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ALUMNI SPOTLIGHT

Alan Nathan – Alumni Spotlight

1. Where are you from?

I am originally from the small town of Rumford, Maine, the same hometown as former US Senator and Secretary of State Edmund Muskie.

2. What schools did you attend?

Montgomery Blair High School (Silver Spring MD), 1964
University of Maryland, 1964-68, BS 1968
Princeton University, 1968-9, 1971-5, MS 1972, Ph.D. 1975
(1969-71 was spent in the U. S. Army)

3. What led you to the University of Maryland?

Our family moved to Silver Spring, Maryland when I was in high school, which made it natural for me to attend the University of Maryland. I was a commuter for three years but lived on campus during my last year (Easton B).

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RESEARCH SPOTLIGHT

Particle Physics from a Warped Extra Dimension
By: Kaustubh Agashe

The Standard Model of particle physics has been developed over the past couple of decades to address the fur our universe made of and what holds its constituents together? Within this model, the basic building blocks of natu are of two kinds: (1) matter particles called quarks (which make up protons and neutrons and hence most of the (such as the electron) and (2) force carriers which mediate interactions between the matter particles,namely (ordinary light); the weak force (which appears in radioactivity); and the strong force (which is involved in nuclear is the force of gravity which is responsible for holding us to the earth and, in turn, the earth to the Sun. Howev describing the observed interactions of elementary particles, the Standard Model is an incomplete theory sin unanswered. For example, why is there such a big hierarchy of quark and lepton masses (the electron is a milli quark, which is the heaviest known quark)? Or, why are the strengths of the various forces so disparate? Specif the weak force is about 10,000 trillion times smaller than the mass scale of gravity (which is known as the hierarchy in mass scales is required in order to account for the feebleness of gravity compared with the other fo most of matter in the universe seems to be "dark", i.e., it is not made of ordinary matter.

In 1999, Lisa Randall and Raman Sundrum proposed a novel extension of the Standard Model to solve the Planc problem. Their set-up is based on "warped" 5th dimension, where the mass scales at the two ends of the extra d due to the presence of the curvature in the extra dimension. So, if the gravitational physics resides at one end of t the physics of weak force occupies the other end, then it is natural for the mass scales of gravity and the weak fo also realized that profiles for quarks and leptons in the same extra dimension can account for the hierarchies upshot is that there is a geometrical origin for all hierarchies of Standard Model: the Planck weak mass scales masses.

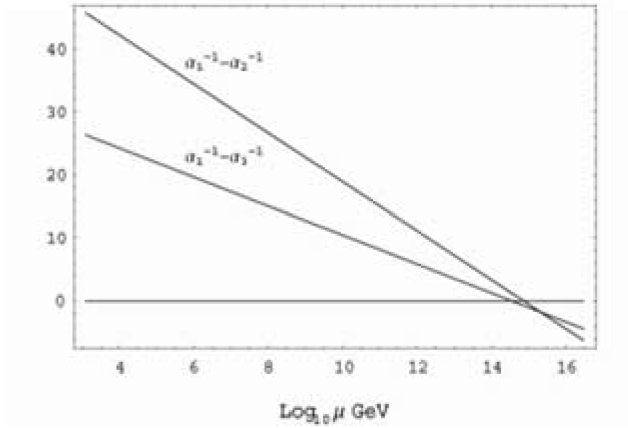

FIG. 1: Evolution of the strengths of the 3 forces in the warped extra dimensional model with energy.

