BOOK REVIEW

BRIAN GREENE

The Fabric of the Cosmos: Space, Time, and the Texture of Reality

by James Stankowicz

Brian Greene is a string theorist at Colombia University. His first general public book, The Elegant Universe, was a Pulitzer Prize finalist, and served as the basis for a three hour PBS TV program of the same name.

The Fabric of the Cosmos in some ways picks up where The Elegant Universe left off, but it is also a stand-alone book that doesn't require any knowledge of The Elegant Universe.

The book is partitioned into fifths. The first section focuses on "Reality's Arena," where the basic arguments for absolute versus relative space are laid out, and spacetime (including special and general relativity) and quantum mechanics are explained. In section two, Greene focuses on the arrow of time, with particular emphasis on entropy which he develops into a statistical concept. Part three moves on to cosmology, where Greene discusses such things as symmetry, the inflationary model, the big bang and its relation to the arrow of time, dark matter, and the Higgs field. For the string theorist fans, part four is what you're looking for. Here Greene explains the history of the theory, illustrates how it can be used to unite quantum mechanics and gravity (what is now a nearly century-old problem), and explains how extra dimensions fit into the picture.

The final part of the book focuses on the experimental efforts (with many references to the LHC) ongoing, the possibility of time travel, and what might be waiting as we delve ever further down into the fabric of reality.

As The Fabric of the Cosmos is written for the general public, there are no mathematical formulas in the main text, although the notes in the back of the book do on occasion contain mathematics. While it is not very exciting to sit there and read (for instance) for the billionth time about how electrons are both waves and particles, Greene presents most of the material an undergraduate physics major is likely to have already encountered in a very exciting and novel way. For instance, Greene in several situations uses characters or places from the Simpsons to exemplify physics. For someone with a physics background, it's a good deal of fun seeing how the γ's and t's and x's and v's from modern physics translate into Bart's and Lisa's world. On the other hand, in areas where an undergraduate is not as experienced (for instance in 6-dimensional Calabai-Yau manifolds), Greene writes with intoxicating excitement about each topic, and again, by using cultural references, makes it almost natural to imagine Homer being connected via wormhole to the Kwik-E-Mart.

The Fabric of the Cosmos, though a little lengthy at just under 500 pages and a little bit slow moving particularly in the first few chapters, is a very good example of a top-rate scientist writing for the non-professional public, and it is also an excellent way for undergrads to get a feel for the kinds of things going on at the cutting edge of high energy and astrophysics.

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LHC CONTINUED FROM FRONT

extraordinary UF faculty and students working on the CMS experiment.

Professor Mitselmakher led the development of the endcap muon detection system. Professor Korytov was responsible for managing the design and construction of the 468 Cathode Strip Chambers for the endcap muon system. As for the ever-charming Professor Acosta, he was responsible for the design and construction of the track-finder trigger for this system. Professor Paul Avery helped established the LHC Grid computing model in the US and is the head of the UF US-CMS Tier-2 center, one of seven such sites in the US. I know it sounds like gibberish, but if you want to learn more, all you have to do is go on Wikipedia or simply catch one of our esteemed professors on campus before they fly to Geneva sometime this week…and every other week.

We are very excited about the LHC over here (with the exception of some theorists), and we hope you are excited as well. Although Stephen Hawking is betting $100 that we will not be able to find the Higgs particle, our professors and students will be pretty busy for the next few years analyzing data and producing evidence and answers to the key questions about the running of the universe, how it functions, and where it all came from. Solid!

