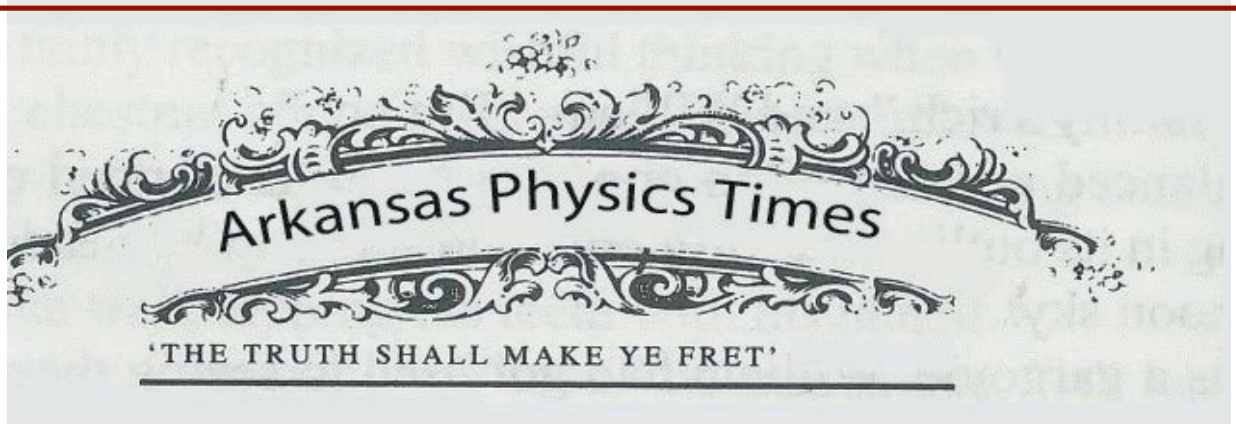
2-21-2008

Arkansas Physics Times, February 21, 2008

Society of Physics Students (American Institute of Physics)



Expedition SEA-CALIPSO: A Future Physicist's Journey to an Active Volcano
by Josiah Walton

Last October, Dr. Glen Mattioli (U. Arkansas) gave a colloquium on his work modeling the magma chamber beneath the Soufriere Hills Volcano (SHV) on Montserrat, West Indies (located in the Caribbean), using ground deformation data collected through GPS geodesy. I attended the talk, wherein Dr. Mattioli expressed interest in taking a few students to help with equipment installation on Montserrat as part of a larger, historic scientific collaboration known as SEA-CALIPSO. I spoke with Dr. Mattioli and he invited me to participate. The trip was one the most incredible, rewarding and memorable experiences of my life.

Foreground: Josiah Walton
Background: SHV

SEA-CALIPSO is short for "Seismic Experiment with Airgun-source—Caribbean Andesitic Lava Island Precision Seismo-geodetic Observatory". It is a large scientific collaboration comprised of leading research institutions from around the world, including Duke, Cornell, U. Arkansas, NM Tech, Penn State, Bristol University in the UK, in addition to the Montserrat Volcano Observatory and other universities. SEA-CALIPSO's main scientific objective is to create the first ever 3D tomographic image of the magma system and deep crust beneath the SHV, using active source seismic tomography. The project is the first of its kind ever attempted.

The SHV has been active for over a decade now and it remains one of the premier locations to study an active andesitic volcano. (Andesitic refers to the igneous rock andesite, which has an intermediate chemical composition.) The SHV awoke from dormancy on July 18, 1995 and has been erupting on and off ever since. The most notable eruption occurred on June 25, 1997 when a massive pyroclastic flow (a portion of the eruption column that has gravitationally collapsed) buried the capital city of Plymouth, killing 23 people and virtually transforming it into a modern day Pompeii. SEA-CALIPSO will allow researchers to understand the SHV in greater detail, contribute to the larger understanding of andesitic volcano processes (which constitute a formidable threat to large portions of the population residing near volcanoes on the "ring of fire") and improve forecasting for volcanic events—all of which can help mitigate the effects of future volcanic disasters. (cont. on pg 5)

