2006 APS April Meeting

Dallas, TX

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Saturday, April 22, 2006 10:45AM - 12:33PM –
Session B5 DAP FHP: Cosmology I Hyatt Regency Dallas Pegasus B

10:45AM B5.00001 Why Aristotle took so long to die DENNIS DANIELSON, Univ. of British Columbia — Like young people looking askance at their parents, we often have trouble taking seriously the interests or even the intellects of "scientists" from centuries gone by (an attitude already betrayed by the urge to use quotation marks). After all, their theories were wrong. But the greatest wrong physicist of them all was Aristotle. The earliest thinkers we today classify as scientists (Bacon, Galileo, Newton) cut their teeth trying to show how he was wrong–but it wasn't easy. In order to see why it was so hard, we need to transport ourselves mentally back to the period between ancient Greece and seventeenth-century Europe and try to think like Aristotelians. That way we can catch a taste of the intellectual pleasures of Aristotelian physics and cosmology–including Aristotle's concepts of elements, cause, natural motion, and the "two-storey" universe. By becoming (temporary) Aristotelians, we'll be able to see better, for example, why Copernicanism took a hundred years to catch on. For the heliocentric "celestial machine" demanded a new physics that nobody had yet provided. Finally, to examine Aristotle's long monopoly on physics–based on what had grown to look like simple common sense–is also to stir up questions about how we might gain enough perspective on our present habits of thought to avoid getting stuck in our own orthodoxies. We may even find that those habits, as exemplified by modern astrophysics, still conceal unpurged remnants of Aristotle.

11:21AM B5.00002 The New Mysteries of the Cosmos , ELIZABETH BARTON, Center for Cosmology, University of California, Irvine — From WMAP's precise measurements of the Cosmic Microwave Background, to evidence for dark energy, to the ever-accelerating search for the early galaxies responsible for the reionization of neutral intergalactic hydrogen in the early universe and first light, the recent advances in observational cosmology present a number of serious challenges to our understanding of the physical universe. I will describe some of the leading puzzles posed by recent and ongoing observations.

11:57AM B5.00003 The Future of Cosmic Microwave Background Observations , JOHN CARLSTROM, University of Chicago — Measurements of the cosmic microwave background radiation (CMB) have led to a remarkable picture of the origin, make-up and evolution of the universe. The measurements provide support for the inflation theory of the big bang. In the broadest sense, the measurements have allowed a full accounting of the stuff that makes up the universe, although we know few details beyond the few percent contributed by ordinary matter. Future measurements will focus on characterizing the temperature anisotropy on finer angular scales and the polarization anisotropy on all angular scales. These measurements can be used to constrain the neutrino mass and the equation of state of the Dark Energy. The most exciting future prospect, and by far the most challenging experiment, is the possibility of detecting the signature of inflationary gravitational waves generated in the first instants of time imprinted on the CMB polarization. After a brief review of the current status and ongoing experiments, this talk will focus on the expectations and challenges for future CMB observations.

Saturday, April 22, 2006 1:30PM - 3:18PM –
Session C5 DAP FHP: Cosmology II Hyatt Regency Dallas Pegasus B

1:30PM C5.00001 Before the Microwave Background: Early Big Bang Cosmology (The J. Robert Oppenheimer Lecture) , HELGE KRAGH — Finite-age (or big-bang) cosmological models can be traced back to G. Lemaître's relativistic model of 1931 (or even earlier, to A. Friedmann in 1922). However, the big bang concept does not exclusively belong to the class of relativistic models, and in the 1930s it was often associated with E.A. Milne's very different, so-called kinematic cosmology. But it was only with G. Gamow's research program in the late 1940s that the big-bang scenario became widely known and turned into a nuclear-physical theory of the early universe. How does the theory of Gamow and his collaborators R. Alpher and R. Herman compare with Lemaître's earlier ideas of a "primeval atom"? And with the post-1965 version of big bang cosmology? The strange fate of the Gamow-Alpher-Herman hot big bang theory can only be understood if taking into account that relativistic evolution cosmology faced stiff competition throughout the 1950s from the steady-state theory of F. Hoyle and others.

