2009 APS March Meeting
Pittsburgh, Pennsylvania
http://www.aps.org/meetings/march/index.cfm
2:30PM D5.00001 Prehistory of Silicon Valley, from 1910 to 1965 STEWART GILLMOR, Wesleyan University — The term “Silicon Valley” was coined in 1971, some six decades after the emergence of the San Francisco Bay Area as a center of innovation and invention in the fields of radio and electronics. The geographical position of San Francisco with respect to continental and Pacific transportation and communication needs; the growth of West Coast universities, markets, and population; the importation of talent from the East; innovative industrial and business methods—all these provided a thriving center of instrumentation, electronics, avionics, and high energy physics when Silicon arrived in the “Valley of the Heart’s Delight.”

3:06PM D5.00002 W. Hansen, Microwave Physics, and Silicon Valley, DAVID LEESON, Stanford University — The Stanford physicist W. W. Hansen (b. 1909, AB ’29 and PhD ’32, MIT post-doc 1933-4, Prof. physics ’35-’49, d. 1949) played a seminal role in the development of microwave electronics. His contributions underlay Silicon Valley’s postwar “microwave” phase, when numerous companies, advertising their unique scientific debt to Hansen, flourished around Stanford University. As had the prewar “radio” companies, they furthered the regional entrepreneurial culture and prepared the ground for the later semiconductor and computer developments we know as Silicon Valley. In the 1930’s, Hansen invented the cavity resonator. He applied this to his concept of the radio-frequency (RF) linear accelerator and, with the Varian brothers, to the invention of the klystron, which made microwave radar practical. As WWII loomed, Hansen was asked to lecture on microwaves to the physicists recruited to the MIT Radiation Laboratory. Hansen’s “Notes on Microwave,” the Rad Lab “bible” on the subject, had a seminal impact on subsequent works, including the Rad Lab Series. Because of Hansen’s failing health, his postwar work, and MIT-Stanford rivalries, the Notes were never published, languishing as an underground classic. I have located remaining copies, and will publish the Notes with a biography honoring the centenary of Hansen’s birth. After the war, Hansen founded Stanford’s Microwave Laboratory to develop powerful klystrons and linear accelerators. He collaborated with Felix Bloch in the discovery of nuclear magnetic resonance. Hansen experienced first-hand Stanford’s evolution from its depression-era physics department to corporate, then government funding. Hansen’s brilliant career was cut short by his death in 1949, after his induction in the National Academy of Sciences. His ideas were carried on in Stanford’s two-mile long linear accelerator and the development of Silicon Valley.

3:42PM D5.00003 From Bell Labs to Silicon Valley: A Saga of Technology Transfer, 1954-1961 , MICHAEL RIORDAN, UC Santa Cruz — Although Bell Telephone Laboratories invented the transistor and developed most of the associated semiconductor technology, the integrated circuit or microchip emerged elsewhere—at Texas Instruments and Fairchild Semiconductor Company. I recount how the silicon technology required to make microchips possible was first developed at Bell Labs in the mid-1950s. Much of it reached the San Francisco Bay Area when transistor pioneer William Shockley left Bell Labs in 1955 to establish the Shockley Semiconductor Laboratory in Mountain View, hiring a team of engineers and scientists to develop and manufacture transistors and related semiconductor devices. But eight of them—including Gordon Moore and Robert Noyce, eventually the co-founders of Intel—resigned en masse in September 1957 to start Fairchild, bringing with them the scientific and technological expertise they had acquired and further developed at Shockley’s firm. This event marked the birth of Silicon Valley, both technologically and culturally. By March 1961 the company was marketing its Micrologic integrated circuits, the first commercial silicon microchips, based on the planar processing technique developed at Fairchild by Jean Hoerni.

4:18PM D5.00004 The Origins and Development of the Silicon Valley Startup Model, JAMES GIBBONS, Stanford University — No abstract available.

Wednesday, March 18, 2009 8:00AM - 11:00AM — Session P8 FHP: Centenary of Lev Landau 414/415

