

2012 Quadrennial Physics Congress
Hosted by Sigma Pi Sigma, the physics honor society
November 8-10 • Orlando, FL

PhysCon

PhysCon Articles

by SPS Chapter Reporters



Letter from the Director

It has been nearly a year since the 2012 Quadrennial Physics Congress (PhysCon), hosted by Sigma Pi Sigma. These 'follow-up months' have been filled with ordinary and somewhat tedious tasks (especially when compared to the high level of excitement that permeated the meeting) aimed at properly archiving PhysCon 2012. And while the labor of sorting through registration records, organizing workshop documents, captioning hundreds of photos, and finding a storage place for the on-paper memory of PhysCon 2012 might seem at first glance like a soporific activity, it has been an enlightening experience.

With over 800 attendees, a lengthy waiting list, and the office already receiving inquiries about the plans for 2016, the interest in and need for such a unique gathering is undeniable. Registration data reveals that PhysCon 2012 achieved demographic diversity unrealized at many other physics meetings, giving us hope that efforts aimed at inclusivity are working. The roster of attendees included more than 80% undergraduate students with over 30% women and 20% underrepresented minorities. All eighteen of the SPS geographic zones were represented and for the first time, a group of students from an international chapter made the trek.

While combing through the data teaches us many things, it is the words of the students that truly inspire us. Their enthusiasm and changed lives are why we do what we do, and why we continue to fight the sometimes uphill battle to understand the unique challenges faced by undergraduate physics students and seek support to help them overcome those challenges.

As we continue to glean lessons from the PhysCon experience, we take pause to acknowledge the many Sigma Pi Sigma alumni, friends, and science organizations that generously supported the 2012 Quadrennial Physics Congress. Donations to the SPS PhysCon Chapter Reporter Program supported the following articles and, more importantly, the students that wrote them. The \$500 award to the participating chapters was, in many cases, the primary reason students were able to afford attending this life changing event.

As we turn our attention to preparing for the 2016 Quadrennial Physics Congress of Sigma Pi Sigma, with an anticipated attendance nearing 1,200 physics students, alumni, and mentors, we hope that you will join us in looking forward to the stories that will emerge and the lives that will be changed.

Sincerely,



Toni Sauncy
Director of SPS and Sigma Pi Sigma
October 2013



Toni Sauncy (center) is flanked by her former students from Angelo State University at PhysCon. Photo by Liz Dart Caron

Thank you to the 2012 PhysCon Chapter Reporter Award Donors!

PhysCon Chapter Reporter Awards are \$500 awards available to chapters that bring four or more members to PhysCon and write about their experience for SPS publications. SPS made nearly 20 awards for PhysCon 2012, thanks to the generosity of the following organizations and individuals:

- American Astronomical Society
- American Center for Physics employees
- Jack Hehn
- National Institute of Standards and Technology
- OSA, The Optical Society



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ABILENE
CHRISTIAN
UNIVERSITY

2012 PhysCon, an Unforgettable Experience

2012 Quadrennial Physics Congress of Sigma Pi Sigma

Orlando, FL November 8-10, 2012

By the Abilene Christian University (ACU) SPS Chapter

Getting to the Congress was a journey that took our chapter's members through internships at national laboratories, outreach projects with local elementary schools, an immense number of fundraisers, and a twenty-four hour long bus ride. Transporting thirty students from West Texas to Orlando in the middle of the semester was no small feat, but even more daunting was the task of funding our quadrennial pilgrimage to the Congress. To help raise money, we held multiple fundraisers, including painting a professor's house, bake sales, restaurant give-back nights, liquid nitrogen ice cream sales, selling coupon cards, and finding sponsors for our elementary school outreach project, the Physics Road Show. One fundraiser in particular has been permanently embedded in the minds of all of our members: the infamous Pink Parade, in which 15 men from our

“We had a great time doing it and made a lot of people's faces light up with our chapter's antics.”

chapter donned elaborately decorated bras for breast cancer awareness. In conjunction with this awareness campaign, our more modest members sold liquid nitrogen ice cream to an enthusiastic and overjoyed crowd of parade spectators.