2:06PM C5.00002 The New Standard Cosmology , DAVID SPERGEL, Princeton University — Cosmology now has a standard model. A relatively simple cosmological model describes the large-scale distribution of galaxies, detailed observations of the microwave background, observations of supernovae, and the abundances of light elements as well as a host of astronomical observations. In this model, the universe is spatially flat, homogeneous and isotropic on large scales. It is composed of ordinary matter, radiation, and dark matter and has a cosmological constant. The primordial fluctuations in this model are nearly scale-invariant Gaussian random fluctuations. I will highlight the key tests of the model and focus on the new results from the Wilkinson Microwave Anisotropy Probe. While this simple model has many successes, many key cosmological questions remain unanswered: what happened during the first moments of the big bang? What is the dark energy? What were the properties of the first stars? I will discuss the role of on-going and future CMB observations in addressing these key cosmological questions and describe how the combination of large-scale structure, supernova and CMB data can be used to address these questions.

2:42PM C5.00003 The Future of Theoretical Cosmology , SEAN CARROLL, University of Chicago — Over the course of the twentieth century, we went from knowing essentially nothing about the large-scale structure of the universe to knowing quite a bit: that it is expanding from a Big Bang, that it is approximately 14 billion years old, that there are perhaps 100 billion galaxies spread uniformly throughout the observable universe. Theory has progressed along with observation: general relativity now forms the basis for all our discussions about cosmology, and advances in quantum field theory and particle physics have allowed us to talk sensibly about nucleosynthesis, dark matter, and primordial inflation. In the twenty-first century, two obvious candidates stand out: the nature of the dark sector, and the beginning of time. With 95% of the energy density of the universe apparently residing in dark matter and dark energy, the issues to be addressed by theorists span a wide range: What are these substances? Do they interact, with each other or with ordinary matter? Can they be detected in the lab? Why do they have the abundances we observe? Do they really exist, or are we being fooled by the behavior of gravity on large scales? Meanwhile, we will continue to stretch our theoretical models further into the past. Did the dark matter decouple from thermal equilibrium at early times? Do phase transitions in the early universe produce observable gravitational-wave backgrounds? Did inflation occur, and if so what were the dynamics of the inflaton field? Why did inflation start? Are there distinct domains within the universe, possibly with different properties? Can quantum gravity resolve the initial singularity, and connect us with a pre-Big-Bang phase? Why is the early universe different from the late universe – what is the origin of time asymmetry? It's impossible to predict what the answers to any of these issues will turn out to be, but we can be confident that we won't be running out of interesting questions.

Saturday, April 22, 2006 3:30PM - 4:51PM –
Session E5a FHP DPF: 50 Years Since the Discovery of Parity Nonconservation in the Weak Interactions I Hyatt Regency Dallas Pegasus B

3:30PM E5a.00001 New Insights to Old Problems , TSUNG DAO LEE, Columbia University — From the history of the θ - τ puzzle and the discovery of parity non-conservation in 1956, we review the current status of discrete symmetry violations in the weak interaction. Possible origins of these symmetry violations are discussed.

3:57PM E5a.00002 Cracks in the Mirror: Saga of a 36 Hour Experiment , LEON LEDERMAN, Fermi National Accelerator Laboratory — The history of the fall of parity, mirror symmetry, emerges from a puzzle in the behavior of particles (T-Θ puzzle). This stimulated the Lee-Yang paper of mid-1956 questioning the validity of parity in the weak interactions. They specifically raised the issue of the weak decays $\pi^{\pm} \rightarrow \mu^{\pm} + \nu$ and $\mu^{pm} \rightarrow e^{\pm} + 2\nu$. In subsequent detailed discussions between C.S. Wu and T.D. Lee, Wu designed a collaborative experiment with physicists from the Bureau of Standards in Washington D.C. which examined the decay of Co^{60}, an easily polarizable nucleus. Early positive results of the Wu experiment were discussed at a Friday lunch traditionally "chaired" by T.D. Lee. The precise date was the Friday of the first working week after the New Year, 1957. Here, for what was probably the first time, the possibility was raised that the failure of parity conservation could be a large effect. The conversation at the very traditional Chinese lunch was exciting. This new concept stirred me in my drive from Columbia to home in Irvington, actually a short walk to the NEVIS laboratory where Columbia's 400 MeV synchrocyclotron lab was housed. The events of the next few days are the substance of my paper. By Tuesday noon, the word had spread around the world that parity conservation was dead. By that time we had a 20 σ effect and many of the essential tests of validity of our experiment were done. Some of the consequences important to that time, and some still relevant in 2006 will be presented.

4:24PM E5a.00003 Do left-handed neutrinos have rights too? , JANET CONRAD, Columbia University — As with any great discovery, the result of C.S. Wu's experiment on parity violation opened up many more questions. This talk explores these questions in light of recent discoveries about neutrino properties and the potential for new discoveries at the highest energy scales.

