NOMINATION COVER SHEET
2009 Virginia Outstanding Faculty Awards

1. NAME

Full (Legal): Lawrence B. Weinstein Preferred First Name: Larry

2. INSTITUTIONAL INFORMATION

Institution: Old Dominion University

Rank/Position Title: Professor and Designated as a University Professor

Year Rank/Title Attained: 2003

Years at Institution: 16

Campus Email Address: lwienste@odu.edu

Campus Phone: (757) 683-5803

Campus Mailing Address: Department of Physics, Old Dominion University, Norfolk, VA 23529

Campus Communications Contact:

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3. PROFESSIONAL INFORMATION

Academic Discipline: Physics

Specialization/Field: Nuclear Physics

Type of Terminal Degree: Ph.D.

Year Awarded: 1988

Awarding Institution: Massachusetts Institute of Technology

4. PERSONAL INFORMATION

Home Phone:

Cell Phone Number:

Home Mailing Address:

Please check only one box:

RESEARCH/DOCTORAL INSTITUTION NOMINEE: ☐
MASTERS/COMPREHENSIVE/BACCALAUREATE INSTITUTION NOMINEE: ☒
TWO-YEAR INSTITUTION NOMINEE: ☐
RISING STAR NOMINEE: ☐
TEACHING WITH TECHNOLOGY NOMINEE: ☐

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President or Chief Academic Officer

Signature: Carol Simpson

Printed Name: Carol Simpson, Provost and Vice President for Academic Affairs

Mission Statement

Old Dominion University

The Mission of Old Dominion University is as follows:

"Old Dominion University promotes the advancement of knowledge and the pursuit of truth locally, nationally, and internationally. It develops in students a respect for the dignity and worth of the individual, a capacity for critical reasoning and a genuine desire for learning. It fosters the extension of the boundaries of knowledge through research and scholarship and is committed to the preservation and dissemination of a rich cultural heritage. Old Dominion University is old enough to value tradition yet young enough to facilitate change. In a spirit of creative experimentation, innovation, and technology, the University is ready to meet the challenges of the twenty-first century."

The Mission Support section of the mission statement describes in detail the principles and practices that underlie the University's undergraduate and graduate teaching, research, and service missions: a sound general education program; critical thinking; diversity; academic freedom; serving the needs of the local, national, and international communities, including military members and their families; and collaborating with government, industry, and alumni. Finally, the Major Goals of the University are described under the following headings: Students; Faculty; Academic Programs; Teaching; Research, Scholarship and Creativity; Distance Learning; Lifelong Learning; Community Service; Student Life; Alumni; and Quality.

A complete statement of the mission and major goals may be found in the Old Dominion University Undergraduate Catalog, 2008-2009 (pp. 2-4) and available at the following web site: www.collegesource.org/cat209/120257.pdf

Summary of Accomplishments

Teaching

Dr. Larry Weinstein has received accolades for teaching physics at every level from Physics 101 to Graduate Quantum Mechanics. He shows that physics is not just another class, but is instead crucial to understand how the world around us works. He demonstrates ideas by doing experiments with apparatus ranging from rubber bands to flame tubes; he engages students in large lecture classes by getting them to discuss questions in small groups and then answer electronically; and he poses real-world context-rich questions that require both common sense and physics skills to answer. Student evaluations and comments demonstrate that he is a superb and demanding teacher. He has received many awards for his teaching, among them the Old Dominion University College of Sciences Faculty Excellence Award for excellence in teaching, research and service (2005), the College of Sciences Distinguished Teaching Award (2006), the Old Dominion University Teaching with Technology Award (2007), and designation as a University Professor (2007), which is the highest honor that the University bestows on a faculty member for teaching excellence.

Physics, especially at the introductory level, is not a subject that can be learned passively. Dr. Weinstein is always searching the results of physics education research for tested ways to better actively engage introductory physics students.

This year, Dr. Weinstein has introduced SCALE-UP (http://scaleup.ncsu.edu/) to ODU. The name really says it all. SCALE-UP stands for “Student-Centered Activities for Large Enrollment Undergraduate Programs.” Students work on interesting activities in carefully structured groups of three, sitting around large round tables with white boards for working out problems and laptops for simulations and web access. While the students work, the instructor roams the classroom--asking questions, sending one team to help another, gently guiding a group, and building relationships with students.

Most of the class time is spent on "tangibles" and "ponderables." These are hands-on activities, simulations, or interesting questions that improve students’ problem- solving abilities and increase their conceptual understanding. Lecturing is done only to provide motivation and a view of the "big picture," which is difficult for students to see when they are not familiar with the entire course. Physics education research indicates that SCALE-UP significantly increases learning, reduces failure rates (especially for women and minorities) and improves performance of “at risk” students in follow-on courses.

SCALE-UP ponderables include problem solving, as well as three different types of activities that Dr. Weinstein already used to engage introductory physics students in standard lecture courses: ConcepTests, Lecture Demonstrations, and Estimation Questions.

The ConcepTests are based on ideas in the book *Peer Instruction* by Eric Mazur. A ConcepTest starts with a conceptual question. For example, Dr. Weinstein will ask the students: “If I shine a red laser beam through a glass of red water onto a screen, will the laser beam be absorbed or transmitted by the water?” He presents the question to the class and gives them one to two minutes to think about it and consult with their neighbors (the peer instruction). During this time he joins some of the discussions to learn how the students think about different problems. He then collects the answers and they discuss it further.

This has many benefits: 1) the teacher gets instant feedback on his teaching; 2) the students get instant feedback on their learning; 3) the students learn by teaching each other; 4) the students participate in class, increasing their attention level; and 5) being quizzed on the question, the students are far more interested in the answer and far more likely to remember it. ConcepTests have been shown by physics education research to give students a much greater understanding of the conceptual bases of physics than traditional lecturing.

The Lecture Demonstrations are small experiments that illustrate specific physical principles. They are extremely important both philosophically and practically. Philosophically, they show that physics is an experimental science. The students need to see the experimental truth of what is taught, rather than just be urged to believe it because an authority figure (*e.g.*, the professor) says so. Practically, demonstrations show students phenomena they had not previously encountered (*e.g.*, diffraction of light) as well as counterintuitive phenomena (*e.g.*, Bernoulli's Principle) that force them to confront their misperceptions. Dr. Weinstein performs approximately 200 demonstrations per year in Physics 101 and 102.

