Chapter 1 : New 'molecular movie' reveals ultrafast chemistry in motion

all of the physical processes and chemical reactions that result in the movement of carbon between the biosphere (living forms) and the geosphere (water, earth, and atmosphere).

Ring-shaped molecules are abundant in biochemistry and also form the basis for many drug compounds. The study points the way to a wide range of real-time X-ray studies of gas-based chemical reactions that are vital to biological processes. A femtosecond is a millionth of a billionth of a second. The results are featured in the June 22 edition of Physical Review Letters. This video describes how the Linac Coherent Light Source, an X-ray free-electron laser at SLAC National Accelerator Laboratory, provided the first direct measurements of how a ring-shaped gas molecule unravels in the millionths of a billionth of a second after it is split open by light. The measurements were compiled in sequence to form the basis for computer animations showing molecular motion. SLAC National Accelerator Laboratory The free-floating molecules in a gas, when studied with the uniquely bright X-rays at LCLS, can provide a very clear view of structural changes because gas molecules are less likely to be tangled up with one another or otherwise obstructed, he added. Ring-shaped molecules play key roles in many biological and chemical processes that are driven by the formation and breaking of chemical bonds. The experiment tracked how the ringed molecule unfurls after a bond between two of its atoms is broken, transforming into a nearly linear molecule called hexatriene. Tracking this ultimately shows how chemical reactions are truly progressing, and will likely lead to improvements in theories and models. Then they fired LCLS X-ray laser pulses at different time intervals to measure how the molecules changed their shape. Researchers compiled and sorted over , strobe-like measurements of scattered X-rays. Then, they matched these measurements to computer simulations that show the most likely ways the molecule unravels in the first quadrillionths of a second after it opens. A gas sample was considered ideal for this study because interference from any neighboring CHD molecules would be minimized, making it easier to identify and track the transformation of individual molecules. The LCLS X-ray pulses were like cue balls in a game of billiards, scattering off the electrons of the molecules and onto a position-sensitive detector that projected the locations of the atoms within the molecules. Additional contributors included scientists at Brown and Stanford universities in the U. SLAC is a multi-program laboratory exploring frontier questions in photon science, astrophysics, particle physics and accelerator research. Department of Energy Office of Science. To learn more, please visit www. The Office of Science is the single largest supporter of basic research in the physical sciences in the United States, and is working to address some of the most pressing challenges of our time. For more information, please visit science.

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Chapter 2 : New â€˜Molecular Movieâ€™ Reveals Ultrafast Chemistry in Motion | SLAC National Accelerat

Change and motion define and constantly reshape the world aroundus, on scales from the molecular to the global. In particular, thesubtle interplay between chemical reactions and molecular transportgives rise to an astounding richness of natural phenomena, andoften manifests itself in the emergence of intricate spatial ortemporal patterns.