Over the past few years, I have been involved in detailed studies of various aspects of the Randall-Sundrum m
excitations of the Standard Model particles in the 5th dimension which are called Kaluza-Klein particles. I have di
this framework whereby masses of these Kaluza-Klein particles as small as a 1000 times the mass of the protc
experimental data, whereas previous models required the mass scale to be much larger for this consistency. I als
will be directly accessible to an upcoming high energy experiment known as the Large Hadron Collider in Europe.
these new particles will be seen in other experiments probing the properties of the quarks and leptons. One
physics is grand unification which is the idea that the 3 forces (other than gravity) are different aspects of the sa
above, the strengths of the 3 forces are observed to be quite different when measured at low energies, but these
higher energies so that it is possible that the strengths are the same at some very high energy scale. However, ir
unification of the 3 forces does not occur. We demonstrated that in the Randall-Sundrum model the evolution of
is modified relative to that in
the Standard Model due to profiles for quarks and leptons in the 5th dimension, resulting in a precise meeting o
see Figure 1. In addition, the above grand unified model has a particle which can play the role of dark matte
prospects to be seen in ongoing direct searches for dark matter. Thus, my work has shown that the framework
solves all the above-mentioned puzzles of the Standard Model. Moreover, these ideas will soon be tested.

Dr. Agashe is an Assistant Professor at the University of Maryland Department of Physics. He is a member of the
For questions and comments, please contact him at kagashe@umd.edu.

4. How would you describe your experience here?

I got an excellent undergraduate education at UMD. I tried to take advantage of a variety of opportunities that were thrown my way. Some examples: participation in the campus honors program; research in the physics department (doing such research is pretty common today but not when I was an undergrad); taking grad-level courses while still an undergrad. I believe I made the most of these opportunities, to the extent that I was very well prepared for graduate school and ended up getting into my first choice (Princeton).

I'd like to take the opportunity to mention my two favorite teachers at UMD. First is Bill Hornyak, who was my teacher for both the sophomore-level E&M and optics course and the graduate quantum course. His enthusiasm for physics was infectious. Second is Alex Dragt, who taught the junior-level advanced classical mechanics and E&M courses. From him I learned the power of careful analytical thinking, which has served me well in my physics career.

5. Where do you currently work?

I am a physics professor at the University of Illinois at Urbana-Champaign. There are three major components to my job: teaching, research, and service. I teach mostly undergraduate physics. I especially like teaching the large introductory courses. My research has two components. The "conventional" component is medium-energy nuclear/particle physics, where I do experiments that teach us about the structure of protons and neutrons, the constituents of the atomic nucleus. These experiments require the use of accelerator facilities. Currently, this component of my research program involves experiments in Lund Sweden, Jefferson Laboratory in Virginia, and the so-called HIGS facility at Duke University. The "unconventional" component of my research is the physics of baseball, where the work involves theory, experiment, and computation. I maintain a web site devoted to the physics of baseball (http://webusers.npl.uiuc.edu/~a-nathan/pob) that many folks have found useful, from kids doing science fair projects, to college students working on Master's theses, to fans trying to settle bar-room bets, to reporters looking for a timely story (e.g., on the effect of the altitude at Coors Field on the flight of a baseball). This work has landed me some nifty consulting gigs with Major League Baseball, the NCAA, the Amateur Softball Association, and others. My involvement with baseball is the ultimate in "having your cake and eating it too," since it combines my two great passions in life: physics and baseball.

6. Do you enjoy your career?

See above answer, where it is pretty clear that the answer is a resounding YES.

7. What positions have you held since graduating from UMD?

After graduating UMD, I immediately went to graduate school (Princeton) to get my Ph.D. That quest was interrupted for two years when I was drafted into the U.S. Army—this was the Vietnam era. After completing my Ph.D. in early 1975, I got a temporary postdoctoral research position at Brookhaven National Laboratory on Long Island, where I worked until landing a faculty job as an Assistant Professor of Physics at U. of Illinois in mid-1977. I arrived in Champaign-Urbana the day before Elvis Presley died and have lived here ever since. I worked my way up through the academic ranks fairly quickly (Assoc Professor in 1980, Professor in 1985). Along the way, I had several sabbaticals (Paris, Seattle, …), a job as an Assistant Dean in the College of Engineering, and a 3-year stint as Associate Head for Graduate Programs.

8. What advice would you give current students?

My primary advice is to work hard as an undergraduate and take advantage of the many great opportunities available to you as a student at a large research-oriented university. In particular, get involved in a research project working with a professor. Learn how to communicate, whether it be written or oral.