Calendar of Events

- Monday, February 25, 5:30 p.m. – 2nd SPS Meeting in PHYS 134
- Thursday, March 13, 6-8 p.m. – SPS Game Night in PHYS 134
- Monday, March 24, 5:30 p.m. – 3rd SPS Meeting in PHYS 134
- April 2-5 – Centennial Celebrations
- April 12-15 – APS Conference

More Than Just Quantum Mechanics: Kicking It with Professor Laurent Bellaiche

By: Ryan "Leo" Elworth
Edited by: Mary Kordsmeier

In America, if you want to be a successful pro athlete, chances are you will play your sport for a college to gain some experience before heading off to the big leagues. According to Professor Laurent Bellaiche, however, playing professional soccer in France is very different. You might ask yourself, how would a professor whose primary academic interest is calculating ferroelectrics and low dimensional systems know about professional soccer? The answer is that after Dr. Bellaiche got his high school diploma, he was faced with the choice of either going to college or trying to make it as a professional soccer player.

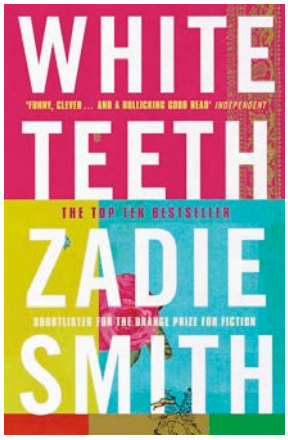
Dr. Bellaiche has always had a love of soccer. From when he was ten until he was eighteen, Dr Bellaiche played the game and took it very seriously. He was very dedicated to the sport and he even played on his department's team in France when he was fourteen and fifteen. A department in France is basically what we would refer to as a state here in America. In France, even when you are young you have a chance to try to prove yourself and start thinking about the higher level game. So when Dr. Bellaiche earned the right to represent his department's soccer team, he began to think about a future career in soccer. He never made it on to the higher level, nation-wide, French youth team. Nevertheless, he still felt like he had a chance to make it as a pro soccer player.

In my interview with Dr. Bellaiche there were many questions that came to my mind. First and foremost, why did Dr. Bellaiche choose physics over soccer? He answered by saying, "In France, you have to choose between soccer or academics." Then he told me that "being professional in soccer is kind of a gamble. In physics you can just work, work, work. But in soccer you have to be gifted." He also told me that his parents wanted him to go to college instead. I then was curious if he felt he had made the right choice looking back on it. He replied by saying, "I made the safe choice," and, "I like both physics and soccer." So Professor Bellaiche went to college and kept playing soccer, but on a less serious note.

Today, in addition to teaching senior level quantum mechanics in the UA physics department, Professor Bellaiche coaches the Comets, an eight- and nine-year-old club team based in Springdale and Fayetteville. His son plays on the team and Dr. Bellaiche seems to have made the right choice in pursuing academia. However, he still seems to miss the "special feeling when you score a goal."

This Brit's Got Bite: Zadie Smith's *White Teeth*

A book review by Shawn Ballestenssoro (rating: 5 out of 5 Feynmans)



Fresh, young, and incredibly talented Zadie Smith's debut novel, *White Teeth*, has received all the buzz one would expect about a book that has won prestigious awards including Editor's Choice in *The New York Times Book Review*, the *Guardian* First Book Award, and the Whitbread First Novel Award. Smith addresses issues including class, race, what it means to be foreign in an increasingly hybridized world, as well as various manifestations of the ever-popular generation/culture gap. Fellow cultural explorer Salman Rushdie says of *White Teeth*, "Zadie Smith's fizzing first novel is about how we all got here--from the Caribbean, from the Indian subcontinent, from thirteenth place in a long-ago Olympic bicycle race--and about what here turned out to be. It's an astonishingly assured debut, funny and serious, and the voice has real writerly idiosyncrasy. I was delighted by *White Teeth* and often impressed. It has . . . bite." (cont. on page 6)

Youth vs. Experience: Notes on Becoming a Physicist with Wayman Bell III & Elaine Christman

Interview by A.J. Salois

Wayman Bell III and Elaine Christman are not so different. Although one might be more experienced when it comes to physics than the other, both experience an insatiable drive to further their schooling through the University of Arkansas Physics Program.

