior seems to have been preserved over millennia of evolution.

The symptoms that accompany illness appear to negatively affect one's chance of survival and reproduction. So why would this phenomenon persist? Symptoms, say the scientists, are not an adaptation that works on the level of the individual. Rather, they suggest, evolution is functioning on the level of the "selfish gene." Even though the individual organism may not survive the illness, isolating itself from its social environment will reduce the overall rate of infection in the group. "From the point of view of the individual, this behavior may seem overly altruistic," says Dr. Keren Shakhar, "but from the perspective of the gene, its odds of being passed down are improved."

In the paper, the scientists go through a list of common symptoms, and each seems to support the hypothesis. Appetite loss, for example, hinders the disease from spreading by communal food or water resources. Fatigue and weakness can lessen the mobility of the infected individual, reducing the radius of possible infection. Along with the symptoms, the sick individual can become depressed and lose interest in social and sexual contact, again limiting opportunities to transmit pathogens. Lapses in personal grooming and changes in body language say: I'm sick! Don't come near!

"We know that isolation is the most efficient way to stop a transmissible disease from spreading," says Prof. Guy Shakhar. "The problem is that today, for example, with flu, many do not realize how deadly it can be. So they go against their natural instincts, take a pill to reduce pain and fever and go to work, where the chance of infecting others is much higher."

The scientists have proposed several ways of testing this hypothesis, but they also hope its message sinks in: When you feel sick, it's a sign you need to stay home. Millions of years of evolution are not wrong.

Prof. Guy Shakhar's research is supported by the Leona M. and Harry B. Helmsley Charitable Trust; the Dr. Dvora and Haim Teitelbaum Endowment Fund; the Murray Goodgold Memorial Cancer Research Fund; Simone Pastor, Monaco; Lord David Alliance, CBE; Paul and Tina Gardner, Austin, TX; the Steven B. Rubenstein Research Fund for Leukemia and Other Blood Disorders; the Paul Sparr Foundation; the Comisaroff Family Trust; and the estate of Georges Lustgarten.

http://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.1002276