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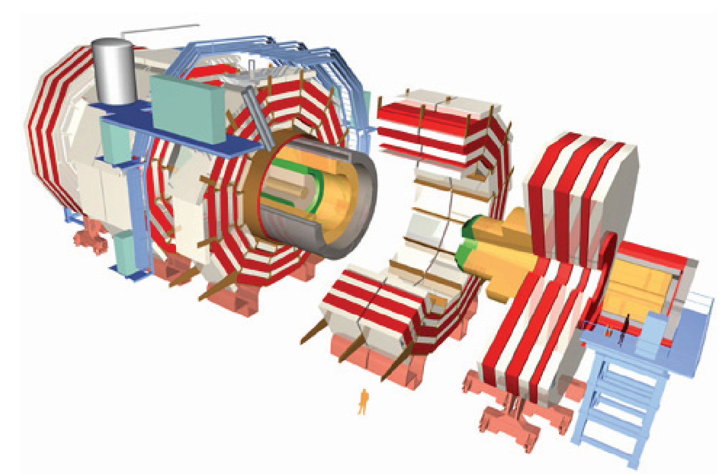
LARGE HADRON COLLIDER UNVEILED!

by Daniel Bannoura

It's the world's biggest and most ambitious scientific experiment in human history. From revealing what happened in the moments after the Big Bang, to probing the fundamental nature of matter, the Large Hadron Collider could unlock the secrets of the universe. The vast facility straddles the border of Switzerland and France. From the surface, you see hardly anything because this 27 kilometer long (26,659 meters, to be exact) machine is buried deep underground. Building it required extraordinary feats of engineering. It cost billions of dollars and involved thousands of scientists from a hundred countries around the world. The Large Hadron Collider works by firing particles into a series of accelerators, propelling them to almost the speed of light, and boosting them to massive levels of energy. Two beams of the particles ascend in opposite directions, entering the tunnel, and hurtling around the tubes 11,000 times every single second. They are forced to collide, and when they do, they release enormous amounts of energy which could unearth new clues about the laws of physics. Giant detectors, positioned in huge caves, track and analyze exactly what happens. With more than 600 million collisions every second, staggering volumes of data are generated, hundreds of megabytes every second. In fact, there is so much data, that a brand new network computing system, the Grid, is being used to connect computing centers all over the globe for data monitoring and analyses.



One hundred meters beneath the French countryside in an underground laboratory is located one important part of the LHC, the Compact Muon experiment. One of the tasks of the CMS is to hunt for one of the Holy Grails of modern Physics: the Higgs Boson, or so called "God particle". The Higgs, named for Peter Higgs by Peter Higgs, may be the mechanism which gives mass to particles. The detector will also be used to investigate a wide range of physics like extra dimensions, and particles that could make up dark matter. Yes, you heard me right. It's true!

Of course, a school like ours, and an astounding department like this, just has to have a piece of that Nobel-prize kind of cake. Ardent and proficient professors, like Guenakh Mitselmakher, Darin Acosta, and Andry Korytov, are manning a group of 30

CONTINUED ON BACK

who we are

UP is a monthly undergraduate physics newsletter sponsored by the University of Florida's chapter of the Society of Physics Students, for students, by students. We seek to strengthen the undergraduate physics community at the University of Florida by providing a forum for undergraduates to share their views and experiences with each other and to act as a source of information for opportunities and events in physics.

Visit Department
Coffee Time
Tuesdays & Thursdays
3-4pm In NPB 2205
Professors, staff, and students are all invited!
Coffee, tea, hot cocoa, and cookies only 50 cents

what's UP
in this issue

Professor Spotlight

DR. HO-BUN CHAN

by Steven Hochman

UPNews: Where were you born?
Ho-Bun Chan: I was born in Hong Kong. It is now part of China.

UP: Where did you go to school?
HC: I came to the US to do my undergrad degree at Princeton. I majored in physics and also have a certificate in engineering physics. Then I went to MIT for graduate school.

UP: What was your doctoral thesis, and how much work was it?
HC: My PhD thesis was on tunneling spectroscopy of two dimensional systems. These are electrons confined to move in two dimensions in semiconductors. They exhibit quantum Hall effect in a perpendicular magnetic field and other phenomena due to electron electron interaction when the density is low. Most people study the transport by flowing a current in the plane of the 2D system, while injected the current perpendicular to the plane.