Saturday, April 22, 2006 5:00PM - 5:27PM –

Session E5b FHP DPF: 50 Years Since the Discovery of Parity Nonconservation in the Weak Interactions II Hyatt Regency Dallas Pegasus B

5:00PM E5b.00001 In which direction is the door? , C. N. YANG, SUNY-Stony Brook, Emeritus — This abstract was not received electronically.

Sunday, April 23, 2006 1:15PM - 3:03PM –

Session J5 CSWP FHP: Pioneering Women Astronomers Hyatt Regency Dallas Pegasus B

1:15PM J5.00001 Henrietta Leavitt: Turn of the Century Trailblazer , JEAN TURNER, UCLA — This abstract was not received electronically.

1:51PM J5.00002 Cecilia Payne-Gaposchkin: A Stellar Pioneer (The Dorritt Hoffleit Lecture) , KATHERINE HARAMUNDANIS — In a world of Newtonian mechanics and Darwinian evolution, we also have Paynian composition of the stars and universe. While Payne, later Payne-Gaposchkin, did not extend her data and conclusions to the universe, her 1925 monograph, described by Otto Struve as "the most brilliant PhD thesis ever written in astronomy," is a pioneering landmark that for the first time combined astronomical observations of stellar spectra with the then new atomic theories of Bohr and Saha. Her conclusions were suppressed by her advisor, H.N. Russell, but she wisely published her data with a disclaimer. Though facing overt gender discrimination throughout her career, and suffering the "pink paycheck" so well known to many women, she persevered and, towards the end of her working lifetime at Harvard University, became Chairman of the Department of Astronomy, a department she had helped to establish with the exuberant director Harlow Shapley in the 1920s and 1930s. One colleague, who called her "An Astronomer's Astronomer," admired her as a person of great kindness, graciousness, humor and humility, who conveyed her love for the science "lucidly and enthusiastically." She never lost her love and ardor for astronomy and astrophysics and made innumerable contributions to these sciences. Her work continues to inspire and provoke those working in the field, and she remains a model for all scientists to follow.

2:27PM J5.00003 Never A Team Member; Suddenly A Team Leader! , JILL TARTER, SETI Institute — In the 1960's there weren't many female engineering students, and 'teaming' was not an official part of the curriculum. Teams were formed casually, as a way to share the enormous load of lab reports and problem sets – that is unless you were one of those female students. Physical isolation and institutional lockdown in the female dorms made my participation in study teams extremely difficult. As a result, I got a better formal education (working all the problem sets myself), but I missed out on learning a very practical skill. Leading a team is hard work, particularly if you've never been a member of a team. One solution is to work harder than almost anyone else. Another trick is to choose a small pond in which to be a big frog. I chose SETI (the search for extraterrestrial intelligence) because I was captured by the idea that I live among the first generation of humans who can try to answer this ancient question (Are we alone?) by making observations, rather than accepting some belief system. I'm still hooked by that concept and struggling to make the pond bigger (and financially secure) to bring in the next generation and the generation-after-that, for as long as it may take to end our cosmic isolation, or accept our singularity.

Monday, April 24, 2006 10:45AM - 12:33PM –

Session P10 FHP DNP: 50 Years Since the Discovery of Parity Nonconservation in the Weak Interactions III Hyatt Regency Dallas Cumberland C

10:45AM P10.00001 The Question Answered , RALPH P. HUDSON, National Institute of Standards and Technology (retired) — Fifty years ago, theoreticians T.D. Lee and C.N. Yang reached the conclusion that no experimental evidence existed to show that parity is conserved in weak interactions. The speaker will explain how it happened that that a team of physicists at the U.S. National Bureau of Standards in Washington, DC came to perform the revolutionary experiment that demonstrated the failure of parity conservation in nuclear beta-decay.

11:21AM P10.00002 Chien-Shiung Wu as a Person and a Scientist , VINCENT YUAN, Los Alamos National Laboratory — Chien-Shiung Wu is well known for her outstanding contributions to Nuclear Physics in Parity Violation and Beta Decay. I will discuss my view of her as seen from my vantage point as her son.

11:57AM P10.00003 Looking through the Mirror: Future Directions in Parity Violations , M. RAMSEY-MUSOLF, California Institute of Technology — Over the past fifty years, studies of parity violation (PV) involving atoms, nuclei, and elementary particles have taught us a great deal about the electroweak and strong interactions. The future of this field promises to be equally rich. In this talk, I discuss new initiatives using PV to study weak interactions among quarks, to probe the structure of the nucleon, and to search for physics beyond the Standard Model.