“Partnering with the Center for Contemporary Arts for their breast cancer awareness project was a great way for us to step up and be active in our community while at the same time raising funds for our chapter's trip to PhysCon,” said junior physics major and ACU-SPS vice-president Andrew Miller. “We had a great time doing it and made a lot of people's faces light up with our chapter's antics.”

Along with multiple fundraisers, many of our students participated in summer research projects that allowed them to present posters at the Congress poster session and get some travel support. In all, eight of our members presented posters on the

work they had done at Los Alamos National Lab, FermiLab, Brookhaven National Lab, the Albert Einstein Institute, and ACU's own solid state lab. In addition to these eight, four students presented



Spencer Lynn in front of NASA's Vehicle Assembly Building during the tour of NASA.



posters on some of our chapter's outreach projects in the Abilene community. After months of planning, fundraisers, and organizational meetings, we climbed aboard our bus and drove into the East.

“I got to see how I can apply my physics degree to anything.”

We arrived at the Congress stiff legged, tired from a full day of driving, and not fully aware of what to expect. The big highlights, a tour of the Kennedy Space Center and a talk by Freeman Dyson, were known, but our members were unsure of what to expect from the remaining aspects of the conference. In the end, our members left with more knowledge about science outreach and careers than they ever could have expected. One aspect that was most informative was the information about careers in physics. The variety of speakers who had taken their education in physics and applied it in diverse ways was both informative and encouraging to everyone who did not feel like the research or academia route was their calling.

“I enjoyed hearing how there are a lot of physicists doing things that you wouldn't normally expect them to be doing. I learned how it's possible to find a niche for yourself rather than being restricted to certain aspects of the physics world, because physics is such a broad subject,” said senior Ryan Pinson. “From all the different talks and all the different speakers, I got to see how I can apply my physics degree to anything. I had never seen anything like that before.”

The theme of “Connecting Worlds” brought the promise of connecting physics with the general public and the 2012 Congress more than lived up to this expectation. Our chapter places a heavy emphasis on community outreach, and we were looking forward to learning about new ways to enhance our ongoing efforts and pick up new techniques as well. The “Connecting Physics & the Public” workshop in particular resonated with our group. Presenter Henry Reich's message about bringing physics to the public in a way that is content rich but not bogged down in jargon is something that we plan on putting into action back home in Abilene.

“One thing I realized is that we could probably do a better job connecting the world of physics to the general public. Many people that I've met out of the general public have some respect for physics majors, but they also harbor some fear of the subject, or simply state that they know nothing about physics,” said junior engineering-physics major Erik Forrister. “During the workshop about connecting physics and the public, Henry Reich talked about ‘MinutePhysics,’ his YouTube channel that seeks to explain various physics concepts to the general public. I realized that we could use more scientists with this same mindset and the skills to explain physics to the public to make it easier to understand and less intimidating for the future physicist.”

Throughout the Congress, we were constantly amazed with what we saw and learned. Freeman Dyson reminiscing about the past seventy years of physics and the opportunity to hear from distinguished scientists and a Nobel laureate were part of what made the 2012 PhysCon an unforgettable experience

Meeting Highlight: The Higgs Boson Experience

During lunch on the first day of the Congress, Dr. Dan Green of Fermi National Accelerator Laboratory discussed the discovery of a boson that has many similarities to the theorized Higgs boson, although scientist are not ready to say definitely that this is it. Beginning with an explanation

of how particle physics deals with the elementary constituents of matter and the forces that control their behavior, Dr. Green quickly moved into the story of the search for the Higgs boson beginning with the Tevatron, located at FermiLab, and reaching fruition at the Large Hadron Collider at CERN. He also gave a general overview



of the Higgs boson.

“It’s the new vacuum. You think the vacuum is empty but if this is truly a Higgs, then the vacuum has a field that is everywhere in space and time, and particles moving through it are retarded and acquire a mass,” said Dr. Green in a post session interview. “It’s hypothesized to be responsible for all the masses of all the particles. It’s very fundamental but is unique because it’s the only quantum field which has a non-zero vacuum value.”

As stimulating as the discovery of the Higgs boson may be, perhaps just as exciting is the history behind the search. According to Dr. Green, the search goes back over twenty years to the ill-fated Superconducting Super Collider. After the Super Collider project was derailed, the natural successor to carry the torch in the Higgs search became the Large Hadron Collider (LHC) that, at the time, was still in the planning stages. After well over twenty years of work that went into the Higgs search, earlier this year the CMS and Atlas experiments at the LHC were ready to make the most anticipated announcement in particle physics.