Chemistry alumni dinner, Royal Society of Edinburgh. Douglas Robertson The likes of Joseph Black are historic giants of the field, and today our researchers and teachers continue to lead the way, both in their science and in public engagement. Her research was highly regarded, but she is most fondly remembered by alumni and colleagues for her commitment to teaching and training future chemists. James Crawford Teaching of chemistry at Edinburgh began more than three centuries ago when Leith-born James Crawford was appointed to the Chair of Physick and Chymistry in His appointment and his work, with limited resources, played an important role in the recognition of the subject. Joseph Black Joseph Black was educated at home by his Scottish mother, and began his university studies at Glasgow, moving to Edinburgh to graduate in medicine. In he outlined to the Philosophical Society of Edinburgh the experimental approach that became a foundation of a revolution in chemistry. Black was a luminary of the Scottish Enlightenment. Adam Smith, the political economist, loved nothing more than to get Black and James Hutton, the geologist, together at the Oyster Club and listen to them talk. ChemSoc today plays an important role in the life of the School of Chemistry, organising lectures and social and sporting events, and with a membership that includes most staff and students. Crum Brown grew up in Edinburgh, and joined the University as an arts student, before a second degree in medicine. He went on to study chemistry in Germany. He took a lectureship at Edinburgh before being appointed Chair of Chemistry in He had a lifelong interest in weaving, knitting and knots, and his famous, pioneering model showing the crystal structure of Sodium Chloride, held in the School of Chemistry Collection, is made from knitting needles and balls of wool. Walker was planning a new home for chemistry when war broke out. During the war Walker and his colleagues undertook exceptionally successful production of TNT for the government. In Miller graduated from the University of Edinburgh with a BSc with special distinction, having won the class medal, and was awarded the Vans Dunlop Scholarship which allowed her to undertake research for her PhD. She worked under Professor Sir James Walker, and went on to produce the first sample of pure phosphorus trioxide in By showing it emitted no light, she proved it did not cause the glow of phosphorus. Her interests include public engagement and the promotion of women in science, and she makes regular appearances at international conferences on gender equality. Her research specialism is spectroelectrochemistry, focusing on optimising the structure of dyes for use in solar cells. She is a Fellow of the Royal Society, having been appointed in for her experimental research. Her recent work includes the development of nanoelectromechanical devices using carbon nanotubes. This article was published on Jun 27,

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Chapter 3 : Multimedia: Molecules in Motion | Chapter 1, Lesson 2 | Middle School Chemistry

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Taking timing to this new extreme of speed and accuracy at the Linac Coherent Light Source X-ray laser, a DOE Office of Science user facility, will make it possible to see the formative stages of chemical reactions. Pump-probe experiments at LCLS are used to study a wide range of processes at the atomic or molecular scale, including studies of biological samples and exotic materials like high-temperature superconductors. They have inherent jitter that causes them to fluctuate in arrival time, energy, position, duration and the wavelength of their light. There are several tools and techniques that scientists use to understand and limit the impacts of jitter on experiments, and timing tools counter the arrival-time jitter by offering very precise measurements. These measurements can help scientists to interpret their data by pinpointing the timing of changes they see in samples after they are exposed to the first laser pulse. Some experiments would not be possible without precise timing tools because of the ultrafast scale of the changes they are trying to observe. The new pulse-measuring system, which is highlighted in the July 27 edition of Nature Photonics, builds upon the existing tools and pushes timing to attoseconds, which are quintillionths billion-billionths of a second. The upper edge of the dark blue pattern represents the arrival time of the X-ray laser pulse. The scale at left measures the relative delay of X-ray and optical laser pulses, and the bottom measures the wavelength of the transmitted optical light. The colorful patterns it displays represent the different wavelengths of light that passed, at slightly different times, through a thin sample of silicon nitride. This material experiences a cascading reaction in its electrons when it is struck by an X-ray pulse. This X-ray-caused effect shows up in the way the light from the other laser pulse passes through the silicon nitride â€” it is seen as a brief dip in the amount of light recorded by the spectrograph, like the after-image of a camera flash. An image-analysis algorithm then precisely calculates, based on the recorded patterns, the relative arrival time of the X-ray pulses. The new timing system is designed to avoid distortion effects caused by some other timing tools and to work reliably with a variety of focusing and filtering tools. It can provide real-time readouts of laser arrival times and jitter to benefit experiments in progress, and can be added to existing timing setups at LCLS. Hartmann said additional innovations could expand the applications of the new system: The left panel shows how the X-ray beam fluctuates in its direction. The middle panel shows how the spectrum wavelength or "color" of the X-ray laser changes randomly from pulse to pulse. The right panel shows the X-ray-caused dip in the amount of light being recorded. Nature Photonics, 27 July SLAC is a multi-program laboratory exploring frontier questions in photon science, astrophysics, particle physics and accelerator research. Located in Menlo Park, Calif. The Office of Science is the single largest supporter of basic research in the physical sciences in the United States, and is working to address some of the most pressing challenges of our time. For more information, please visit science. The dashed line, produced by an algorithm that analyzes the colorized spectrograph image bottom represents the arrival time of the X-ray laser.