Monday, April 24, 2006 1:30PM - 3:18PM –

Session Q14 FHP: History of Physics Hyatt Regency Dallas Cumberland I

1:30PM Q14.00001 Was Nazi Germany on the Road to an Atomic Bomb after all? , HARRY LUSTIG, The City College of the City University of New Yrok (emeritus) — The story of Germanys efforts to develop a nuclear weapon during World War II is a much written about and contentious subject. However there has been agreement on one thing: by the end of the War the Germans had not achieved and were nowhere near to building a bomb. The dispute therefore has been about why Germany did not succeed. Now, from Germany, comes a challenge to this truth, in the provocative book Hitlers Bombe by Rainer Karlsch. The bombshell in Hitlers Bombe is the assertion that German scientists developed and tested a primitive fission and fusion nuclear weapon in March 1945. Karlsch bases this claim on testimony of witnesses in 1962, previously secret Russian documents, and the results of soil tests carried out in 2004 and 2005. However the physics is very murky and it seems out of the question that Germany had enough Uranium 235 or produced any Plutonium for a bomb. Hitlers Bombe also makes other, better documented and more credible revisionist assertions. These include the claim that the Nazis did continue to try to build a bomb after 1942 and that not Werner Heisenberg, but Kurt Diebner and Walther Gerlach were then the leaders of the German Uranium project. Karlschs book therefore deserves more attention from physicists and historians than it has received in the United States.

1:54PM Q14.00002 Einstein and Oskar Klein: The Fifth Dimension as a Bridge across Quantum Chasms , PAUL HALPERN, Univerisity of the Sciences in Philadelphia — In the mid 1920s, various physicists grappled with the underlying mechanisms for quantization. While at Ann Arbor, Oskar Klein developed a deterministic theory based upon the assumption of an undetectable fifth-dimension. With the rise of modern quantum mechanics, Klein, along with his colleagues, embraced the idea of wave functions acting in Hilbert space, and abandoned, for a time, the concept of an extra physical dimension. During the same period, Einstein, in contrast, began to explore five-dimensional unified field theories—first along with Walther Mayer, then with Peter Bergmann and Valentine Bargmann. This talk will explore connections—conceptual and philosophical—between Einstein's and Klein's theories, analyze the differences, examine the correspondence between the two theorists, and delve into the reasons each came to embrace and abandon the idea of the fifth dimension.

2:18PM Q14.00003 SED Alumni—breeding ground for scientists , BENJAMIN BEDERSON, New York University — In 1943 the US Army established the Special Engineering Detachment (SED), in which mostly drafted young soldiers possessing some scientific credentials (though usually quite minimal) were reassigned from other duties to the Manhattan Project to assist in various research and development aspects of nuclear weapons. The Los Alamos contingent, never more than a few hundred GIs, worked with more senior scientists and engineers, often assuming positions of real responsibility. An unintended consequence of this circumstance was the fact that being in the SEDs turned out to be a fortuitous breeding ground for future physicists, chemists, and engineers. SEDs benefited from their close contacts with established scientists, working with them side by side, attended lectures by luminaries, and gained invaluable experience that would help them establish academic and industrial careers later in life. I will discuss some of these individuals (I list only those of whom I am personally aware). These include Henry "Heinz" Barschall*, Richard Bellman*-RAND Corporation, Murray Peshkin-ANL, Peter Lax-Courant Institute, NYU, William Spindel*-NRC,NAS, Bernard Waldman- Notre Dame, Richard Davisson*-U of Washington, Arnold Kramish- RAND, UNESCO, Josef Hofmann- Acoustic Research Corp, Val Fitch- Princeton U. *deceased

2:42PM Q14.00004 Rosenfeld, Bergmann, and the Invention of Constrained Hamiltonian Dynamics , DONALD SALISBURY, Austin College — Significant progress in the invention of constrained Hamiltonian dynamics was made by Leon Rosenfeld in a paper he published in the Annalen der Physik in 1930. He applied his general formalism to general relativity with electrodynamical field and Dirac electron sources. His proposed Hamiltonian will be compared and contrasted with an independently developed precursor investigated by Peter Bergmann and collaborators in 1949-50.