In addition, Lecture Demonstrations are an important category of ConcepTest. Before almost every demonstration, Dr. Weinstein 1) describes the demo carefully, 2) asks the students to predict the results of the demonstration using the PRS remote response system, 3) performs the demo, and 4) explains why and how it worked. This four-step method causes the students to watch the demo very carefully and has been shown by Physics Education research to greatly enhance learning. In contrast, it has been shown that, if you just "do the demo," students frequently remember seeing what they expected to see, rather than what actually happened.

Dr. Weinstein has rebuilt the Physics Department's lecture demonstration capability by organizing information about hundreds of lecture demos in two Web sites and by creating approximately 100 new demonstrations. These Web sites are widely consulted by physics faculty. The new demonstrations include: the flame tube, the seat of nails, hit professor on head with hammer, the bowling ball pendulum, and the vacuum cannon.

Dr. Weinstein earned the Teaching with Technology Award in 2007 for using electronic responses with ConcepTests and for developing the Physics Department lecture demonstration capability.

The Estimation Questions are another way Dr. Weinstein gets the class involved by using physical principles to estimate real-life problems that do not have exact answers. For example, they estimate the amounts of coal and uranium required to fuel coal- and nuclear-power plants. They also estimate the average number of students in the lecture hall that will die in an automobile crash at some time during their lives.

These efforts are reflected in Dr. Weinstein's positive evaluations and student comments for Physics 101, a required course for many students wishing to teach grades K-6. Student comments included "I hate physics, but I loved this class. Professor Weinstein is so helpful and so approachable. He is always willing to meet with you if you have questions about homework or tests. He always has great demos to help us visualize physics in the classroom, and you can tell he loves what he does. I learned so much in this class." Another student wrote, "Prof. Weinstein is awesome! His ability to relate physics to real life is unbelievable. The course is hard, but his notes and demonstrations make it easier. The tests are long and difficult, but if you do well on the homework they will be a breeze. Pay attention to the mini-quizzes in class because the explanations can be the same for the homework and on the test. I look forward to learning even more in Physics 102!!!" One year after taking the course, Jonathan Robertson

wrote, “I just wanted to write what I consider a long overdue letter to let you know how much I absolutely loved and greatly benefited from my enrollment in Physics 101 and 102. I have taken numerous college courses at the University of Southern California, and a few at William and Mary and ODU. In the entirety of my college experience, I can only think of about four or five professors whom I consider truly gifted. I consider you one of them. Your enthusiasm for the subject matter was only exceeded by your clarity and skill in explaining and demonstrating the concepts involved.”

The ability to estimate is even more important for upper-level physics students. They should be able to apply their classroom knowledge to real-world situations such as estimating the effect of highway crash barrels on the lethality of automobile accidents or estimating the relative energy storage densities of gasoline and batteries. Dr. Weinstein created the course, Physics on the Back of an Envelope, to teach physics majors how to estimate physical phenomena. The course teaches students many things beyond estimation, including the ability to use their physics knowledge to understand the world around them, the need to roughly verify the results of their calculators, and the ability to integrate and apply knowledge of different fields of physics. Student comments on the class include “It's been beneficial in other classes, as well as everyday life,” and “The most useful physics course I have ever taken.”

Dr. Weinstein’s teaching skills at the highest levels are shown by his evaluations in Graduate Quantum Mechanics (1999-2000) which were a stellar 5.7 and 5.9 out of 6. The students’ comments reflected this: “Excellent course, one of the best I've ever had. Dr. Weinstein's method of teaching encouraged student involvement, making learning enjoyable. Class ran more like a group discussion on quantum theory than it did like a formal class. Dr. Weinstein went out of his way to help me as a student and was very accommodating as an instructor. I couldn't give this class any higher ranking,” and “The best course I took in ODU to the current moment. Dr. Weinstein is a great teacher. Thank you.”

A physic’s masters student, T. David Pyron summed it up when he wrote, “Dr. Weinstein empowered me to learn. He was not only a good teacher, he was a good coach. He made time to work with his students until “they got it” and to feed their interest in areas beyond the scope of required learning. Dr. Weinstein is an excellent example and role model for how professors can enable their students to learn, grow and achieve.”

Discovery

Dr. Weinstein is internationally recognized for his work in electron scattering nuclear physics. He was named a Fellow of the American Physical Society in 2004 “for his original contributions to the study of nucleon-nucleon correlations in nuclei.” He has co-authored over 100 papers in peer-reviewed journals that have been cited over 3,000 times. He has given more than 45 seminars at universities and invited talks at international conferences and workshops. He has also been Principal Investigator or co-Principal Investigator on research grants totaling over $6 million.

Dr. Weinstein performs his research primarily at the Thomas Jefferson National Accelerator Facility (Jefferson Lab) in Newport News. Jefferson Lab, funded by the U.S. Department of Energy, is the world’s premier laboratory for studying the transition from nucleon to quark degrees of freedom in the nucleus of the atom. Scientists at Jefferson Lab study nuclei by bombarding them with high-energy electrons and detecting the particles (electrons, protons, neutrons, pions, etc.) that are ejected. The ejected particles are detected using huge spectrometers comprised of massive magnets and complicated particle detectors.

Dr. Weinstein's leadership role at Jefferson Lab is shown in many different ways. He served as Chair of the CLAS Collaboration from 2003-2005. The Collaboration coordinates the efforts of the 200 physicists using the CEBAF Large Acceptance Spectrometer (CLAS), one of Jefferson Lab's three experimental halls. This includes maintaining CLAS, guiding new experiment proposals, performing experiments, analyzing the data, and reviewing physics results. As Chair, Dr. Weinstein helped guide the CLAS physics program, encouraging new proposals to search for the pentaquark (a possible new type of elementary particle) and overseeing the review of their results. He was elected to the Jefferson Lab Users Group Board of Directors for the second time in 2007. The UGBoD represents the interests of the Jefferson Lab users (*i.e.*, all the hundreds of outside physicists that use the lab facilities) to lab management and to the outside world. He is also co-spokesperson (leader) of five approved experiments at Jefferson Lab. An experiment typically is performed by 100-200 physicists, has sole use of one of the experimental halls for about two months, and is responsible for a significant fraction of Jefferson Lab's scientific output for the year.

The CLAS is a huge (40-foot diameter) spherical spectrometer with six concentric layers of detectors designed to measure all of the charged particles emitted in a nuclear collision. Dr. Weinstein led the Old Dominion University group that built the multimillion-dollar Region II Drift Chambers, one of the six detector layers. These drift chambers measure the trajectories of high-energy elementary charged particles (*e.g.*, electrons, protons, pions, kaons) to a fraction of a millimeter. Representing the largest single-university contribution to the construction of Jefferson Lab, the drift chambers have been used successfully for more than a decade.