8:00AM P8.00001 Lev Landau: A View from the West, PIERRE HOHENBERG, New York University — The tragic accident which ended Landau’s scientific career at an early age meant that Lev Landau was known personally to only a small number of western scientists. His remarkable influence on twentieth century physics thus came from his published work and indirectly from the members of the famed Landau school, who are so well represented at this Symposium. Regarding the published work, I would distinguish three distinct ways in which Landau’s influence has been felt. The most obvious is the set of seminal papers on a broad set of topics ranging from Landau diamagnetism, to the phonon-roton theory and two-fluid hydrodynamics of $^3$He, Fermi-liquid theory and zero sound, the theory of second-order phase transitions, the Landau-Hopf theory of fluid turbulence and many more. The second class of contributions consists of the famed Landau-Lifshitz Course of Theoretical Physics, which first appeared in the West in the late fifties and early sixties. In many ways the third aspect of Landau’s influence, although more difficult to define, is probably even more significant. This is Landau’s pervasive presence in a large number of the major theoretical advances in condensed matter and statistical physics throughout the second half of the twentieth century. So many major developments can be viewed as elaborations, advances and - yes - corrections to the foundational theories and points of view laid down by Landau. One example is the theory of superfluidity in Bose liquids, for which one may ask why Landau resisted London’s explanation in terms of Bose condensation, which has turned out to be important after all. A second example is the Fermi liquid theory and important later developments stemming from superfluid transitions or effects of strong correlations. A third example is the theory of second-order phase transitions which lays the foundations for the study of critical phenomena using the renormalization group. In each case one marvels at the important foundational role played by Landau’s work and one may ask to what extent he himself anticipated the later developments. It is hoped that the subsequent speakers might address some of these questions.

8:36AM P8.00002 Landau and theory of quantum liquids, LEV PITAIEVSKII, CNR INFN-BEC, University of Trento, Trento, Italy and Kapitza Institute for Physical Problems, Moscow, Russia — General conceptions and history of the Landau Theory of superfluidity and the Theory of Fermi liquid will be discussed.

9:12AM P8.00003 Landau and Theory of Phase Transitions$^1$, VALERY POKROVSKY, Texas A&M University — Landau’s theory of phase transitions is probably his most general and most influential work. I describe history of its creation, its basic ideas and their developments and extensions and its deep influence on modern science.

9:48AM P8.00004 Landau and Feynman diagrams, IGOR DZYALOSHINSKII, University of California, Irvine — Landau considered the Feynman diagrams and the Dyson concept of their visual summation as a breakthrough in the physics of particles. This visual perception in his opinion activated the person intuition. In this intuitive way Landau introduced the concept of partial summation which led to major results in the particle physics and the condensed matter theory. Some of his and of the members of his school results will be presented in a pure visual way.

$^1$The DOE support through the grant DE-FG02-06ER46278 is acknowledged.
in good agreement with known data. Which is in good agreement with the published value. With the same consideration, the latent heats of fusion of ammonia and methanol are calculated and the paradox? The internal energies of 0 °C water and ice are considered from the perspective of degree of freedom and latent heat of fusion of water is calculated, density is lower so it should have larger potential energy, which indicates an incredible conclusion that ice has higher internal energy. How do we explain this same temperature, their molecules should have same kinetic energies. Therefore their potential energies among molecules need to be compared. Because ice's of water is 0.9998 g/cm³ and the density of ice is 0.9162 g/cm³. Question: For 0 °C water and ice, which has a higher internal energy? Because they have same temperature, their molecules should have same kinetic energies. Therefore their potential energies among molecules need to be compared. Because ice’s density is lower so it should have larger potential energy, which indicates an incredible conclusion that ice has higher internal energy. How do we explain this paradox? The internal energies of 0 °C water and ice are considered from the perspective of degree of freedom and latent heat of fusion of water is calculated, which is in good agreement with the published value. With the same consideration, the latent heats of fusion of ammonia and methanol are calculated and the results are in reasonable agreement with the published values. This simple strategy can give specific heats of water, liquid ammonia, and methanol, which are in good agreement with known data.
Introducing Raman Spectroscopy of Crystalline Solids in the Undergraduate Curriculum

BAHGRAM ROUGHANI, Kettering University, DAVID WARNER, UMA RAMABADRAN, Kettering University — We describe an experiment designed as an upper level physics laboratory that introduces students to Raman Scattering of electronic materials and research methodology. This experiment is an effective approach in demonstrating the relationship between the Raman intensity of the scattered light from crystals and symmetry dependent Raman selection rules. In our measurements we alter the angle between the crystal axis and the polarization of the incident laser beam by sample rotation. The three dimensional plot of the intensity profile versus the theoretical model is used to distinguish between various crystal plans of the same electronic material. This experiment combines knowledge regarding properties of materials with optical characterization. It is suitable as an upper level physics laboratory or for introducing new graduate student to use Raman spectroscopy as a research tool.

