

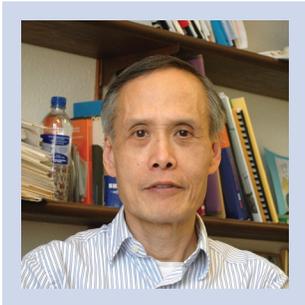


University of Virginia Physics News

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Letter from the Chair



Dear Alumni & Friends,

We have rapidly passed the middle of our Spring term and our students are pre-registering for their next academic year's courses in earnest. This winter, our department was one of the seventeen physics

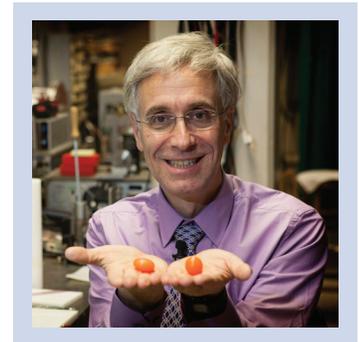
departments in the country invited to take part in a video filming by the international film and broadcasting company, WebsEdge, in its first partnership with the American Physical Society. The film segments featuring the seventeen departments were debuted at the March meeting of the APS. If you have not seen these film segments yet, you can view them at <http://www.aps.org/meetings/march/services/apstv.cfm>. As this Newsletter is going to press, the video featuring our department has been seen by more than thirteen hundred viewers. It is directly accessible on youtube at <http://tinyurl.com/UVaAPSVideo>. Undergraduate and graduate education is one of the important themes in the featured film. While we continue to highlight the exciting research carried out by our faculty, we also believe that it is timely to feature some of their exemplary efforts in the areas of teaching and outreach. Many of you have sent us your appreciation and encouragement, for which I am most thankful. Your continued support of the department is always appreciated and remembered.

This issue of our Newsletter features the education and outreach efforts of Louis Bloomfield, Michael Fowler, Richard Lindgren, and Stephen Thornton. Over the years, these four colleagues have developed innovative courses and pedagogical practices to engage students in active learning. They lecture both in class rooms and in the digital space (online) to students and K-12 teachers. Their lectures, textbooks, and online postings are well received nationally and internationally. No doubt, our department is now on the front line of new teaching methods in this information age. I hope you will enjoy reading these four stories as much as I have enjoyed reading them.

Joseph Poon
Chair, Department of Physics

How Things Work on Coursera

Physics has played a leading role in the dawn of the computer age, from the invention of the transistor, to the design of increasingly powerful microchips, to the introduction of the web for massive data transfer. It is only fitting that physics should now be on the front line in the possible revolution



of higher education brought about by online teaching and information sharing. Our Department has been very active in these areas, and now has the distinction of being among the first 33 Departments to offer a full online course on Coursera.

On March 4 the first installment of Lou Bloomfield's *How Things Work* was released; others will follow weekly through the spring. This course and three others offered by UVa are reportedly being followed by 200,000 viewers. It is currently available for free viewing (try it!), but is accompanied by online testing for registered users, who aim to receive credit for it.

Coursera is a commercial enterprise, and its courses must meet professional production standards. Professor Bloomfield has previous media experience, having hosted the series *Some Assembly Required* on the Discovery Channel. He developed *How Things Work* as a course for UVa undergrads twenty years ago, and has written a book of that title that is now a classic. However, even for him, producing the highly polished Coursera lectures poses a challenge. It is not simply a matter of lecturing in front of a camera: the subject matter is brought in from the real world, using common objects and devices, to be dissected and explained in real time. Recently, he could be seen filming himself at his garden door while taking apart the lock, or perhaps the doorbell. There is also the challenge of creating computer animations and interactive graphics. But Bloomfield is a computer wizard: he is well known for having created an agent that mines information about UVa courses and displays it on *Lou's list*, which is overwhelmingly preferred to the official catalog of course offerings.