Dr. Weinstein's research focuses on the behavior of nucleons (protons and neutrons) in nuclei. He led one of the first experiments performed at Jefferson Lab, measuring the momentum distribution of single protons in oxygen. His research team found about 70% of the expected number of protons, indicating that 30% of the time protons in the nucleus are not single. They also found that when the proton was single, it behaved remarkably like a free proton, despite the distorting presence of the other 15 nucleons.

In order to understand the non-single protons, Dr. Weinstein and his students used the CLAS to perform the first measurement of the momentum distributions of pairs of nucleons. The study of correlated nucleon pairs was one of the initial scientific justifications for the construction of Jefferson Lab. Dr. Weinstein studied pairs in a rare isotope of helium that contains only three nucleons. He looked at collisions where an electron knocked out one of the three nucleons and measured the momentum distributions of the other two. This novel technique allowed him to study nucleon pairs that were undisturbed by the electron-nucleus collision. Just like humans, nucleons have many similarities and differences in behavior when they are studied individually or in pairs. Nucleons in pairs have much greater momentum than single nucleons. Nucleons in pairs are also much closer together than unpaired nucleons. According to Dr. Weinstein, "Nucleons are like people. When they are far apart they ignore each other, when they are close they can attract each other, but when they get too close, they repel each other violently."

Dr. Weinstein is currently working on producing a mixed matter/antimatter beam of electrons and positrons (the anti-particle of the electron). This beam will be used to compare the interactions of electrons and positrons with the proton in order to resolve major discrepancies between two different measurements of the proton charge distribution. Producing usable amounts of positrons is a major experimental challenge. Dr. Weinstein and his collaborators will use the Jefferson Lab primary electron beam to produce high energy photons by *bremsstrahlung* and then divert the electrons to a beam dump using a large magnet. By

passing the photons through a thin metal foil, they cause some of the photons to produce electron-positron pairs. Then the electron-positron pairs are separated by magnets, the remaining photons are stopped in a tungsten block, and the electron and positron beams are recombined with more magnets. This experiment will help scientists understand the structure of the proton, one of the fundamental building blocks of matter.

Integration

Dr. Weinstein integrates his teaching and research in many ways. He involves undergraduate and graduate students in research, he describes his research for high school students and for newspapers, he leads Jefferson Lab tours for his classes, he organizes lectures and lecture series, and he teaches nuclear physics summer school lectures. He is also bringing the art of estimation to a local and national audience.

He brings estimation questions to a national audience as the Fermi Question column editor for *The Physics Teacher*, the monthly journal of the American Association of Physics Teachers. One recent question asked readers to compare the mass of hydrocarbons used to produce their grocery-store plastic bags with the mass of hydrocarbons burned in their cars each year. In order to reach a more general audience, he has written, together with Prof. John Adam (a 2007 SCHEV Outstanding Faculty Award winner), *Guesstimation: Solving the world's problems on the back of a cocktail napkin*, published by Princeton University Press in April 2008. The book contains 80 estimation questions and answers, covering topics such as automobile and air safety, nuclear waste, electric cars, solar power, and the total length of pickles consumed by Americans each year. *Guesstimation* has been featured on the *Wall Street Journal* Numbers Guy blog, reviewed in Times Higher Education, Business Week, Games, Nature Physics, and Science, and is already in its second printing. Neil deGrasse Tyson, astrophysicist at the American Museum of Natural History, called it "a delightful book that, page after page, gleams with insight into the measure of all things--from house pets to lottery tickets and from the kitchen to the cosmos. Meanwhile, the authors cleverly teach you some fundamental chemistry, physics, and biology, leaving you enlightened and curiously comfortable with all that once seemed intractable in the world."

In order to help bring critical thinking skills to students and scientific knowledge to the general public, Dr. Weinstein organized the 2000 College of Sciences Dean's Distinguished Lecture Series entitled "Investigating Modern Pseudoscience." He invited seven scholars to lecture on subjects such as astrology, alternative medicine, UFOs, ghosts, and scientific foolishness and fraud. More than 1,000 people attended the lectures. The tremendous response to this lecture series encouraged Dr. Weinstein to organize Science and Reason in Hampton Roads (SRHR), an organization devoted to the critical examination of dubious or extraordinary claims. SRHR hosts lectures, organizes events such as the Superstition Celebration (where they found that 40% of ODU students and staff were scared to smash a mirror on Friday the 13th) and maintains a Web site at www.physics.odu.edu/~weinstei/srhr.html. He also works to explain Jefferson Lab research to the general public, through many talks to high school audiences and through newspapers. His research on nucleon-nucleon pairs was described in the Newport News Daily Press and he was featured in an April 2005 article in the Washington Post on Jefferson Lab (see the additional information section).

Dr. Weinstein also involves students in his research at all levels. He has worked with many undergraduate students on research projects. These projects range from the construction of the huge Region II Drift Chambers described above to a measurement of cosmic radiation rates underneath the Hampton Roads Bridge Tunnel roadway. He has advised five graduate

students performing their thesis research on Jefferson Lab projects. These projects included building detectors, performing experiments and analyzing experimental data.

Service

Dr. Weinstein contributes a tremendous amount to the University, to physics, and to the community.

In his University service, he has served as Physics Graduate Program Director, chair of the College of Sciences Graduate Committee, a member of the Provost Search Committee, advisor to the Society of Physics Students and to the Physics Graduate Student Association, and as a member of the Council on Teacher Education.

In his service to the Physics community, he has refereed publications for journals such as *Physical Review Letters* and *The Physics Teacher* and reviewed grant proposals for the National Science Foundation. He is also serving his second term on the board of directors of the Jefferson Lab Users Group.

Dr. Weinstein brings physics to the community by organizing many interactive physics events, performing physics demonstration shows, and inviting public lecturers. Dr. Weinstein also served as science consultant to the Virginia Children's Museum in Portsmouth, advising on exhibit construction and descriptions and training museum staff on their science exhibits.

He has invited many speakers to give public lectures at ODU and at Jefferson Lab, including Robert Friedhoffer who offered "Einstein and Beyond - The Magic Show" and Brian Fields who spoke on "When Stars Attack." He also led the post-documentary discussion for "Who Killed the Electric Car" at the Naro Theater in Norfolk.

He has performed dozens of physics demonstration shows for thousands of students at local elementary, middle and high schools. He has also organized the yearly interactive ODU Physics booth at the Virginia Children's Festival for well over a decade. Each year over 30 faculty and students demonstrate various physics phenomena (including angular momentum, pressure, electromagnetism, and quantum colors) to at least 2,000 festival-goers.