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Chapter 4 : NEET Chemistry Faculty Kota | Best Chemistry Faculty Kota | Motion

Hypervalent Iodine Chemistry is the first comprehensivetext covering all of the main aspects of the chemistry of organicand inorganic polyvalent iodine compounds, including applicationsin chemical research, medicine, and calendrierdelascience.coming a comprehensive overview of the preparation,properties, and synthetic.

June 19, , SLAC National Accelerator Laboratory Shape changes that occur in quadrillionths-of-a-second intervals in a ring-shaped molecule that was broken open by light. The colored chart shows a theoretical model of molecular changes that syncs well with the actual results. SLAC National Accelerator Laboratory Scientists for the first time tracked ultrafast structural changes, captured in quadrillionths-of-a-second steps, as ring-shaped gas molecules burst open and unraveled. Ring-shaped molecules are abundant in biochemistry and also form the basis for many drug compounds. The study points the way to a wide range of real-time X-ray studies of gas-based chemical reactions that are vital to biological processes. A femtosecond is a millionth of a billionth of a second. Before your eyes, a chemical reaction is occurring that has never been seen before in this way," said Mike Minitti, a SLAC scientist who led the experiment in collaboration with Peter Weber at Brown University. The results are featured in the June 22 edition of Physical Review Letters. The free-floating molecules in a gas, when studied with the uniquely bright X-rays at LCLS, can provide a very clear view of structural changes because gas molecules are less likely to be tangled up with one another or otherwise obstructed, he added. The measurements were compiled in sequence to form the basis for computer animations showing molecular motion. Ring-shaped molecules play key roles in many biological and chemical processes that are driven by the formation and breaking of chemical bonds. The experiment tracked how the ringed molecule unfurls after a bond between two of its atoms is broken, transforming into a nearly linear molecule called hexatriene. Tracking this ultimately shows how chemical reactions are truly progressing, and will likely lead to improvements in theories and models. Then they fired LCLS X-ray laser pulses at different time intervals to measure how the molecules changed their shape. Researchers compiled and sorted over , strobe-like measurements of scattered X-rays. Then, they matched these measurements to computer simulations that show the most likely ways the molecule unravels in the first quadrillionths of a second after it opens. The simulations, performed by team member Adam Kirrander at the University of Edinburgh, show the changing motion and position of its atoms. Each interval in the animations represents 25 quadrillionths of a secondâ€”about 1. A gas sample was considered ideal for this study because interference from any neighboring CHD molecules would be minimized, making it easier to identify and track the transformation of individual molecules. The LCLS X-ray pulses were like cue balls in a game of billiards, scattering off the electrons of the molecules and onto a position-sensitive detector that projected the locations of the atoms within the molecules. A Successful Test Case for More Complex Studies "This study can serve as a benchmark and springboard for larger molecules that can help us explore and understand even more complex and important chemistry," Minitti said.

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Chapter 5 : Chemistry in motion | The University of Edinburgh

After a slow start, pharmaceutical and fine chemicals manufacturers are scaling up continuous processes for production.