3:06PM Q14.00005 Historic Patterns in Astronomical Incomprehension , VIRGINIA TRIMBLE, UC Irvine & Las Cumbres Observatory — Because astronomy is old, it has had a chance to display some very prolonged battles in the war between ideas (theories) and observations (data) that we call science. It is possible to discern two major patterns – data leading vs. ideas leading – and very short to very long durations of the events that eventually led to understanding. A variant has the community converging with vigor around a wrong answer (gamma ray bursters are a recent example). The talk will explore some of the author's favorite examples of each pattern. These include the rapid basic understanding of quasars and pulsars vs. the extremely long times required to figure out the solar corona and pulsating variable stars. Among the cases where theory has led via prediction, discovery was almost immediate for 21 cm radio emission and superluminal motion in quasars, but very slow for fluctuations in the cosmic microwave background radiation, certain kinds of polarization, and (surely a record never to be broken) heliocentric parallax.

Monday, April 24, 2006 3:30PM - 5:54PM –

Session S4 FHP FPS: FHP/FPS Award Session Hyatt Regency Dallas Marsalis A

3:30PM S4.00001 Pais Prize Lecture: History and Physics , JOHN HEILBRON, UC Berkeley — Modern history and experimental physics entered the university together, in the course of the eighteenth century. They shared several practices and projects. Historians began to emphasize physical factors, and so drew on, and occasionally contributed to, meteorology and physical geography; and they developed ancillary disciplines, like numismatics, diplomatics, and paleography, which required the analysis of metals, paper, and inks, and the careful comparison of material objects. In physics, historical reviews of newer subject matters, such as electricity, optics, and pneumatics, guided instruction where neither the facts nor their interpretation compelled consensus. The inherently historical science, geology, was a favorite subject of the age: the earth received a history, and the cosmos, too; evolutionary ideas found applications everywhere. The new physics and the new history became potent weapons of Enlightenment. A product of their collaboration is the lengthiest history of physics ever written, J.G. Fischer's *Geschichte der Physik* (8 vols., 1801-1808). It appeared within a series edited by Johnn Gottfried Eichhorn, Germany's leading exponent of the "higher criticism," the corrosive application of historical and literary considerations to the stories of the Old Testament. The writings of historians like Eichhorn were more subversive than the work reported by Fischer in so far as humans are more concerned with their place in the world than with the details of its behavior. The coincidental matriculation of modern history and experimental physics, and its consequences, will be discussed.

4:06PM S4.00002 Szilard Prize Lecture: Seismic Monitoring of Nuclear Explosions , PAUL RICHARDS[1], Columbia University — Seismic monitoring of the more than 2000 nuclear test explosions since 1945 has been vigorously pursued, both to track the weapons development of potential adversaries, and to support initiatives in nuclear arms control, including various test ban treaties. Major funding from the US Department of Defense built up new global seismographic networks and over several decades established practical capability in monitoring nuclear explosions "teleseismically" (i.e. from distances more than about 1500 km), for tests that the testing nation did not attempt to conceal. What then is the capability to monitor compliance with, for example, the Comprehensive Nuclear-Test-Ban Treaty (CTBT) of 1996, particularly if evasion scenarios are considered? Note that the CTBT, though not ratified by some countries (including the US), is now being monitored by networks that include seismographic stations at "regional" distances ($<$ 1500 km) from candidate explosion locations. Years of R and D have shown that regional signals can be used to monitor down to yields significantly lower than can be detected and identified teleseismically. A US National Academy of Sciences study in 2002 concluded that "an underground nuclear explosion cannot be confidently hidden if its yield is larger than 1 or 2 kt." About 1000 earthquakes and chemical explosions are now detected per day, and documented via seismic data, providing plenty of challenges for nuclear explosion monitoring organizations. Explosion monitoring capability will improve in many parts of the world, due to the growth of networks that monitor even small earthquakes to study seismic hazard. But political problems can impede improved international explosion monitoring, due to national restrictions on data access.

[1]A member of the American Geophysical Union

4:42PM S4.00003 Burton Award Lecture: A.Q. Khan and Illicit Nuclear Trade , DAVID ALBRIGHT, Institute for Science and International Security — This abstract was not received electronically.

5:18PM S4.00004 Sakharov and the Grey Zone: Difficult Areas of Human Rights Activity , YURI ORLOV, Laboratory for Elementary-Particle Physics, Cornell University — Drawing on my experience in human rights work and my discussions with A. D. Sakharov, I will explore some difficult areas of human rights activity in which human rights defenders cannot reach a consensus on how to proceed, and even on how to define the problem.

Monday, April 24, 2006 5:30PM - 6:30PM –
Session T14 FHP: FHP Business Meeting Hyatt Regency Dallas Cumberland I

5:30PM T14.00001 FHP Business Meeting –