Dr. Weinstein also helps organize the annual Tidewater Physics Olympics, where several hundred middle and high school students compete in fun physics-related events such as the Slow Bicycle Race, Build a Magnet, and Mirror Maze. He also served as a judge for the Florida State Science Olympics.

His most smashing service is helping the Society of Physics Students organize their yearly "Pumpkin Drop," where they drop dozens of pumpkins from the tallest building on campus and challenge teams to build "pumpkin catchers" that can stop the plummeting pumpkins without damaging them.

Personal Statement

It was a dark and stormy night. Eerie lights flickered and strange moans sounded as my specially equipped car screamed up to the haunted house. This was no ordinary case and I was relieved to have Joe Nickell, a top ghost-buster, riding shotgun.

Wellllll, no. It **was** dark and Joe Nickell **is** the country's most experienced paranormal investigator, but the rest of that is just not true.

As president of Science and Reason in Hampton Roads, I was glad to put my physics knowledge to a somewhat unusual use. We listened carefully as George and Mary described the unnatural lights, strange sounds, swaying blinds, and slamming doors. These unexplained phenomena convinced them that their house was haunted. Without questioning what they had heard and seen, we pointed out possible physical explanations. For example, wind blowing over the chimney can cause pressure changes that slam doors and headlights of passing cars can make strange lights slither across walls. They didn't seem convinced.

A follow-up call to Mary the next week found her thinking very differently. She had discovered that throwing back the bedcovers could make the blinds sway. The phenomena were no longer so mysterious and unexplained. Mary was relieved and thankful for our visit.

Although ghost-busting is not an everyday occurrence for a nuclear physicist, it exemplifies what I love about being a scientist. I investigate unexplained phenomena, determine possible causes, communicate findings, and improve people's lives.

The phenomena I seek to understand range from the mundane to the quantum. I love to know what happens as you flip a light switch, how the sensors at traffic lights work, why cars have crumple zones, and when protons pair up. Physics shows us how to understand much of the world around us.

Understanding the subatomic world is much more challenging. However, the method of study comes naturally to any 5-year-old: hit it hard and see what comes out. We hit the nucleus with high-energy electrons from a particle accelerator at the Thomas Jefferson National Accelerator Facility and then we detect the particles that come out of the collision using huge spectrometers comprised of massive magnets and complicated particle detectors.

Much of my research involves how protons and neutrons behave in the nucleus of the atom. I measure how fast they move, both singly and in pairs. I measure what fraction of time they spend in pairs. I try to understand what happens when they are so close that they overlap.

Research at Jefferson Lab involves many skills and activities. I spend time thinking about physics and how to measure things; I analyze data on computers; I interpret results; I design and build huge particle detectors; I wear a hard-hat, steel-toed shoes and safety harness turning a large wrench 20 feet above the ground installing the detectors. The variety makes life interesting.

As a professor, I also delight in teaching--from the individual to the classroom and the lecture hall to the printed word. Whereas research involves communicating newly discovered facts to peers, teaching involves communicating previously known facts and ways of thinking to students. Researchers already appreciate the joy of discovery and the delights of

understanding the world around us; students need to be introduced to these joys and delights. Teaching allows me to communicate the love of learning to others.

Research is inseparably intertwined with teaching. A graduate student serves the equivalent of an apprenticeship, learning their trade by working closely with their advisor. I have mentored several students, teaching them the techniques and the ethics of research and sharing with them the joys of discovery. Teaching at the individual level lets one intensively nurture students, helping them grow from hesitant apprentices to mature and confident scientists.

Research is also inseparably entwined with teaching another way. After discovering a new fact, we must communicate it to our peers, typically through discussions, presentations at conferences and papers in journals. We also must communicate to the general public (who, after all, are the ones paying for the research) what we do and why we are doing it. I have given many tours, talks and presentations to school and community groups explaining the intellectual gratification and practical applications of nuclear physics.

As a researcher and as a teacher, it is crucial to use the most up-to-date techniques. I helped introduce "Peer Instruction" and other interactive lecture techniques to the physics department. These have been shown by physics education research to greatly increase student conceptual learning. This year, together with a colleague, I am pioneering the Scale-Up technique for introductory physics. Scale-Up engages the students in hands-on activities and simulations to improve the students' problem-solving abilities and to build comprehension. In a Scale-Up classroom, the focus changes from the professor's lecturing to the students' learning.

When I teach physics, I try to make it far more than a catalog of equations to be applied to artificial situations. I try to make it immediately applicable to students' lives. We estimate the number of students in the class likely to die in a car crash and the physics of how seatbelts, airbags, and highway crash barrels save lives. We discuss how electric guitars work and why we don't drive electric cars. We calculate specific problems such as the kinetic energy of a car at highway speed and we estimate less well-defined problems such as the kinetic energy of a drifting continent or the extra farmland we would need to fuel all of our cars with ethanol.

These types of questions are a great teaching technique and estimation is a crucial skill to acquire. A typical textbook physics question includes all the information needed to answer it. An estimation question--such as "What is the weight of all the plastic supermarket bags used by Americans each year?"--requires that the student understand the situation, devise the method of solution, and then supply the missing information.

Estimation gives us the tools to understand and deal with many questions without relying on experts; it is the anchor of common sense and a powerful tool for an informed citizenry. How much power can we get from windmills? How much landfill space do we need? How many solar panels would we need to supply all of our energy needs?

In order to teach estimation to a broad audience, I initiated a monthly estimation column for the journal *The Physics Teacher* and, together with John Adam (2007 SCHEV Faculty), I have written a book titled *Guesstimation: Solving the world's problems on the back of a cocktail napkin* published by Princeton University Press in 2008 (and already in its second printing).

I may never have the chance to investigate another haunted house, but I will continue to study the universe and share the fruits of this study with my colleagues and students.

