Past Physics Department Colloquia Speakers

2007-2008

General Colloquium: **Dan Amidei (Co-Chair), Bob Savit (Co-Chair), Aaron Leanhardt**

Fall 2007: http://www-personal.umich.edu/~aehardt/fall2007colloquium/

Sept. 5, 2007

- **Myron Campbell**, University of Michigan
- *"State of the Department Address"*

Sept. 12, 2007

- **Fred Adams**, University of Michigan
- *"Effects of Young Embedded Stellar Clusters on their Constituent Solar Systems"*

Sept. 19, 2007

- **Alexei Tkachenko**, University of Michigan
- *"Nanoparticles with key-lock interactions: from self-assembly to drug delivery"*

Sept. 26, 2007

- **Deborah Jin**, JILA/NIST/University of Colorado
- *"Pairing atoms in an atomic Fermi gas"*

Oct. 3, 2007

- **David Gerdes**, University of Michigan
- *"Exploring the Accelerating Universe"*

Oct. 10, 2007

- **Richard Boyd**, Lawrence Livermore National Laboratory
- *"Creating a Star in the Laboratory: the National Ignition Facility"*

Oct. 17, 2007

- **James Wells**, University of Michigan
- *"Deforming the Higgs Boson"*

Oct. 24, 2007: Ta-You Wu Lecture

- **Note Location: 1324 East Hall**
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- **Frank Shu**, University of California
- *"The Formation of Stars and Planetary Systems"*

Oct. 31, 2007

- **Anette Hosoi**, Massachusetts Institute of Technology
- *"Optimizing Low Reynolds Number Locomotion"*

Nov. 7, 2007: H.R. Crane Centennial Colloquium

- **Jens Zorn**, University of Michigan
- *"H. R. Crane: an Icon of Physics at Michigan"*

Nov. 14, 2007: H.R. Crane Centennial Colloquium

- **Gerald Gabrielse**, Harvard University
- *"New Measurement of the Electron Magnetic Moment and the Fine Structure Constant"*

Nov. 21, 2007

- Colloquium canceled for Thanksgiving.

Nov. 28, 2007

- **Bob Park**, University of Maryland
- *"Science Advice in an Age of Superstition"*

Dec. 5, 2007

- **Roberto Merlin**, University of Michigan
- *"Negative Refraction, Radiationless Interference and Subwavelength Focusing: The Quest for the Superlens"*

Winter 2008: http://www-personal.umich.edu/~aehardt/winter2008colloquium/

Jan. 9, 2008

- **Lisa Randall**, Harvard University
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- *"Warped Geometry: Consequences and LHC Signatures"*
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- Extra dimensions, and warped geometry in particular, might hold the key to the solution to the hierarchy problem of particle physics. We discuss the underlying mechanism and how the LHC will test this idea.

Jan. 16, 2008

- **Jack Bass**, Michigan State University
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- *"Giant Magnetoresistance and Some Consequences"*
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- The Nobel Prize in Physics for 2007 was given jointly to Albert Fert and Peter Grunberg. It was awarded for: "The Discovery of (a new physical effect) Giant Magnetoresistance (GMR)"; "The technology used to read data on hard disks"; and "One of the first real applications of nanotechnology". But Giant MR was not the largest known MR, either at cryogenic temperatures or room temperature. And the physics underlying it is not fundamentally new. So why the prizes? The answer has several parts. (1) Largest MR is not necessarily the most important criterion for devices. Within a decade of its discovery, additional work allowed GMR to satisfy criteria that let it be used at the (billion $)/year level, enabling much higher density of information storage and access, leading to more powerful computers, including laptops. (2) The discovery demonstrated that artificially structured multilayers, with layers only a few atoms thick, could generate new behaviors and functionalities. (3) Fert's explanation of GMR led to growing recognition that not only the electron's charge, but also its spin (magnetic moment), could be used for both new physics and new devices–the latter now designated by the buzzword 'spintronics'. New concepts spawned by this recognition include 'spin-transfer-torque (STT)'. New phenomena spawned with actual or potential device applications include tunneling MR (TMR), current-induced magnetization switching (CIMS), and current-generated GHz radiation.
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- I'll focus on spintronics in metallic systems–both physics and devices. I'll not discuss semiconductor spintronics, which has led to interesting physics, but not yet devices.

