

EARNEST C.
WATSON
LECTURE SERIES

2009 – 2010

May 19, 2010

“NEURONAL MECHANISMS OF MEMORY FORMATION”

Thanos Siapas,

Associate Professor of Computation and Neural Systems; Bren
Scholar, Caltech



The hippocampus is a brain area that is critical for making new memories. This lecture describes how neuronal activity in this area is organized during awake behavior as well as during sleep, and discusses how these activity patterns may support learning and memory formation.

THE WATSON LECTURE SERIES featuring prominent Caltech researchers is named for the late EARNEST C. WATSON, who founded the series in 1922. He presented one of his most popular lectures, “Liquid Air,” as one of the first programs at the new Beckman Auditorium, a gift of Arnold O. and Mabel Beckman, in October 1964.

All lectures are held on Wednesdays at 8:00 p.m. in Beckman Auditorium, which is located near Michigan Ave., south of Del Mar Blvd.

Through a gift from the estate of Richard C. Biedebach, the Watson Lecture Series has expanded to nine lectures annually.

ADMISSION IS FREE.

SEATING INFORMATION: A minimum of 700 seats is available on a free, no-ticket-required, first-come, first-served basis, beginning at 7:30 p.m. each lecture evening.

PARKING IS FREE: Parking is available in the lots south of Del Mar Boulevard between Wilson and Chester Avenues, as well as in the parking structures at 341 and 405 South Wilson Avenue, and 370 South Holliston Avenue. Parking is free, with no permit required, after 5:00 p.m. on weekdays and all day on weekends.

DVDs AVAILABLE: Selected Watson Lectures are available for purchase on DVD. Visit www.events.caltech.edu/watson.

FOR INFORMATION: Call: (626) 395-4652 • Web: www.events.caltech.edu • e-mail: events@caltech.edu

OUR COMMITMENT TO PATRONS WITH DISABILITIES: For information about our services, which include wheelchair seating and large-print programs, please call us at (626) 395-4652 or send an e-mail to events@caltech.edu for information and assistance.

MAIL Ticket Office, Caltech (332-92), 332 S. Michigan Ave., Pasadena, CA 91125-9200

Image credit: NASA/JPL-Caltech

April 7, 2010

“THE ANCIENT CALIFORNIA RIVER AND HOW
IT CARVED THE GRAND CANYON IN THE AGE OF
TYRANNOSAURUS REX”

Brian P. Wernicke, Chandler Family Professor of Geology,
Caltech



Anyone who stands at the rim of Grand Canyon is confronted with one of the most humbling spectacles in the solar system, a high, featureless plateau interrupted by a mile-deep chasm. Its origin has been controversial ever since John Wesley Powell’s historic navigation of the Colorado River in 1869. A long-held consensus is that the canyon is six million years old and was carved by the river. This lecture will examine data collected over the last three years suggesting instead that the canyon was incised between 70 and 80 million years ago, by a river flowing in the opposite direction to the modern Colorado River.

May 5, 2010

“FROM NEWTON’S CRADLE TO NEW MATERIALS”

Chiara Daraio, Assistant Professor of Aeronautics and Applied
Physics, Caltech



The bouncing beads of a Newton’s cradle toy hide complex dynamic behavior in their symmetric dance. Lift a bead from one side, let it swing back and strike the others, and a bead bounces off the other side. Adding more beads to the toy causes its behavior to change: more beads fly off. This is an example of nonlinear wave dynamics. By assembling particles in specific geometries that support nonlinear waves, we are developing new materials and devices with unique properties. We create acoustic lenses that allow sound to travel as compact bullets for medical applications, materials that absorb blasts and vibrations, and nondestructive techniques to test the integrity of structures. *This lecture is the Richard C. Biedebach Memorial Lecture.*



October 14, 2009

“EXPLORING THE ULTRAVIOLET UNIVERSE”

Christopher Martin, *Professor of Physics, Caltech*



Each band of the electromagnetic spectrum is tuned to individual physical processes that reveal the astrophysical mechanisms behind the seen and unseen Universe. The space ultraviolet, visible only with rockets and satellites above the Earth's atmosphere, has given us a dramatic new perspective on the formation of cosmic structure. This lecture discusses some of the many discoveries of NASA's UV-mapping Galaxy Evolution Explorer (GALEX)—including remarkable clouds of gas and dust around nearby stars and the star formation that converted primordial gas into stars as the Universe evolved. Future UV missions will allow us to map a hitherto invisible component of the Universe, the intergalactic medium that was the birthplace of galaxies.