Abbreviated Curriculum Vitae
Lawrence B. Weinstein

Education

1981	Yale University. Bachelor of Science in Physics, *cum laude*
1988	Massachusetts Institute of Technology, Doctor of Philosophy in Physics

Professional Experience

1992-Present	Physics Department, Old Dominion University University Professor, 2007-present Professor, 2003-present Associate Professor, 1998-2003 Assistant Professor, 1992-1998
1988-1992	Department of Physics and Laboratory for Nuclear Science, Massachusetts Institute of Technology Research Scientist, 1991-1992 Sponsored Research Staff, 1988-1991

Honors and Awards

2008	Finalist, Virginia Outstanding Faculty Award
2007	Appointed University Professor, Old Dominion University, for excellence in teaching
2007	Teaching with Technology Award, Old Dominion University
2006	Distinguished Teaching Award, Old Dominion University College of Sciences
2005	Faculty Excellence Award, Old Dominion University College of Sciences
2004	Elected Fellow of the American Physical Society
2003-2005	Chair of the CLAS Collaboration at the Thomas Jefferson National Accelerator Facility (Jefferson Lab)
1980	Ranked 22nd nationally on the Putnam Mathematics Exam

Teaching Innovations

Introduced SCALE-UP to ODU for teaching introductory physics.
Developed and catalogued over 100 new Physics lecture demonstrations.
Introduced ConcepTests and recording student responses to the ODU Physics Dept.
Developed a new course, “Physics on the Back of an Envelope,” to teach estimation.

Books

2008	*Guesstimation: solving the world’s problems on the back of a cocktail napkin* (co-authored with John Adam, Princeton University Press)

Monthly Column

Fermi Questions, Column Editor, *The Physics Teacher*, 2007-present.

Journal Publications (selected from over 100 with over 3000 citations since 1995)

Probing Cold Dense Nuclear Matter, R. Subedi, *et al.*, *Science* 320, 1476 (2008).
Deeply virtual compton scattering beam-spin asymmetries, F.X. Girod, *et al.*, *Physical Review Letters* 100, 162002 (2008).
Bayesian analysis of pentaquark signals from CLAS data, D.G. Ireland, *et al.*, *Physical Review Letters* 100, 052001 (2008).
Investigation of proton-proton short-range correlations via the ^{12}C(e,e’pp) reaction, R. Shneor, *et al.*, *Physical Review Letters* 99, 072501 (2007).

Observation of an exotic S = +1 baryon in exclusive photoproduction from the deuteron, S. Stepanyan, *et al.*, *Physical Review Letters* 91, 252001 (2003). (538 citations)
Observation of an exotic baryon with S = +1 in photoproduction from the proton, V. Koubarovsky, *et al.*, *Physical Review Letters* 92, 032001 (2004). (344 citations)
The CEBAF Large Acceptance Spectrometer (CLAS), B. Mecking, *et al.*, *Nuclear Instruments and Methods* A503, 513 (2003). (125 citations)

Invited Presentations (selected from a total of 47)
Short Range Correlations, Jefferson Lab Users Group annual Meeting, Jefferson Lab, Newport News, VA, June 16-18 2008.
Nuclear and Hadronic Physics with Electromagnetic Probes, four lectures presented at the 14th United Kingdom Nuclear Physics Summer School, Newcastle, UK, August 29 - September 8, 2007.
Deciphering the short-range structure of nuclei with the CLAS detector, the International Workshop on Dense and Cold Nuclear Matter and Hard Exclusive Processes, Gent, Belgium, August 20-24, 2007.
The Nucleons Went Two by Two: Studying Correlations with (e,e'pp), the Fifth International Workshop on Neutrino-Nucleus Interactions in the Few-GeV Region, Fermi National Accelerator Laboratory, Batavia, IL, May 30-June 3, 2007.
Short Range Correlations in Nuclei, 9th Conference on the Intersections of Particle and Nuclear Physics (CIPANP 2006), Rio Grande, Puerto Rico, June 2, 2006.

Graduate Students
T. David Pyron, MS 1996.
Rustam Niyazov, PhD 2003.
Hovhannes Baghdasaryan, PhD 2007.

External Funding
Principal Investigator or co-Principal Investigator on grants from the U.S. Department of Energy and from Jefferson Lab totaling over $6 million for research in experimental medium energy nuclear and hadronic physics.

Professional and Community Service
Jefferson Lab Users Group Board of Directors, 1995-1997, 2007-2009
Jefferson Lab CLAS Collaboration Chair, 2003-2005
External reviewer: *Physical Review Letters*, *The Physics Teacher*
External grant reviewer: National Science Foundation, Department of Energy
Science consultant: Children's Museum of Virginia, 1997-1998
Co-organizer, annual Tidewater Physics Olympics for middle and high school students
Founder and President, Science and Reason in Hampton Roads, an organization devoted to the critical examination of extraordinary or dubious claims
Performed physics demonstrations to thousands of middle and high school students
Organizer: the Physics Department booth at the annual Virginia Children's Festival, 1994-present
President, Princess Anne High School Crew Club Auxiliary

Letters of Support (Excerpted)

"His teaching evaluations are excellent across the board. He makes them all available on the Internet at http://www.physics.odu.edu/~weinstei/teaching/evals/teaching_evals.html. One can see that even for introductory courses, where the students are often difficult to please, Professor Weinstein receives overall effectiveness scores well above the departmental average. He is clearly one of our most popular professors.… Professor Weinstein has not just practiced effective teaching. He has helped other members of our department to improve their own teaching. He has taken it upon himself to supervise the construction or purchase of …demonstration equipment for the introductory classes. Many of the physics professors have incorporated these demonstrations into their courses, thus improving the educational experience of hundreds of students. He maintains lists of the demonstrations that he uses on his web site at http://www.physics.odu.edu/~weinstei, which is a resource for all faculty. I have also called upon Professor Weinstein to mentor a new member of the faculty to help him improve his teaching. He has invited researchers in Physics Education to campus and helped the faculty understand their methods, including Peer Instruction, which many of us use. He introduced a Personal Response System into his classroom so students can provide instant feedback in answer to his questions. Professor Weinstein is always ready to learn about new methods of teaching physics and, despite the daunting amount of work, takes the time to apply them to his classroom.… He is widely published and has expanded recently into pedagogical writing. Further, he shares his scientific expertise with peers, educates the next generation of scientists through his work with his graduate students and makes special efforts to expose undergraduate and high school students to the thrill of science."

-- Gail Dodge, Professor and Chair, Department of Physics, Old Dominion University

"I became acquainted with Professor Weinstein several months ago when he offered to edit a new monthly column in *The Physics Teacher* called "Fermi Questions." He explained that he had strong interest as well as a great deal of experience in creating physics-related estimation problems that are both challenging and stimulating. Dr. Weinstein suggested that his solutions be posted each month at *TPT-Online*. I agreed to introduce the column in our journal on a trial basis. It has now appeared in several of our issues and has been more successful than I could ever have predicted. The column has generated a large volume of positive response from physics teachers (high school through university level) not only in the U.S. but in other countries as well. This has been entirely due to Larry's outstanding efforts in creating the questions, writing clearly thought-out solutions, and corresponding with journal readers."