Civic Engagement through Differential Equations

SHAFIQUOR RAHMAN, Allegheny College, Meadville, PA 16335 — In a technological society such as ours, optimal allocations of limited resources frequently require a clear understanding of the sciences. However, policy makers often lack background in this area, and physics majors almost never get exposed to ideas that lie at the intersection of science and society, certainly not in a quantitative way. As a result, the latter show little interest in such issues. To address this problem, we have developed a short course titled Civic Engagement for Physicists. A substantial part of the course is quantitative. For example, when covering issues connected to energy, a topic of major current interest, we use a differential equation from population dynamics to study predictions about when the peak in world oil production might occur, and what the true amount of world oil reserve might be. On the other hand, topics such as Characteristics of Science and National Science Policy are covered in a qualitative way. In this talk, I’ll present details of both the quantitative and the qualitative areas covered by the course, as well as reaction of students.

Supported by a Civic Engagement Grant from The Center for Political Participation at Allegheny College.

Challenges and opportunities of undergraduate research

DANIELA M. TOPASNA, GREGORY A. TOPASNA, Virginia Military Institute — Undergraduate research at small schools is becoming the norm rather than the exception that it was years ago. Faculties are now faced with the challenges of incorporating students with varying degrees of academic preparedness and motivation in their research. This coupled with the students’ own constraints within the academic schedule can make undergraduate research a challenge for both students and faculty. Like many small undergraduate schools, VMI’s faculty and students are faced with these obstacles when engaging in undergraduate research. However, such difficulties can lead to creative solutions that allow multiple benefits for students and faculty mentors. We present our unique perspective and experiences for this challenging yet rewarding experience as related to thin film research performed at VMI.

Reactive to Galileo: Introducing a New Approach for Gen Ed Science

MICHAEL PETTERSEN, Washington and Jefferson College — Either Galileo was right, or he was wrong; either way, why was there ever any debate about it? And why should we care today about the opposing positions, which proven wrong so long ago? In the “Reacting to the Past” series of curricular materials, students engage with key turning points in human intellectual history by taking sides and recreating the original debate. In this way, students personally identify with points of view that they would otherwise find wrong, boring, and incomprehensible — and they learn how we test ideas by challenging them, and defend them by marshaling evidence, which is the core of critical thinking. Students almost universally report that the “Reacting” experience is tremendously engaging. I shall describe an application of the “Reacting” format to the case of Galileo. The scientific issues involved are comprehensible to non-science majors, the cultural context of Renaissance Italy is rich and wonderful, and Galileo’s personal history is tremendously moving. The materials include labs designed to be taught by non-scientists teaching cross-disciplinary liberal arts courses. Other “Reacting” science materials have been published or are under development.

Flint and the British Tradition of Relativity Theory

JAMES BEICHLER, Semi-retired — Most scientists and scholars are familiar with Sir Arthur Eddington’s role in verifying General Relativity in 1919. A few less are aware of his work introducing the theory to the English scientific community. Still less know of Eddington’s extensions of relativity theory, especially his attempts to develop a unified field theory. But very few scientists, historians or even physicists are aware of the important role played by other English scientists in the acceptance and development of relativity. In fact, H.T. Flint and his colleagues published more than thirty-five articles in peer reviewed journals in Britain over a period of four decades in an attempt to extend relativity to include electromagnetism and the quantum. Yet his work and that of his close associates is almost completely unknown today, in spite of the fact that he published a book describing his complete unified field theory in the 1960s, well before most quantum theorists even began thinking along the lines of unification. In a world filled with speculations about gravitons, superstrings, quantum loops and other unification models, Flint did it first, but his work has all but disappeared from the scientific consciousness. From Eddington to Flint, the English school of relativists has produced ardent supporters of relativity and numerous advances beyond the standard interpretations of general relativity.

Ukrainian Physical-Technical Institute (UFTI) in the 1930’s

D.H. MCNEILL, Consultant, 3955 Bigelow Blvd., Pittsburgh, PA 15213, YU. N. RANYUK, O.S. SHEVCHENKO, Kharkov Inst. of Physics and Technology, Ukraine — UFTI (Ukrainian Physical-Technical Institute; now Kharkiv Institute of Physics and Technology, KhFTI), founded in 1928, was among the first national laboratories. In the 1930’s, L. Shubnikov, B. Podolsky, G. Placzek, L. Tisza, F. Houtermans, A. Weissberg, V. Weisskopf, and others worked there on important and interesting research in many areas (low-temperature, electronics, nuclear physics, theory). 2008 was the centenary of Lev Landau, who established his school of theoretical physics and began his Course of Theoretical Physics in Kharkov. It is now ~70 years since the Great purge at UFTI (and, simultaneously, throughout the USSR). UFTI’s history, a stark reminder of politics in science, is less known than that of institutions in Moscow and St. Petersburg. “Delo” UFTI 1935-1938 [The UFTI Affair, Yu. V. Pavenko, Yu. N. Ranyuk, and Yu. A. Khramov, Kiyv, 1998] is a study, using documents available after 1990, of the lab’s early years and its near destruction in the Stalinist purges. Many scientists at UFTI were killed or imprisoned. Documents from this time will be shown. A timeline of the 1930’s at UFTI will be presented.