Lou is also a creator of new things that work in new ways, most recently Vistik, a viscoelastic material that can bounce like a superball, or slowly regain its original shape after being compressed or imprinted. It sticks to itself, but not to other objects. Sheets of Vistik bind together on contact, but separate easily when pulled apart. Bloomfield calls it the "molecular equivalent of Velcro."



Educational Innovation and Outreach

Innovative achievements in physics education, for students at all levels and the general public, have brought nationwide recognition to Professor Stephen Thornton and his collaborators in our Department. Thornton has created or renovated many college-level physics courses, with special emphasis on distance learning, through closed-circuit TV and online. On the screen or live, Steve can hold an audience spell-bound with dazzling lecture-demonstrations. In this capacity, he is best known for the Physics Day Show, a hugely popular performance for the general public, especially families. Repeated every spring with enduring success since its inception in 1995, it has been imitated by other physics institutions, prompting the NSF and the American Physical Society to declare the National Physics Day, which this year falls on April 24. The APS-sponsored Buzz Blog, at <http://tinyurl.com/PhysicsDayGenesis>, recounts the history of the event, interviewing Thornton and Professor Craig Dukes, who has helped run the show in recent years. Craig is as enthusiastic as Steve about it. "It's always been focused on getting young children interested, and they're a fantastic audience," he said to Buzz Blog. And how do you get the kids excited? "The kids always like something that goes boom."

Of course, many years of preparation and experience preceded the first Physics Day Show, starting with lecture demos that Thornton developed while teaching introductory physics classes for engineering and pre-med students. Our Department has always been fortunate to have a well-equipped Lecture Demo Lab with a dedicated staff, eager and able to maintain, improve and innovate an expanding stock of teaching aids. It was Thornton's idea to offer a selection of this material to a broader public, not only at Physics Days, but also as a traveling show, packed in a white van, prominently labeled with the logo Phun Physics. At least 30,000 persons have attended Phun Physics road shows, in schools of grades 3-12 around Virginia, and also at large-scale performances such as at King's Dominion Science Day. The white van was retired in 2005, but Phun Physics lives on as a list of exciting demos on its own web site.

Thornton's involvement in physics education is deep and varied. He has developed eight courses for K-12 teachers, shown by closed-circuit TV throughout Virginia. He is a co-founder and the current Director of



the Master of Arts in Physics Education Program, described on page 3. He has authored three well-known textbooks, and the online materials that go along with recent editions. He began this facet of his career in 1988 as a replacement of the late J. Marion for the third edition of *Classical Dynamics of Particles and Systems*, and has taken over the later editions and revisions of this text. In 1992, after coauthoring *Physics for Scientists and Engineers* with Paul Fishbane and Stephen Gasiorowicz, he joined forces with Andrew Rex, a 1982 UVa PhD, to write *Modern Physics for Scientists and Engineers*, which has now reached the fourth edition.

Through the last fifteen years Thornton has redesigned the introductory lecture and laboratory courses for premeds and engineers, introducing in-class instant quizzing with clickers, web-based assignments, and computer-based probes to take and analyze experimental measurements. His efforts were much appreciated by students and earned him a UVa Teaching+Technology Initiative Fellowship in 1997. Currently, he is writing a textbook for a course about energy for non-science majors, *Energy for the 21st Century*. Professor Gordon Cates started this very successful course around 2000.