UP: What did you do after you received your Ph.D?
HC: I became a postdoc at Bell Labs, Lucent Technologies. I changed my subject to micromechanical systems and had to learn a new set of skills. These devices are small, movable structures fabricated on a silicon wafer, using processes similar to computer chip manufacturing. They make use of the mechanical properties of silicon instead of the electrical properties. The silicon structures are capable of motion and are used in various sensors and actuators.

UP: Can you tell me a bit about your research?
HC: I have many projects involving micromechanical devices. My group uses them as sensitive detectors, such as in measurement of Casimir forces that arise from zero point fluctuations of the electromagnetic field, and in micromechanical magnetometers for measuring the magnetization of very small samples in the highest magnetic fields. We also look into ways to improve the capability and increase the sensitivity of micromechanical devices. For example, we perform experiments on the fluctuation induced switching in nonlinear oscillators with multiple stable states. We fabricate structures on the surface of metallic films that are smaller than the wavelength of light. These structures channel the incoming optical energy to specific and localized positions. We put additional structure at these locations to maximize the interaction of the optical field and the mechanical structure.

UP: What are your thoughts on teaching?
HC: I try to be thorough in explaining the concepts in classes. I give examples to illustrate the relevance of the material whenever I can. Teaching is fulfilling when I see that the students are making an effort to learn, and I am happy to help.

UP: Who are your graduate students and undergrad researchers?
HC: I have 5 graduate students and 1 undergrad working in my lab. Yiliang Bao works on the Casimir force measurement. Corey Stambaugh studies fluctuation induced switching in driven nonlinear oscillators. Kostantinois Ninios makes micromechanical magnetometers. Zsolt Marcet investigates evanescent field coupling in subwavelength metallic structures. Jie Zou is looking at new detection schemes in nanomechanical oscillators.

SPS INFORMATION

by Arthur Ianuzzi

This year SPS is starting a new mentoring program. Studying physics can be a daunting process at times. Combine this with the challenges of navigating around such a large university, and even the most hard-core students will become overwhelmed from time to time. To address this issue, SPS now offers mentoring for students who are new to UF and/or physics. Just let us know, and we'll pair you up with someone who has already weathered the storms that brew in your future.

Another exciting development this year will be the return of the Physics is Phun Shows that were offered to local schools in years past. The idea is simple – we get the next generation of physics students addicted to physics. A little bit of smoke, mirrors, and liquid nitrogen should go a long way to getting kids interested in physics. This year, we will try to enhance the program by adding activities that allow the students to get some hands on experience with physics toys, and maybe even let them leave with a cool souvenir. If you would like to help out, just let us know.

We'll also be having some exciting ROFU and REU meetings throughout the Fall semester. ROFU (Research Opportunities For Undergraduates) is a great way to find out about research that undergraduates can get involved with right here at the UF Physics Department. At the meetings professors give a presentation about their areas of research, and maybe even a tour of their lab. If you find the research interesting, you can contact the professor about gettng involved. Another great program is the research experience for undergrads, or REU. This program involves spending the summer working on a research project. These programs generally involve more interaction with the other undergraduates in the program, trips to related laboratories, and other special activities designed to enhance the research experience. Towards the end of November, Prof. Ingersent will be giving a presentation on how to find a good program and how to put together a good application. Also, a GRE study group has been formed. If you are fortunate enough to have the exciting experience of taking the GRE Physics Subject Exam, you'll want to check this out. Meetings will be held on Thursdays at 6:00pm and Sundays at 2:00pm – location to be announced. The program will run from now until the last exam date in the fall, and if there is enough interest, we'll keep it going though the spring for people who are taking the exam next year.

Finally, we're going to try something new this year – a physics/science competition for local high school students. If you've ever participated in something like this then you know what great fun these events are. We'll need help writing questions, planning, and of course putting on the event sometime in late spring.