Experience in teaching intensive course of thermal physics for undergraduate physics students

FARKHAD ALIEV, Universidad Autonoma de Madrid — This talk of non-technical nature describes experience of the author in teaching the intensive course of thermal physics for the undergraduate physics students at the Universidad Autonoma de Madrid, Spain. After brief introduction to the program, description of the WEB support of the course, I shall describe practical classes ( home-works, visits to the Laboratories, experimental demonstrations, typical problems and typical topics for presentations on the advanced thermodynamics, etc. ). I shall further discuss different possible actions to wake up an interest of the students to the thermal physics and ways to simulate their active participation in the class discussions. I also describe different schemes employed in the last few years to evaluate effectively and the students work and knowledge. Finally, I will analyze the efficiency of our methodic in improving teaching of thermal physics at University level.

Supported by Universidad Autonoma Madrid and Spanish MEC (MAT2006-07196)
2:30PM X8.00001 Anderson localization in the seventies and beyond. DAVID THOULESS, University of Washington — Little attention was paid to Anderson’s challenging paper on localization for the first ten years, but from 1969 onwards it generated a lot of interest. Around that time a number of challenging questions were raised by the community, on matters such as the existence of a sharp distinction between localized and extended states, or between conductors and insulators. For some of these questions the answers are unambiguous. There certainly are energy ranges in which states are exponentially localized, in the presence of a static disordered potential. In a one-dimensional potential all states are localized. There is clear evidence, in three dimensions, for energy ranges in which states are extended and diffusive. Magnetic and spin-dependent interactions play an important part in reducing localization effects. For massive particles like electrons and atoms the lowest energy states are localized, but for massless particles like photons and acoustic phonons the lowest energy states are extended. In a one-dimensional disordered system all states are localized. Uncertainties remain. Scaling theory shows that in two-dimensional systems all states are weakly localized, and that there is no minimum metallic conductivity. The interplay between disorder and mutual interactions is still an area of uncertainty, which is very important for electronic systems. Optical and dilute atomic systems provide experimental tests which allow interaction to be much less important. The quantum Hall effect provided a system where states on the Fermi surface are localized, but non-dissipative currents flow in response to an electric field.

3:06PM X8.00002 Tests of Localization in Metals and Semiconductors1, ROBERT DYNES, University of California San Diego — The metal-Insulator transition has been a subject of study for decades. It is now well known that entering the critical region of the transition the characteristics of a highly correlated system dominate. The dimensionality of the system is also very important. In this talk I will reminisce about the concepts and experiments to test models, explore systems, and investigate the role of dimensionality. Mott’s concept of a minimum metallic conductivity drove my own thinking until the landmark paper of Abrahams, Anderson, Licciardello and Ramankrishnan. A series of careful experiments testing the notions of weak localization followed this paper and provided critical tests of the concept. I will describe some of those experiments and the things we learned from this work.

1Work was performed while the author was at Bell Laboratories

3:42PM X8.00003 Anderson Localization of Light, MORDECHAI SEGEV, Technion - Israel Institute of Technology — Photonic lattices are excellent model systems for studying wave localization due to disorder. The recent progress on Anderson Localization of light will be reviewed, including the additional effects of nonlinearity, with an emphasis on the universal features common to all wave systems in nature.

4:18PM X8.00004 Anderson Localization and Mesoscopics, IGOR LERNER, University of Birmingham, B15 2TT, United Kingdom — I will review certain trends developed within the last thirty years of research on Anderson Localization with emphasis on the description of the Anderson transition in terms of the entire distribution function of the conductance mesoscopic fluctuations, and on the role of electron-electron interactions.

4:54PM X8.00005 Direct observation of Anderson localization of matter-waves in an optical disorder1, ALAIN ASPECT, Institut d Optique and CNRS — In 1958, P.W. Anderson predicted the localization of electronic wave functions in disordered crystals, and the resulting absence of diffusion. It has been realized later that Anderson Localization is ubiquitous in wave physics, and this has prompted an intense activity to observe it with light, microwaves, sound waves, and electron gases, but to our knowledge there was no direct observation of exponential spatial localization of matter-waves (electrons or others). We have observed directly exponential localization of the wave function of ultracold atoms released into a one-dimensional waveguide in the presence of a controlled disorder created by laser speckle. We will present this work, and the prospects of extending that experimental scheme to quantum gases in higher dimensions (2D and 3D), and with controlled interactions. We will also discuss its significance in the rapidly growing field of quantum simulators.


1Supported by CNRS and by the “programme blanc” of the Agence Nationale de la Recherche,