Thornton started his career as an experimental nuclear physicist, having earned his PhD at the University of Tennessee while a Graduate Fellow at Oak Ridge National Lab. After a year as Research Associate at the University of Wisconsin, he came to UVa as an Assistant Professor in 1968, rose through the ranks to Full Professor in 1982, and served as Director of the Institute of Nuclear and Particle Physics from 1984 to 1986. He was involved in numerous collaborations at Brookhaven National Lab, Oak Ridge National Lab, and SLAC, among others, resulting in the publication of 125 research papers, and 8 PhD theses. In 1973 he was U.S. Senior Fulbright Hays Fellow at the Max Planck Institut für Kernphysik, Heidelberg, West Germany, and returned there in 1979-80 as a Max Planck Fellow and Fulbright-Hays Fellow. Steve and his wife Kathryn, a former astronaut and now a Professor in the Engineering School, have three children and are active in community service, especially with Habitat for Humanity. He was involved in the Boy Scouts for 43 years serving as Cubmaster, Scoutmaster, President of the local Boy Scout Council, and on the Southeast Region Board.

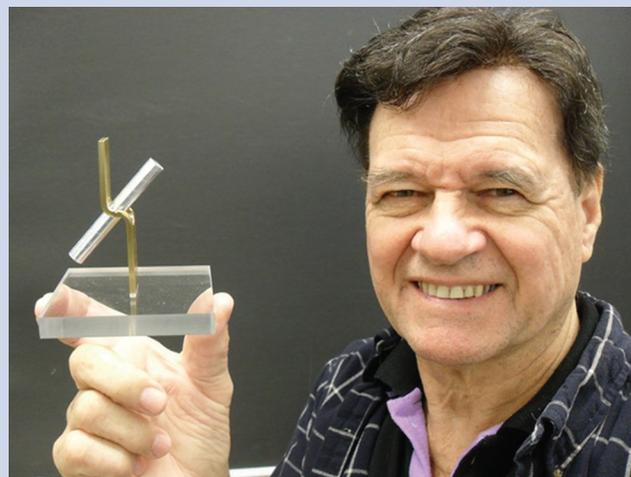
MAPE and Beyond

Dr. Richard A Lindgren has been Research Professor of Physics at UVa since 1985, specializing in physics education and outreach programs for teachers, and conducting research in nuclear and particle physics at the Jefferson Laboratory (JLAB) in Newport News, Virginia. Supported by State Grants from the Virginia Department of Education (VDOE) and Federal grants from the NSF, he has worked with hundreds of high school physics teachers, conducting summer workshops and developing online physics classes. Most notably, he led the founding of the Master of Arts in Physics Education (MAPE) degree program at Virginia and was its Director until he retired in September 2009.

When Lindgren came to UVa as a charter member of the Institute for Nuclear and Particle Physics, he intended to continue a distinguished research career, begun with a PhD at Yale in 1969. Since then, he has authored or co-authored over 175 publications. He turned out to be the right man at the right time for something else, too. In 1984, James McCarthy, Stephen Thornton and Dexter Whitehead had met with Virginia Governor Charles Robb and Secretary of Education John Casteen, concerning the creation of the facility now called JLAB, and the supporting Institute at UVa. Governor Robb told them: "You must do something to help improve secondary science education". In response, the three physics professors decided that teacher education would be an integral part of the new Institute's mission. The stage was set.

Promptly, Lindgren expanded the summer Research Experience for Undergraduates (REU) program, that he directed, to include high school teachers. Realizing that teachers preferred to take physics-related courses rather than summer workshops on specialized topics, he immediately proposed online versions of Bloomfield's *How Things Work* and Fowler's *Galileo and Einstein*. Together with Thornton, he instituted new summer residential courses for teachers. In due time, a committee led by Lindgren proposed that these programs be formalized with the offering of the MAPE degree. In 2000, the proposal was approved.

The MAPE program is designed for licensed teachers who already teach science or physics in grades 6-12, but do not have an undergraduate degree in physics, and for unlicensed teachers who may have retired from an engineering, science, or military career. It consists of special 6000-level courses taken by distance learning and summer study at UVa. The special materials for



these courses were developed largely in collaboration with Steve Thornton. MAPE has grown to graduate 20 students/year from Virginia and other states as far away as California, as well as a few foreign students. It has served as a model for similar programs elsewhere.