Jan. 23, 2008

- **Lene Hau**, Harvard University
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- *"Wizardry with light: freeze, teleport, and go!"*
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- Light pulses are slowed in ultra-cold atom clouds to bicycle speed: 15 miles/hour which is more than seven orders of magnitude lower than the light speed in vacuum.

Associated with the dramatic reduction factor for the speed is a spatial compression of the pulses by the same large factor. A light pulse, which is ~1 mile long in vacuum, is compressed to a size of 20 microns and at that point it fits entirely within the atom cloud. The light pulse can then be completely stopped and stored in the atomic medium for up to several milliseconds, and later revived with no loss.

- In our latest experiments, we take matters further. We stop and extinguish a light pulse in one part of space and revive it in a completely different location. The secret behind this magical trick will be revealed in the talk.

Jan. 30, 2008

- **Rick Gaitskell**, Brown University
- *"Noble Travails: Noble Liquid Detectors Searching for Particle Dark Matter"*
- Particle dark matter is thought to be the overwhelming majority of the matter in the Universe, dwarfing the contribution from conventional material that we, the earth and the stars, are composed of. However, we still have no direct evidence for the existence of particle dark matter. This may soon change...
- I will report on the new results from the XENON10 liquid xenon-based detector at Gran Sasso which is searching for particle dark matter, and now has a world class sensitivity which is a factor 4 better than its current nearest rival (CDMS II). [http://arxiv.org/abs/0706.0039, http://xenon.brown.edu]
- I will also discuss some of the other noble liquid target experiments that are also providing competitive sensitivities in the race for the direct detection of particle dark matter. Theoretical estimates, based on supersymmetric models predict dark matter interaction rates from the best sensitivity of existing direct detection experiments of ~1 evts/kg/month, down to rates of ~1 evts/100 kg/yr, and below this. Current and future noble liquid experiments for dark matter searches, range in scale from 10's kg to tonnes, and are designed to rise to this challenge. The new liquid xenon detector, LUX, which has begun construction, will be 100 times more sensitive than current best search experiments. [http://luxdarkmatter.org]

Feb. 6, 2008

- **Geoffrey Marcy**, University of California – Berkeley
- *"Properties of Exoplanets: Orbits, Interiors, and Origins"*
- Ultra-precise Doppler measurements of 2000 stars reveal 250 orbiting planets. The masses range from 20 Jupiter-masses to nearly 5 Earths, with a distribution favoring low mass. The orbits reveal a range of semimajor axes and eccentricities that inform theory. Giant planets beyond 20 AU can be sensed, with implications for imaging efforts. Transiting planets constrain their interior structure and chemical composition, influencing planet formation models. The number of habitable planets in our Galaxy can be estimated, bearing on the existence of microbial and intelligent life.

Feb. 13, 2008

- Colloquium rescheduled for Apr. 16.

Feb. 20, 2008

- **Peter Grassberger**, University of Calgary
-
- *"Mutual Information and Applications: from Sequence Alignment to Heart Beat Analysis"*
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- I will first recall main features of the mutual information (MI) as a measure for similarity or statistical dependence. In particular, I will discuss its embodiments in two versions of information theory: Probabilistic (Shannon) versus algorithmic (Kolmogorov). I will compare two different strategies for estimating the latter, one involving sequence alignment and file compression ("zipping"), the other just zipping alone. Next, I will show how MI in general leads to very simple hierarchical clustering (construction of dendrograms). The last part of the talk will be devoted to estimating Shannon MI from real-valued data, and two applications thereof: So-called "independent component analysis" (ICA) and microarray gene expression. In ICA (a blind source separation technique) a composite signal is linearly "de-mixed" into its least dependent components -- without knowing a priori how the mixing was done and what the components should look like. Our main example here deals with the ECG (electrocardiogram) of a pregnant woman, where the goal is to seperate the heart beat of the fetus from that of the mother (and from noise). Finally, in microarray gene expression we shall see how differences between linear dependency measures (such as the Pearson correlation coefficient) and nonlinear measures (MI) allow to find structural features in gene regulation networks.

Feb. 27, 2008

- Colloquium canceled for Spring Break.

Mar. 5, 2008

- **Lawrence Krauss**, Case Western Reserve University
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- *"Our Miserable Future"*
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- In a universe dominated by a cosmological constant things are as bad as they can possibly be. During this lecture I will discuss the future of life, of computation and information processing, of galaxies and large scale structure, and the future of cosmology. While generally miserable, the news is not all bad: Even if protons ultimately decay, diamonds will be forever, or at least will last as long as our universe does.