-- Karl C. Mamola, Editor, The Physics Teacher Magazine

"I wanted …to let you know how much I absolutely loved and greatly benefited from my enrollment in Physics 101 and 102. I have taken numerous college courses at the University of Southern California, and a few at William and Mary and ODU. In the entirety of my college experience, I can only think of about four or five professors whom I consider truly gifted. I consider you one of them. Your enthusiasm for the subject matter was only exceeded by your clarity and skill in explaining and demonstrating the concepts involved. … I realize that there are some students who don't share my fascination with physics … however, for students eager to learn physics; I can't imagine a better teacher to provide their education then yourself. I hope this letter isn't over the top, but I felt like I owed it to you to let you know how grateful I am."

-- Jonathan Robertson, Former Undergraduate Student in Physics101,
Old Dominion University

"In April of 2008, Princeton University Press published *Guesstimation: Solving the World's Problems on the Back of a Cocktail Napkin* by Lawrence Weinstein and John Adam. The goal of this book is for readers to have an understanding of the meaning of large numbers and to be able to make rough, common-sense estimates starting from just a few numbers. This is an important skill and until this book was published, there was no book that the general public could pick up and very quickly begin to have a command of estimation. In a few short months, the book has become a best seller on Amazon and the reviews have been very positive. The book has been reviewed in a wide variety of journals and newspapers, including the *American Journal of Physics*, *Science*, *Scientific American*, the *Wall Street Journal*, *Business World*, *New Scientist*, and *Games Magazine*. The reason this book has become so popular, I believe, is that it was written by a master teacher, one who knows how to communicate with teens as well as professionals. There are many people who can write monographs, and even great textbooks, but it takes a very special person to write a book that is understood and enjoyed by high school students as well as Ph.D's in math and physics. The examples are fresh and interesting, running the gamut from how many golfballs it would take to circle the globe, to the relative merits of internal-combustion and electric cars and of coal and nuclear energy. It takes more than just a good writer to explain complicated mathematics to the general lay reader. It takes someone who is passionate about his subject and with the desire to make the reader love it just as much as he does. Larry Weinstein accomplished this brilliantly in his book.

-- Vickie Kearn, Executive Editor, Princeton University Press

"I write in support of the nomination of Dr. Lawrence B. Weinstein for the Outstanding Faculty Award of the State Council of Higher Education in Virginia. I have known Larry since he worked with my group at MIT for the Ph.D. … To be explicit, I turn to one area where Larry has recently made a very significant contribution, that of short-range nucleon-nucleon correlations in nuclei. We all know such correlations must exist from many-body theory and from many experimental details about binding energies and spectroscopic factors. However, never have we been able to `see' clearly the signature of these correlations in terms of relative momentum distributions in two-body reactions in nuclei. Among other things, final state processes have always been a large influence in masking the clarity of these two-body effects. Larry, together with his graduate student, spearheaded the effort to study the ^{3}He(e,e'pnp) triple coincidence with CLAS. The data were very complex. However, because of Larry's imaginative analysis techniques he has derived a very clear view of the relative momentum distributions from two-body short-range correlations, an outstanding result."

-- William Bertozzi, Professor of Physics, Massachusetts Institute of Technology

"Larry is a committed teacher. His course evaluations, in a subject that many undergraduates find intimidating, are remarkable! They have high numerical scores and overwhelmingly positive written comments. These comments center on three aspects of Larry's teaching--his enthusiasm, readiness to help students, and the breadth of his knowledge of physics. His evaluations are posted online which is a statement in itself, clearly indicating a concern about teaching and a validation of student's concerns.… If I were to take one discipline at the university where it would be difficult to interface with the public, it would be physics. Just the opposite with Larry—he has drawn the public into an appreciation of physics and even science broader than that of his own discipline. This approach to raising the awareness of the scientific endeavor is exemplified in the establishment of the Science and Reason Club.…This endeavor reflects Larry's understanding of the scientific process (or processes) and its application to a diversity of disciplines

-- Lytton John Musselman, Mary Payne Hogan Professor of Botany and Chair, Department of Biological Sciences, Old Dominion University

“I have known Larry for many years, and consider him to be eminently qualified for such an honor. He is an outstanding teacher; this is evident from his student evaluations that are posted on his website. His research program is both exciting and extremely successful, and his "outreach" activities, within the university community and outside it, are admirable. The former outreach is well illustrated by several major activities he has initiated at Old Dominion; in particular, his past commitment to the Putnam National Undergraduate Mathematics Competition. As for the latter, he has given many stimulating (and just plain fun!) talks and exciting demonstrations in High Schools around the region. Further examples of his hard work in the University community (using his excellent organizational skills) can be noted: he formed the committee and program for the highly successful College of Science Dean's Lecture Series "*Investigating Modern Pseudoscience*". More recently, he organized, started and maintains the highly stimulating “*Science and Reason in Hampton Roads*” discussion group. Many fascinating topics for discussion are presented on a regular basis.… Larry is truly a "Renaissance man" within the Old Dominion community”

-- John Adam, Professor of Mathematics and Statistics and University Professor, Old Dominion University, and 2007 Virginia Outstanding Faculty Award Winner

“Larry’s pedagogy is based on a passionate interest in combining conceptual understanding with simple quantitative analysis. This led him to create his “Back-of-the-Envelope” seminar based on the art and science of making “order-of-magnitude” estimates. This course has now led to a book that Dr. Weinstein is writing, that is both a textbook and a book of popularized science. …Dr. Weinstein is a dedicated and talented researcher and teacher. He has served in important professional leadership roles, particularly at Jefferson Lab. The entire department, and students in all of our courses, have benefited from Larry’s creative dedication to teaching inside and outside the classroom.”

-- Charles Hyde-Wright, Professor of Physics, Old Dominion University

“Dr. Weinstein empowered me to learn. He was not only a good teacher, he was a good coach. He made time to work with his students both until “they got it” and to feed their interest in areas beyond the scope of required learning. Dr. Weinstein is an excellent example and role model for how professors can enable their students to learn, grow and achieve.”