Elaine Christman, a senior majoring in Physics and minoring in Mathematics, came to the University of Arkansas as a freshman majoring in Biology. After a year of various biology colloquia, which she found unsatisfying, Elaine saw her University Physics I class as the only thing that really sparked her interest. Now she approaches the close of her time at the U of A, and with it she shares the wisdom that she has gained. As an entering freshman Elaine found herself struggling to reassure herself that she would not flunk out or lose her scholarships. However, now she believes that as long as you learn as much as you can, and realize that you might not get it all today, but you may tomorrow, the entering freshman will be fine. Elaine also states, "Don't be afraid to ask your classmates for help." She believes that your time spent out of the classroom studying is much more productive when spent in study groups with people that work together.

Reflecting on her years at U of A, Elaine can pick favorites. She remembers her most challenging, but fun, mathematics course as being Advanced Applied Math. While she testifies to the infallibility of the entire physics staff, Elaine sees Dr. Gay Stewart as many see her, the "mom of the physics department." Elaine's most memorable SPS event was the 2006 Haunted Lab, where she enjoyed watching the six year-olds' eyes light up with wonder at all of the amazing techniques used in the lab. The summer after Elaine's sophomore year she participated in SPUR Undergraduate Research at Hunter College in New York to study Molecular Biology. Now she plans on applying to Teach for America where she will have the chance to teach for two years at high-needs school districts.

Wayman Bell III is just now beginning to find his way into the Physics program as a freshman at the University of Arkansas. As a Computer Science Major who is about to become a Physics Major, Wayman has seen over the past few weeks a growing appreciation for physics which has taken him closer to his decision to change his major. He testifies that "it's like a puzzle!" The mathematics that he loves seems to be taking an even more prevalent part in his studies of University Physics I. So far, Wayman finds the labs of UPI the most enjoyable part of physics. They allow hands on experience that deal with real life events, in an isolated environment.

Wayman sees Japan as being a possibility in his future studies. He'd like to either study abroad in Japan or another University in the U.S. He is also looking forward to an honors thesis that may include lifting a car by himself with a system of pulleys. Another interest of his is the study of magnets. Wayman attests that he has, "many, many levels of geek in me." His ultimate goal is to be able to support a family while also doing something that he truly enjoys, and he also wants to invent a anti-gravity gun of some sorts.

So, look for these two rising physics majors as they continue their studies throughout the years. Both have impressive goals and prove themselves daily in the physics laboratory either as a comprehensive TA or a bright student. Someday we may see an anti-gravity gun on the market, or we may hear of a truly remarkable teacher at inner city schools. Either way, physics has once again proved versatile and remarkable as a major at the University of Arkansas.

Ask Toby

Dear Toby,
After last month's query on debacles involving caffeinated beverages, I had to seriously re-evaluate my own coffee intake (I even read your very enlightening book on the matter, though I still think it's not all that delightful Ms. Ono's fault). Despite my new outlook, I still need the occasional fix. Last week I needed a cup and foolishly borrowed my roommate's travel mug. As bad luck would have it, I lost the mug and now I don't know what to do. Help!

Dear Coffee Mate,
Thanks for the testimonial and positive feedback. Matters of roommates and coffee are always aromatic but sticky. You have several options here: Pretend you didn't lose the mug. You don't even know what the thing looks like. Either she won't notice it's missing or she will and you can attempt to convince her she lost it. In a slightly less despicable route, you can replace the mug with one that looks enough like the original to fool the roomie. Again, if she notices the switch, convince her she's the batty one. Alternatively, you could just fess up and hope for the best.
If she leaves you over the mug or makes you move out (highly likely, coffee mugs are serious business), there are some nice flower beds around the physics building that I think would make lovely homes with only the addition of a few knick knacks and a newspaper bed. Good luck, mate.