Mar. 12, 2008

- **Bernardo Huberman**, Hewlett-Packard
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- *"Social Dynamics in the Age of the Web"*

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- The web mediates interactions among distant people on a scale that has never been possible in the physical world. From vast social networks, to grass-root amateur creativity and the creation of encyclopedic knowledge, a collective intelligence is at work in ways that differ from traditional communities in style, intensity and effectiveness of interaction. I will present the results of studies of social interactions underlying wikipedia, amazon, and digg.com, and describe mechanisms we have designed to access this collective intelligence while improving users experiences and their interactions with digital information.

Mar. 19, 2008

- **Byron Roe**, University of Michigan
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- *"Weighing Neutrinos!"*
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- I will briefly review methods of measuring neutrino mass, concentrating on using neutrino oscillations to measure the mass. I will review the solar and atmospheric neutrino measurements, discuss why one set of measurements (LSND) doesn't fit the standard picture. I will then discuss the MiniBooNE experiment which set out to clarify the picture and its results to date. Finally, if time, I will discuss neutrino oscillation experiments for the near future.

Mar. 26, 2008

- **Steven Kivelson**, Stanford University
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- *"Electronic liquid crystals"*
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- Highly correlated quantum fluids are fluids in which the typical interaction strength between neighboring particles is large compared to the zero-point kinetic energy. It is somewhat miraculous that such systems exist at all, since in the limit of large enough interactions, one generally expects frozen (probably crystalline) states to be ubiquitous. However, as in classical complex fluids, for quantum systems, as well, there can exist a host of phases intermediate between the quantum gas, in which interactions are weak, and the quantum crystal, in which the zero-point kinetic energy is small. Classical liquid crystals are frequently viewed as phases that occur due to the complicated shape of the constituent molecules, such as the highly elongated "nematogens" that give rise to most nematic liquid crystals with which we are familiar; this might make the occurrence of such phases in electron fluids seem unlikely. However, liquid crystals can also be viewed as partially melted solids, and from this perspective they can (and do) occur in correlated electron systems, as well.

Apr. 2, 2008: Ford Lecture

- **Note Location: Askwith Auditorium, located in room 140 Lorch Hall**
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- **Margaret Geller**, Smithsonian Astrophysical Observatory
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- *"Newton Meets Einstein: Mapping Dark Matter in the Universe"*
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- Since its discovery 75 years ago, dark matter distributed on large scales in the universe has remained a mystery. The constituents of the dark matter remain unknown. Powerful tools of modern astrophysics, redshift surveys and gravitational lensing, do provide maps of the distribution of dark matter over cosmic time. Dr. Geller will describe how these observations with forefront instruments on large telescopes reveal the structure of the universe.

Apr. 9, 2008

- **Leo Kadanoff**, University of Chicago
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- *"Making a Splash -- Breaking a Neck: The Making of Complexity in Physical Systems"*
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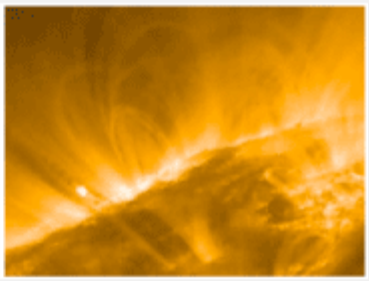
Summary of Talk

The fundamental laws of physics are very simple.

The world about us is very complex.

Living things are very complex indeed.

This complexity has led some thinkers to suggest that living things are not the outcome of physical law but instead the creation of a designer.



Credit: NASA/Trace

magnetic storm on surface of sun

Here I examine how complexity is produced naturally in fluids.

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Apr. 16, 2008: Helmut W. Baer Lecture

- **John Schiffer**, Argonne National Laboratory
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- *"The Early Foundations of Nuclear Physics"*
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- A historical perspective of nuclear physics and the origins of modern physics will be given. This talk was first presented as a part of a symposium in Tokyo celebrating the 100th anniversary of Hiroshi Yukawa's birth. Yukawa was Japan's first Nobel Prize winner, he deduced that the very short range of nuclear forces must imply a new light particle. This particle was discovered a decade later and we now know it as the p meson. In this talk I will survey the discoveries that preceded Yukawa's work, starting with the origins of modern physics around 1890, and following the development of nuclear physics through the 1930's when Yukawa did his work, roughly to the middle of the past century. The resolution of a rumor regarding the interaction of Yukawa and