-- T. David Pyron, Alumnus, M.S. in Applied Physics, Old Dominion University, and Engineering Supervisor, Northrop Grumman Newport News

“Larry is an excellent teacher. Being very good in teaching, I noticed, he permanently invents new methods to encourage students to learn and to think. One of the motivations to understand experimental physics for me for a long time was daily reading of the scientific nuclear physics articles and following discussions of the physics results with Larry. That significantly improved the level of my understanding of physics.… Larry is an outstanding teacher doing excellent work in promoting science to the schools. His physics demonstrations are always bright and explanations of the physics ideas are brilliant. Larry is one of the active participants of the Physics Department tent at the annual Children's Festival in Norfolk. He is one who organizes the tours of high school, undergraduate, and graduate students from ODU to Jefferson Lab demonstrating them the forefront facility of nuclear and particle physics science. …Larry is a brilliant researcher, one of the top researchers in his field. His contribution to the study of short range nucleon-nucleon correlations in nuclei is invaluable. His deep understanding of the nuclear physics and scientific intuition are extremely important in educating the students who will follow the science career. His abilities to teach are exceptional and he is one of the outstanding educators I met through my scientific career.”

-- Rustam Niyazov, Post-Doctoral Research Associate, Jefferson Lab

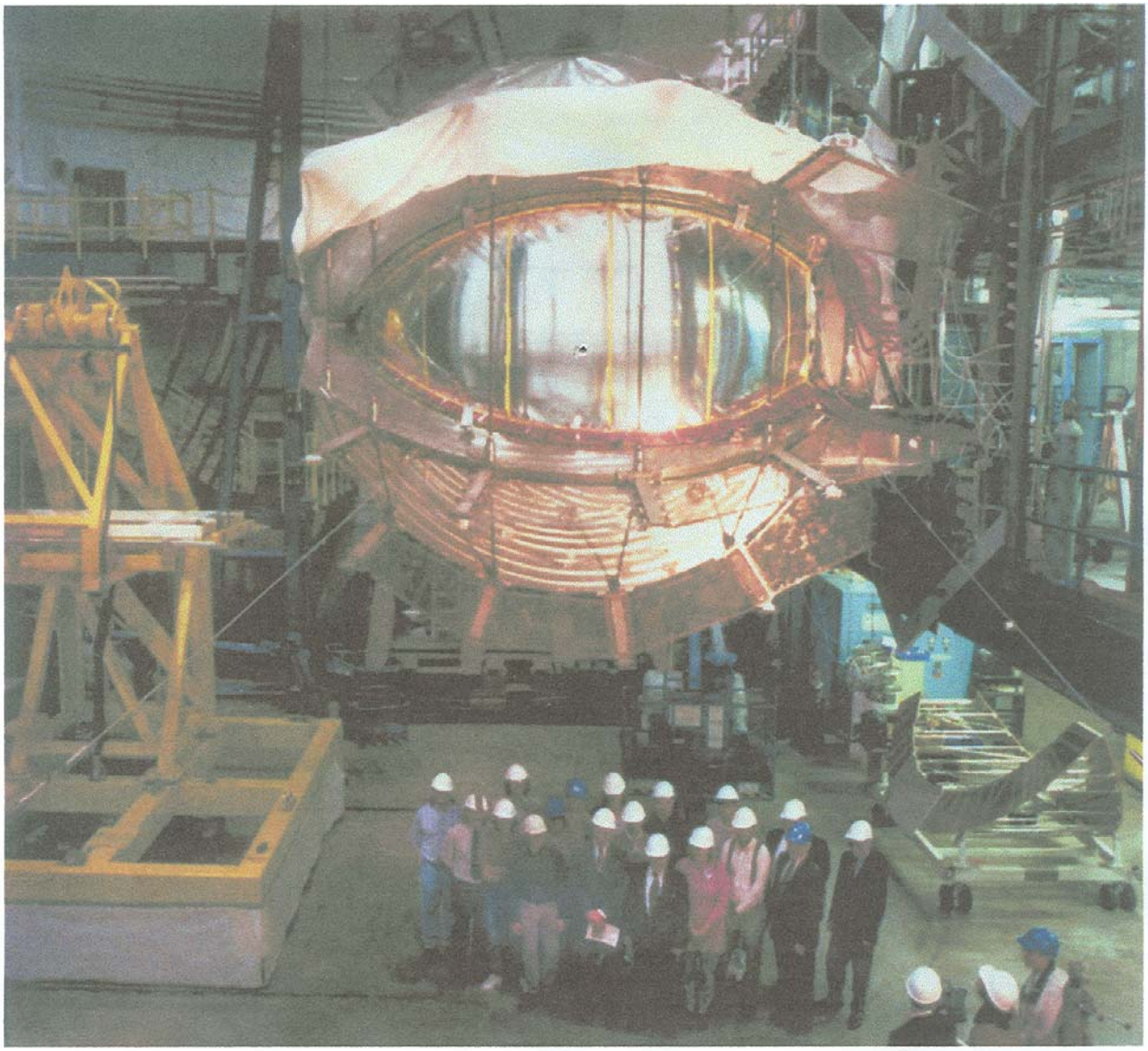
Additional Documentation

Teaching and Outreach – (clockwise from upper left) a) Physics students at the NASA Goddard Space Flight Center, b) a junior scientist at the Virginia Children's Festival, c) Professor Weinstein demonstrating atmospheric pressure at the Festival and d) Professor Weinstein (with a student volunteer) performing a cryogenic demo show using liquid nitrogen to the entire 8th grade at Great Neck Middle School

"Dr. Weinstein is one of the main organizers of the Physics Demonstration at the annual Children's Festival in Town Point Park [Norfolk] – thousands of children have been thrilled with the many fascinating, hands-on activities [Physics] he introduces them at the Festival each year…"
-- Gail Dodge, Professor of Physics and Chair, Department of Physics, Old Dominion University

Professor Weinstein frequently leads students on field trips to internationally prominent research centers such as the nearby Jefferson Lab or the NASA Goddard Space Flight Center (pictured above). There students can tour the cutting edge research labs and gain a greater appreciation of the value of research in our society and for the potential delights of a physics career.

Professor Weinstein also brings physics to the community at the annual Virginia Children's Festival and to middle and high schools, with his frequent talks and physics demonstration shows. He has performed physics demonstrations for many thousands of students and children of all ages.



Research – Delivery Ceremony for the Drift Chamber Project at the Jefferson Lab

Professor Weinstein is a world leader in all phases of nuclear physics research, from building complex experimental apparatus to discovering subtle patterns in experimental data. He led the Old Dominion University group that built the 5-m diameter, 50,000-wire CLAS Region II Drift Chambers for the Thomas Jefferson National Accelerator Facility. The drift chambers, which can measure the trajectories of elementary particles such as electrons and protons to a fraction of a millimeter, are at the heart of the CEBAF Large Acceptance Spectrometer (CLAS). The shiny surface in the picture is the aluminized mylar window of one drift chamber. The chamber is mounted on the CLAS superconducting magnet. A mechanical prototype of the drift chamber can be seen in the lower right side of the picture.