Monster Sudoku

		2	3						1	9	8
	B	4				1					5
		6				3				4	
	8	B		C	4	5		6			
6		C				7	3	2			
1				9			6				
				3			2				C
			2	6	7				8		3
			1		C	4	8		B	2	
	9				5				7		
3					6				C	1	
7	4	1						8	5		

Monster Daily Sudoku: Mon 28-Nov-2005 very hard

Instructions:
Each row, column, and box must contain the numbers 0-9 and the letters A, B,C.

***WARNING**
This sudoku has <u>two</u> solutions. Good luck.

Expedition SEA-CALIPSO: A Future Physicist's Journey to an Active Volcano, cont.

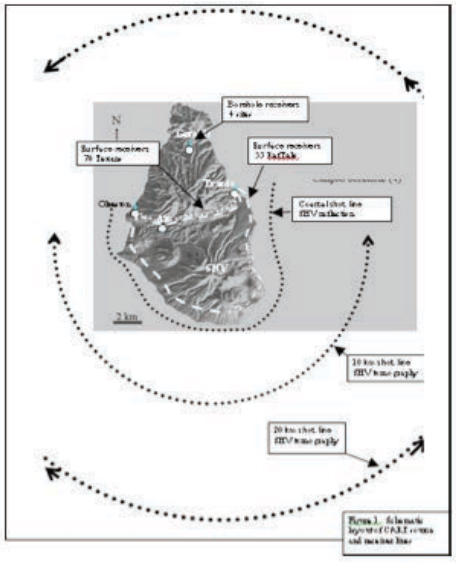


Figure 1. Travel paths around Montserrat (black, dotted lines) for the British research vessel James Clark Ross. Figure reproduced from NSF Proposal No. 0440025 with permission.

The project consisted of two parts: one offshore and one onshore. For the offshore portion, a research vessel named the James Clark Ross, from the British Antarctic Survey, circumnavigated the island in a few pre-determined orbits (Fig. 1). Operated by a team from the UK, the ship towed a special airgun behind the ship and below the water surface. The airgun was a linear array of large air chambers, which were compressed to very high pressures using onboard compressors. Once critical pressure was achieved in each chamber, a large valve would open releasing the pressure inside. The result was a very large pressure wave (P-wave) that propagated towards the sea floor. It turns out water is an ideal medium of propagation since it has a very small compressibility factor (inverse of the Bulk Modulus); hence, the very high wave speeds result in decreased energy dissipation and a large amount of energy transferred to the sea floor. These P-waves couple with the sea floor and generate seismic waves in the crust that both refract and reflect, due to subsurface geologic features, and are ultimately recorded by seismometers on land (a schematic of this process is shown in Fig 2).

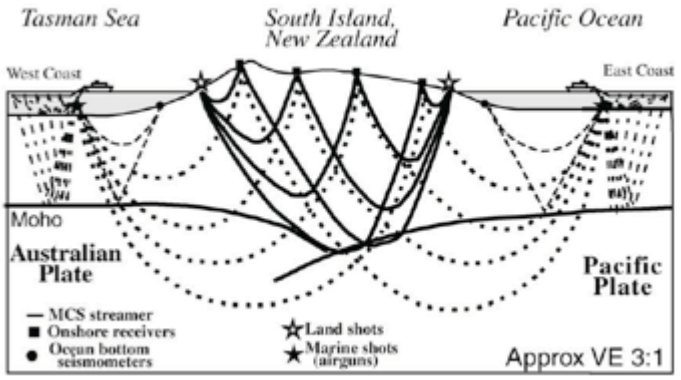


Figure 2. Schematic diagram of an active-source, onshore/offshore study, the 'Supergather' experiment across the South Island of New Zealand by Okaya et al. (2002). All the elements of a complete experiment are shown: (1) onshore seismographs, (2) offshore shot source lines, (3) offshore ocean bottom seismographs, and (4) onshore shot source lines. Examples of several types of signal paths are shown on this diagram, including reflections (straight lines) and refractions (curved lines) from the Moho (crustal plate-mantle boundary) and intracrustal velocity structure. Figure and information reproduced from NSF proposal No. 0440025