Since his retirement, Lindgren has been busier than ever with his four children, three of whom are graduates of UVa and live in the Charlottesville area, and nine grandchildren. But he keeps on working. Through his most recent VDOE grant, he has developed two new physics courses online for science teachers, which include home lab activities in *Light & Optics*, and *Electricity & Magnetism*. His research effort at JLab continues in high gear with the deployment of BigBite, a large acceptance magnetic spectrometer, through a Major Research Instrumentation grant from NSF. Lindgren was the Principal Investigator of this project, with Professor Nilanga as Co-PI. BigBite has become a central piece of equipment in Hall A at JLab, making it possible perform many fundamental measurements, including studies of the internal electrical structure of the neutron.

Thank You!

We greatly appreciate your continued support of the Deaver Scholarship Fund, general pledges and new initiatives. For additional information, please contact:

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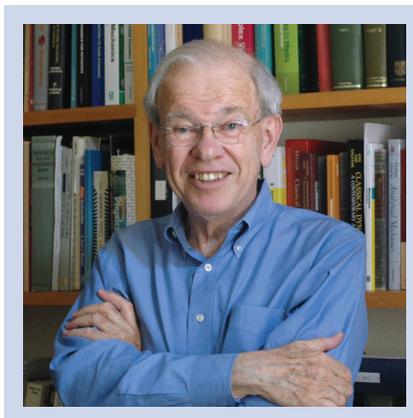
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Google's #1

Increasingly, people get their knowledge and information from the web. In any one field, they flock to the best online sources, led there by word of mouth and Google's click counts. Entering "graduate quantum mechanics" on Google leads, at number one, to the course notes by Michael Fowler on this subject. Many other individual lectures and full courses on Fowler's websites are in the top five in a Google search, often right there with Wikipedia and commercial sites. Searching for "physics lecture notes" brings as one top choice his course notes on *Modern Physics*, at www.phys.virginia.edu/classes/252/. That means they are the most widely read in physics, for any course at any level.

In 2008, Michael Fowler received the George B. Pegram Award of the Southeastern Section of the American Physical Society with the citation: "For excellence in teaching at all levels, outreach efforts and global influence on physics teaching through his websites." The clarity and wit of his writing have been praised by many grateful readers, and are augmented online by clever animations that he has developed with the help of students and small grants. His originality and depth of scholarship are most evident in the hugely popular *Galileo and Einstein: Two Revolutionaries in Science*, a course for non-science majors that is rich both in physics and history. The perfection of his prose has made him an authority beyond physics: CORE Inc. asked permission to print 100,000 copies of his lecture on Isaac Newton for use in online classes of English as a Second Language.



Fowler's pioneering venture in online publishing came late in his distinguished career in research and administration, as well as teaching. As Department Chair in 1986-1991 and again in 1997-2000, he was very influential in setting the direction of our Department, especially towards an expansion of elementary particle physics and theoretical physics. With his research students, he has published elegant papers in theoretical condensed matter physics, especially one-dimensional systems, magnetic and superconducting. By using advanced mathematical techniques for solving these problems, he has gained expertise applicable more generally to theoretical physics. His brilliant lectures span the whole range from introductory physics courses to general relativity and graduate quantum mechanics. He is a Fellow of the American Physical Society.

Michael Fowler was born in England, got his PhD from Cambridge in 1962, and came to Virginia in 1968 after wandering through Princeton, Maryland, and Toronto. Since 1998, he has been the Maxine S. and Jesse W. Beams Professor of Physics. He and his late first wife, Dulcey, had a home cleverly designed to incorporate an old stone silo. He now lives there in style with his second wife, Tyler, and their young child, Nicholas. Tyler is an Associate Professor of Art History and leads her family to archaeological sites in Greece and the Middle East. Michael is now preparing for the web the latest set of lectures, *Classical Dynamics*. He is also working with an undergraduate physics major on rendering his postings more effectively on mobile devices. He has no intention of retiring.

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