Professor Weinstein then went on to use the CLAS to perform the first measurements of the momentum distribution of correlated (paired) nucleons in the nucleus. This ground breaking measurement helped answer one of the five high-priority physics questions that the $600 million Jefferson Lab was built to answer.

Integration –

Professor Weinstein has been teaching the art and science of estimation to many audiences, from introductory physics, to his Physics on the Back of an Envelop class, to the readers of *The Physics Teacher.*

Guesstimation: Solving the World's Problems on the Back of a Cocktail Napkin, by Lawrence Weinstein and John Adam (Princeton University Press, April 2008), brings the art and science of estimation to a much wider audience.

"This book is a stimulating collection that will help the reader to reach informed judgments and will be a useful source of inspiration for mathematics and physics teachers: my only concern is that if my students have read it before they arrive at university, I may have to find a new approach to my first day's teaching."--Tony Mann, *Times Higher Education*

"While few can hope to emulate the brilliance of a Nobel Prize winner like [Enrico] Fermi, coming up with pretty good guesstimates is a skill that can be taught. And that's the aim of Guesstimation. After a quick tutorial, the authors get down to business with a host of wide-ranging worked examples, from estimating the numbers of piano tuners in Los Angeles to figuring out the impact of deforestation on greenhouse gas levels. The results are sometimes surprising."--Robert Matthews, *BBC Focus Magazine*

"[Guesstimation is] a left-brain book that helps you approximate answers to the types of questions actually asked in some job interviews today."--Peter Coy, *BusinessWeek*

"[A] delightful account of mathematical approximation, which instills the beauty and power of the back-of-the-envelope calculation. The puzzles make addictive confidence builders by breaking down tricky questions into manageable parts. Never again will you take a newspaper figure at face value without feeling the need, and confidence, to guesstimate your own figure."--Matthew Killeya, *New Scientist*

Integration - Bringing Physics to the general public, *The Washington Post*, April 15, 2005

On the Move

The Heart of the Matter

By Jeff Baron
Special to The Washington Post

Field Trip

THE MILE-LONG track at the Department of Energy's Thomas Jefferson National Accelerator Facility in Newport News, Va., may be the world's fastest speedway, with laps clocked at a few millionths of a second.

The loop is an electron accelerator: Scientists from around the world use the giant atom smasher for basic research on the structure of the atom. Jefferson is open to the public just once every two years — and Saturday's the day. Visitors to the biennial open house will be able to tour the facility and hear its scientists discuss their work.

"Jefferson Lab is unique," said Emmanuel Paschos, a physics professor at the University of Dortmund in Germany, during a recent visit to the lab. "Of the world's dozen or so high-energy accelerators, it is the most powerful built specifically to investigate the structure of everyday matter."

Everyday matter? That's us, and everything around us.

Research at the lab comes down to some pretty simple methods. "I study the nucleus like a 5-year-old does," says Larry Weinstein, a physics professor at Norfolk's Old Dominion University. "I hit it hard and see what comes out. I'm hitting something really small, a target of some atoms at the end of the accelerator, so I need a really small hammer. And I have to hit the atoms really hard, so I need that hammer moving really fast."

Weinstein's hammer is a single electron, accelerated almost to the speed of light to vastly increase its mass. He measures what happens to the atomic target during the collision, using the lab's incredibly sensitive instruments "to learn about the structure of the nucleus, how quarks combine to form protons and neutrons, how protons and neutrons combine to form the nucleus of the atom, and about the forces that hold those building blocks of the nucleus together."

All the major components of the electron accelerator will be on view at the open house. Fired into the accelerator by a laser gun, electrons travel in a tightly focused beam about the diameter of a human hair, enclosed in a pipe 1½ inches in diameter. The accelerator loop is set in a bored-

BY GREG ADAMS — JEFFERSON LAB

Larry Weinstein, left, and Steven Suhring at the Thomas Jefferson National Accelerator Facility in Newport News, Va. The lab, open to the public Saturday, houses an electron accelerator, which helps scientists study atomic matter.

The business end of the accelerator is three huge experimental halls, where spectrometers record the collisions between the electrons and their targets. One magnet alone, used to steer the electrons, weighs 450 tons.

Super-speed, super-collisions, superconductivity. Jefferson has the largest installation of superconducting technology of any accelerator on the planet, used to drive the electrons to higher and higher speeds. Superconductivity? Think cold, very cold. The inside of the electron beam pipe is chilled by liquid helium to 456 degrees below zero Fahrenheit to keep the electrons zipping along. To prevent the electrons from colliding with anything before they hit their target, the pipeline is kept at a nearly perfect vacuum.

The lab's scientists will show visitors some of the 300,000 instruments set up along the accelerator track to speed up the electrons and keep them in tight focus. Jefferson's electron beam is so powerful, and its detectors so precise, that measuring the collisions between the electrons and their atomic targets in the experimental halls gives new insight into the structure of matter. Until recently, for example, scien-

BY LARIS KARKLIS—THE WASHINGTON POST

tists could only study the behavior of individual protons and neutrons, though these particles in nature are often paired up.

At the open house, Weinstein will describe how "just as people behave differently as couples than as individuals, so do protons and neutrons. Just like some human couples, when they get too close they violently repel each

around at almost the speed of light, trying to escape. We study what keeps them together: Relationship dynamics on a very, very small scale."

Jefferson's open house may be particularly apropos in 2005, the International Year of Physics, which marks the 100th anniversary of Einstein's theory of relativity. After all, explains Department of Energy physicist John Harvey, "What happens at the accelerator is really the application of the theory of relativity."

THOMAS JEFFERSON NATIONAL ACCELERATOR FACILITY — 12000 Jefferson Ave., Newport News, Va. 757-269-7100. *www.jlab.org*. Biennial open house Saturday from 9 to 2. About a hundred scientists will participate and 5,000 visitors are expected at the event. In addition to the accelerator tunnel and the experimental halls, visitors can see the world's most powerful tunable laser — a building-size laser whose beam can be "tuned" to any color for different uses. The accelerator tunnel is accessible only by a stairway; all other locations are handicapped-accessible. Organizers recommend allowing two to four hours to tour the facility. Free. Take Interstate 95 south to I-295 south (toward Norfolk, Newport News), then I-64 east to Newport News. From I-64, take Exit 256A Oyster Point. Turn left at the first light onto Canon Boulevard. After a half-mile, turn left onto Achievement Way (entrance to Canon Virginia Inc., second light). Follow special-event parking signs for free parking in the Canon Virginia lot.

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