To keep informed on all of these events, be sure to join the SPS listserve, spsmembers-L. Instructions on joining, and other great information can be found on the SPS website at http://www.phys.ufl.edu/~sps.

Spotlight on Science

CONDENSED MATTER PHYSICS

by Victor Albert

Throughout the last 100 years, science has fragmented into a mess of various disciplines, most of which overlap each other. This section attempts to clear up and organize the various scientific kingdoms and phylums, one topic at a time. This is only an attempt, as the distinctions among the fields are almost always debatable. This month we deal with the complicated world of condensed matter physics.

Condensed matter physics is the largest branch of physics, mostly because it is an umbrella field for a lot of different subfields, all of which have vast applications in engineering. Condensed matter physics is the study of macroscopic properties of matter. "Condensed" stands for any matter where the interactions between particles are strong, i.e. liquids and solids. The "matter" is to distinguish this field from studies that deal with single atoms and molecules, such as "atomic" physics or "molecular" chemistry. As opposed to those fields, condensed matter scientists study large-scale interactions between atoms and systems of atoms. Good examples would be properties for which you generally have a lot of atoms, like crystals or paramagnetism. So, when you're not specifically looking at one "atom" or "molecule," you're studying "matter."

Condensed matter started out as solid-state theory, but then scientists figured out that a lot of the things they were studying for solids also worked for liquids. As a result, **solid-state physics**, the study of rigid matter such as crystals, is now only a branch of condensed matter. Solid-state generally deals with two major structures: crystal lattices (periodic structures like salt or diamond) or amorphous crystals (structures that do not have periodicity). Other structures include polymers, quantum nanocrystals, and nanotubes because all of these very interesting properties. These topics greatly overlap with other fields, including **nanoscience** (the study of small things) and **electronic structure** (the study of electrons and how they behave in large systems).

There are of course theoretical and experimental branches of condensed matter physics. Additionally, there is an applied cousin called **materials science and engineering**. The difference between condensed matter experimentalists and materials engineers is the former are trying to discover a material and analyze its properties, while the latter are trying to perfect that material and apply its properties for industrial applications. As you might have guessed, materials science and condensed matter physics are almost the same field, but the people in it are introduced to the field from two different angles. Similar to mathematicians and physicists working together in mathematical physics, engineers with materials science degrees and physicists with condensed matter degrees work side-by-side in order to discover novel materials.

...BECAUSE GATOR DINING SUCKS

by Alicia Swift

When in need of a break from studying physics, you should consider wandering downtown to some great undiscovered locations with equally great food. For breakfast, go to Bagels Unlimited on 13th and University. It is open until 3 pm for late sleepers and has every breakfast food you can imagine. Be sure to buy the chocolate chip brownies by the cash register for $1. Not only are they huge, but they are the best brownies on the face of the planet.

One option if you are looking for a quick but healthy gourmet sandwich or fabulous pasta salad, head over to Harvest Thyme on University Avenue for breakfast and lunch until 4 pm.

For a slightly more expensive and international option, you could try Emiliano's Cafe on First and Main Streets. With delicious tapas and imported wine, you can't go wrong. The Cuban Burrito and the Curry Chicken Wrap are outstanding, and on Mondays and Wednesdays, you can enjoy the live jazz band and your half-priced bottle of wine.

For your hot date on Saturday night, I recommend Ti Amo (by the Hippodrome), a Mediterranean restaurant with homemade hummus and cinnamon ice cream. Another option is Manuel's Vintage Room, which is a tiny Italian restaurant straight from Florence and located right on Main Street. Order the lobster ravioli with a cream and truffle sauce, and you will be far from disappointed. Top it all off with dessert from The Gelato Company, which has (you guessed it) amazing gelato and also cheesecakes and pies. This is right next to Emiliano's, which can be quite convenient.