Quantum mechanics is a set of principles describing physical reality at the atomic level of matter molecules and atoms and the subatomic particles electrons , protons , neutrons , and even smaller elementary particles such as quarks. These descriptions include the simultaneous wave-like and particle-like behavior of both matter and radiation energy as described in the waveâ€"particle duality. In the quantum mechanics, due to the Heisenberg uncertainty principle , the complete state of a subatomic particle, such as its location and velocity, cannot be simultaneously determined. Many of these "imperceptible motions" are only perceivable with the help of special tools and careful observation. The larger scales of imperceptible motions are difficult for humans to perceive for two reasons: Universe[edit] Spacetime the fabric of the universe is expanding meaning everything in the universe is stretching like a rubber band. This motion is the most obscure as it is not physical motion as such, but rather a change in the very nature of the universe. Another reference frame is provided by the Cosmic microwave background. Thus, the solar system is moving. Earth[edit] The Earth is rotating or spinning around its axis. This is evidenced by day and night , at the equator the earth has an eastward velocity of 0. The fastest-moving plates are the oceanic plates, with the Cocos Plate advancing at a rate of 75 millimetres 3. At the other extreme, the slowest-moving plate is the Eurasian Plate , progressing at a typical rate of about 21 millimetres 0. Internal body[edit] The human heart is constantly contracting to move blood throughout the body. Through larger veins and arteries in the body, blood has been found to travel at approximately 0. Though considerable variation exists, and peak flows in the venae cavae have been found between 0. The most familiar would be the occurrence of peristalsis which is where digested food is forced throughout the digestive tract. Though different foods travel through the body at different rates, an average speed through the human small intestine is 3. The lymph fluid has been found to move through a lymph capillary of the skin at approximately 0. Cytoplasmic streaming is a way which cells move molecular substances throughout the cytoplasm , [16] various motor proteins work as molecular motors within a cell and move along the surface of various cellular substrates such as microtubules , and motor proteins are typically powered by the hydrolysis of adenosine triphosphate ATP , and convert chemical energy into mechanical work. Thus the molecules and atoms which make up the human body are vibrating, colliding, and moving. This motion can be detected as temperature; higher temperatures, which represent greater kinetic energy in the particles, feel warm to humans who sense the thermal energy transferring from the object being touched to their nerves. Similarly, when lower temperature objects are touched, the senses perceive the transfer of heat away from the body as feeling cold. This area is called the electron cloud. The speed of light or c is also the speed of all massless particles and associated fields in a vacuum, and it is the upper limit on the speed at which energy, matter, information or causation can travel; the speed of light is the limit of speed for all physical systems. In addition, the speed of light is an invariant quantity: This property makes the speed of light c a natural measurement unit for speed. Types of motion[edit] Simple harmonic motion â€" e. Linear motion â€" motion which follows a straight linear path, and whose displacement is exactly the same as its trajectory.

Chapter 6 : Catching Chemistry in Motion | SLAC National Accelerator Laboratory

Chemistry in Motionâ„¢ supports you in learning and developing contact improv dance skills, whether you are new to the practice or are a seasoned dancer. This facilitated event fosters your inner connection with your most profound and enlightened sense of self.