November 11, 2009

“WHERE THE WIND COMES FROM, ON EARTH AND OTHER PLANETS”

Tapio Schneider, *Professor of Environmental Science and Engineering, Caltech*



Winds on Earth have prevalent directions, a fact that has been exploited by sailors and explorers in centuries past and that still influences airplane routes today. Surface winds blow predominantly from the east in the tropics and from the west in midlatitudes; at higher altitudes, each hemisphere usually has one eastward jet stream with 90 mph winds. Jupiter and Saturn have up to seven eastward jet streams at different latitudes in each hemisphere, with winds up to five times stronger than on Earth; giant storms, such as the Great Red Spot, are embedded in the jets. This lecture explores how the wind patterns on different planets come about, how they have been in Earth's past, and how they may change in the future.

December 2, 2009

“REMEMBRANCE OF FINANCIAL CRISES PAST”

Jean-Laurent Rosenthal, *Rea A. and Lela G. Axline Professor of Business Economics; Executive Officer for the Social Sciences, Caltech*



As we dig out of the financial crisis, we face a daunting problem: designing financial institutions for the 21st century. This talk explores some valuable cautions provided by economic history and microeconomics. Prosperity depends on maintaining a vibrant capital market, as no economy over the last four centuries has achieved world leadership without finance. Moreover, because financial crises will recur, we should design institutions that limit their damage. Technological change and financial sophistication are less responsible for spawning booms and crises than commonly believed; instead, we were driven into our current predicament by individuals exploiting informational advantages. A few simple departures from our history would limit the scope of the next crisis.

January 13, 2010

“PHYSICS AT THE LARGE HADRON COLLIDER: A NEW WINDOW ON MATTER, SPACETIME, AND THE UNIVERSE”

Harvey B. Newman, *Professor of Physics, Caltech*



We are embarking on a new generation of exploration at the high-energy frontier as the Large Hadron Collider comes online at CERN in Geneva. Caltech physicists and students and their colleagues are in the final stages of commissioning the Compact Muon Solenoid experiment. Using CMS and the LHC, two of the most complex instruments ever devised, and new methods developed at Caltech, we will search for the Higgs particles thought to be responsible for mass in the Universe; supersymmetry; evidence of extraspatial dimensions; excited states of electrons and muons; and other exotic new particles and forces of nature. This lecture describes this work, and the road to the discoveries that may lie ahead.

January 27, 2010

“DNA-MEDIATED SIGNALING”

Jacqueline K. Barton, *Arthur and Marian Hanisch Memorial Professor and Professor of Chemistry; Chair, Division of Chemistry and Chemical Engineering, Caltech*



We think of the DNA double helix as the library of the cell, encoding all that we are, but it can also serve as a conduit for the flow of electrons over long molecular distances, depending upon the stacking of the helix's base pairs. Like a stack of copper pennies, the base-pair stack can be conductive. We can utilize this chemistry in designing sensitive DNA-based diagnostic sensors. This lecture also describes work showing that DNA charge transport chemistry may be used for long-range signaling to DNA-bound proteins, to activate responses to cellular stresses, and the repair of bases damaged by oxidative stress.

February 17, 2010

“INTERSONIC EARTHQUAKES: WHAT LABORATORY EARTHQUAKES TEACH US ABOUT REAL ONES”

Ares J. Rosakis, *Theodore von Kármán Professor of Aeronautics and Professor of Mechanical Engineering; Chair, Division of Engineering and Applied Science, Caltech*



Directly studying earthquakes presents a host of insurmountable difficulties, the least of which is our inability to trigger earthquakes of various magnitudes at will and the lack of means of scrutinizing the behavior at depth while the quake propagates. We have developed techniques to produce miniature laboratory earthquakes and follow their progress with high-speed imaging tools. Our quakes mimic actual quakes, and have demonstrated the existence of “super-shear” or “inter-sonic” rupture speeds. The propagating fronts of such inter-sonic ruptures feature a Mach-cone of shear shock waves similar to that of supersonic aircraft. This unusual feature produces potentially catastrophic ground shaking signatures (equivalent to sonic booms) with unexpected implications to seismic hazard analysis.