The onshore teams oversaw the installation, quality control, removal and data acquisition of some 200 temporary 1-component seismometers set in strategic locations to monitor and record vertical ground deformation caused by the seismic waves (a layout of this seismometer array is shown in Fig 3). The passing seismic wave was recorded as a signal using Faraday's Law (a simple principle of electromagnetism which states that the induced electromotive force in a closed loop is directly proportional to the time rate of change of magnetic flux through the loop). The part of the 1-component detector used to "hear" the seismic wave is the geophone. It's essentially a metal spike pressed vertically into the ground with a small magnet on top and a stationary wire coiled around the magnet; the passing wave vibrates the ground, setting the spike into motion along with the magnet, ultimately inducing a current in the coil via a time varying magnetic flux. This current is digitized and stored in a data logger for further use. By studying various properties of the recorded seismic signals (e.g., the amount of attenuation, variations in the amplitudes) and using certain mathematical techniques, researchers can construct a 3D tomographic image of the SHV magma system and the deep crust. Additionally, the study provides a baseline for future projects of similar nature that would provide the first-ever study of the time-lapse spatial evolution of a magma chamber.

The preliminary data collection phase was completed near the end of last December and the next step is the data analysis phase. It was a very exciting bonus that the Discovery Channel had agreed to fund part of the experiment. Consequently, a freelance film crew, hired by a Discovery Channel private contractor, was on hand to film the entire expedition. Once the data analysis phase is completed, the film will enter final production and will be aired on national television sometime in late spring or early summer 2008. If you are interested more in the technical aspects of the science, there is a wealth of resources on this fascinating topic. I would personally like to thank Dr. Mattioli for giving me this great opportunity.

Figure 3:
Layout of seismometers

This Brit's Got Bite: Zadie Smith's *White Teeth*, cont.

Despite all that, *White Teeth* is not a book one would expect to see on a physicist's shelf. Why? Because it is neither about a famous scientist nor filled with math jargon. What *White Teeth* does offer the culturally savvy scientist (a necessity in a hybrid universe) is a picture of the postmodern world. Smith fluctuates in time and space to create a rich impression of the characters and their various motivations, from whitebread Archie to his best friend Samad, a devout Muslim, to their kooky wives and crazy children, all searching for their own truths that are in turn intertwined. If that mixed bag of humorous social commentary doesn't appeal to you physicists already, take a closer look at Magid Iqbal. His father sends him away to be educated as a proper Muslim and what does he do? He comes back a scientist. Look for yourself in this passage:
"Magid was proud to say he witnessed every stage...No random factors...Just certainty. Just certainty in its purest form. And what more, thought Magid—once the witnessing was over, once the mask and gloves were removed, once the white coat was returned to its hook—what more is God than *that*?"
Now, go get yourself a copy and enjoy.

Saturday Night Is Party Night: Getting Down with E+M

While most other university students were out enjoying their weekend, the dedicated and downtrodden E+M warriors spent their Saturday night, what else, studying. Despite all our efforts, there were still plenty of panicked cries for help during Dr. Stewart's office hours Monday. Luckily, during the study session, Brad Miller led me to what may become the key to maintaining my sanity through some physics-laden moments of doom. The Millerian code is essentially this: Bask in your successes while you can. Even if the answer you got is incorrect. The moment will pass too quickly anyway for those details to matter. Words to live by from the committed masochists.
-SCB

Pictured (clockwise from left): Ashley Stewart, Matt Naglak, Josiah Walton, Shawn Ballard, Chris Sharp, Matt McKnight, Elaine Christman, August Clark and Scott Steele's uplifting thumbs up.

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