Amanda Hummon is busy these daysâ€”even by Notre Dame standards of busyâ€"would be an understatement. She insists otherwise, of course. In addition to teaching classes to Notre Dame undergraduates, Hummon is guiding no less than four major research projects this academic year on varying aspects of cancer research. We spoke with Dr. What research are you pursuing with your grant? Using a technique called mass spectrometry, my laboratory has developed a way to evaluate how well that will work. His lab synthesizes apoptotic imaging probes. If you give one of thoseâ€”his lab has a library of 25â€"to someone with cancer, the probes help figure out where the tumor is. We can again use our approach, using mass spectrometry, to test those compounds and find out if they can make it to the tumor. The Smith lab was testing these compounds in rodents, but can now do preliminary testing with us in the 3D cultures before trying them in animals. Eventually these probes could be used in humans. This will make testing compounds more rapid. How is that research progressing so far? We just published a paper a few weeks ago, really applying the methodology as a proof of concept. Congratulations, too, on the RO1 Award. What kind of research are you conducting through that grant? The Spence Lab has developed a 3-D-printed device that enables you to give very specific doses of drugs to cells. We started putting our 3-D cell cultures in this device, and we can very accurately deliver a specific dose of a therapeutic compoundâ€"or a combination of compoundsâ€"to the cell culture, and see how the drug affects the 3-D culture and how the 3-D culture affects the drug. Because our approach is high-throughput, we test many more of these permutations, faster. Now we can test so many more combinations, so much faster. This is a really effective way to screen new chemotherapies and combinations of chemotherapies. And we can test them on any kind of cancer. Any kind of tumor mimic you can grow, we can test chemotherapy on it. And help bridge the gap between the lab and the clinic. How has that research been going? It will be exciting when we can start evaluating new drugs and start evaluating new drug combinations. Because the 3-D cultures are actually human cells, you can really quickly test new chemotherapies. Previously, we had to do this as longer clinical trials. When we last spoke, you mentioned another project about low-level radiation. We know a lot about awful things like atomic bombs, high levels of radiation and the damage that it does to organisms. Is that an actual cancer risk for them or not? This summer, we wrote a big proposal to NASA to study the changes that occur to astronauts when they exit the atmosphere and go into outer space. How did the NASA proposal turn out? We were not funded, but they really liked it. They actually suggested a couple tweaks to the proposal, and we revised it and we will re-submit it in June. Fingers crossed on that one. Usually it takes a few go-arounds to get funded. I was pretty pleased with that. We also talked about another project to predict recurrence of colon cancer. Fundamentally, I got into this line of research because I wanted to have a better understanding of colorectal cancer. That, for me, is the driving force: If we understand this better, we can make better recommendations and treatments to help people. Statistics professor Steven Buechler and I have a project where we look at genomic profiles for patients who have had stage II colorectal cancer and who have had their tumor removed. In those cases, the doctor has to make a decision whether or not to recommend chemotherapy for these patients. We can look at their gene expression levels and figure out whether or not their cancer will come back. That project has been very meaningful. That could have a real, huge impact on patients with colorectal cancer. How has that project progressed? What are the difficulties with that kind of research? It can be challenging to find patients who fit the criteria for the study. The Marshfield Clinic in Wisconsin has some samples in their repository, and we are now collaborating with them. And if they perform well with samples, then we will apply to establish clinical trials. You also taught general chemistry for non-science majors in the fall. I requested this teaching assignment because I think we need to do a better job teaching non-scientists to appreciate science as well. I wondered, going in, whether the non-scientists would be into the class. But they really loved the class. It was a lot of fun. I taught the course from the perspective of how some molecules have changed the course of human history. We looked at penicillin, and how developing antibiotics has completely changed mankind. We also looked at things like isopreneâ€"the fact that you can have tires or various other uses of plastics. And they really got into the assignment. That was lots of fun. We also blew up things a lot. In one lecture, we talked about the Hindenburgâ€"why did the Hindenburg blow up? Obviously hydrogen is a lot more reactive than helium. We talked about how, if someone had appreciated the chemistry a little moreand insisted on using helium, the Hindenburg outcome would be different. When I teach, I lecture for 20 minutes intervals and then show clips of YouTube videos. I love to break lectures up with little fun clips. Stepping back from it all, has it been more than you expected? Has it been workable? All the projects we are now working on have evolved organically. Either projects evolved in a different direction from what I originally had in mind, or someone proposed a collaboration. But that part of the lab has taken off the fastest. In some ways, one of the most rewarding parts of the job is whenever students come up with their ideas on their own.

Chapter 7 : "Chemistry in Motion" Indy ACS National Me | ACS Network

In October the Chemistry teaching laboratories, which were opened in , were renamed the Christina Miller Building. Dr Christina "Chrissie" Miller () studied and worked at the School of Chemistry from to , and in was the first female chemist to be elected to the Royal Society of Edinburgh.

Chapter 8 : UConn Chemistry in Motion at Science Salon Junior Event | Department of Chemistry

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Chapter 9 : Motion (physics) - Wikipedia

6 â€¢ Wrack Lines: A Connecticut Sea Grant Publication. 3. Chemistry. in motion. Research project examines how Long. Island Sound waters change with the.