Despite all the fanfare and excitement over the discovery, Dr. Green is confident that there are still many more discoveries on the horizon and important questions about the Higgs that have to be answered.

“We know it’s a particle. We know its mass is about 125 GeV. We know, because we tried to make these precise detectors, its fractional width, the width of the signal versus its mass. We know it’s not a spin 1 particle. By the end of the year...we should be able to say if it has the quantum numbers of the vacuum,” said Dr. Green. “We need to understand how it couples to other things it’s supposed to couple to. It’s supposed to couple to mass and to heavy quarks. It’s supposed to couple with a given strength to photons and we are trying to hone in on those and see if it has exactly the couplings that are predicted. We are going to keep pushing on this data. There is still a lot to do, and we are going to keep doing it.”



Appalachian State at PhysCon 2012

2012 Quadrennial Physics Congress of Sigma Pi Sigma

Orlando, FL November 8 – 10, 2012

By Michael Harrington and the Appalachian State University SPS Chapter

Our journey to the 2012 Quadrennial Physics Congress began in March of 2012 upon the election of our new club president, Tyler Foley. Tyler has the drive and leadership ability to make things happen and found the perfect opportunity in the 2012 Quadrennial Physics Conference, or “PhysCon” for short.

We held bake sales on campus and sold drinks and snacks in the physics study room to raise money for the event. With the help of grants, we raised enough money to send 10 club members to PhysCon for little-to-no money out of pocket. The day before our departure, Tyler went to pick up the van reserved for the trip only to find no vans left at the motor pool. Luckily for us, one of the astronomy professors, Dan Caton, allowed us to take the brand new department van at the cost of everyone’s firstborn child. On the way down, we made a few stops for coffee, food, and bathrooms and met some interesting people along the way. The 12-hour drive consisted largely of discussing the physics of everyone’s chosen zombie apocalypse weapon.

On Thursday morning, we met up at the conference center to load tour busses for NASA’s Kennedy Space Center. A few of us were able to go on a special press tour, during which we visited four different NASA labs and the shuttle launch pads. The first lab we went to was the RESOLVE lunar rover development lab (RESOLVE is short for Regolith and Environment Science and Oxygen and Lunar Volatiles Extraction). In this lab, the focus was on combining robotics and chemistry to extract, analyze, and produce water from regolith (lunar soil). The second lab was an applied physics lab, and the scientists there showed us a schlieren optical technique for visual air leak detection. The third lab focused on developing automated and remote-controlled mining techniques for Moon and Mars missions. Much of their effort goes into determining the best materials for building launch and landing pads on lower gravity bodies. In the last lab there were many different projects going on. These varied from the collection and detection of minerals by a rover in motion to the effects of LEDs on the sleep cycles of astronauts.



The Appalachian State group on the beach at St. Augustine.

I noticed lots of projects related to cutting the cost and increasing the efficiency of space travel. Specifically, the extraction of oxygen, hydrogen and other elements from regolith to use as fuel, water, and air for the next leg of the journey. Many different fields of science were being utilized



together at NASA to further human space exploration.

Upon returning, those of us on the press tour compared our tour experience with the rest of our group, who went on the general tour. They were disappointed that they did not get a more in-depth tour, but they were able to see some of the major sites and spend some time at the visitor center.

Our group then went to the PhysCon Exhibit, which was packed with graduate schools and other organizations. Schools from all across the country were happy to tell us about their specialties, ranging from theoretical particle physics to bioengineering. Some popular non-school exhibits were the Optical Society, Teach for America, the American Physical Society, the Society of Physics Students, LIGO (Laser Interferometer Gravitational Wave Observatory), and Gradschoolshopper.

That night at the opening ceremony we heard an excellent talk by astronaut John Grunsfeld. Grunsfeld opened by telling us stories about his childhood and how he became interested in physics, and how he got involved with NASA. He enthralled the audience with stories and videos of missions to fix and update the Hubble Space Telescope. My favorite line from Grunsfeld's talk was, "In 1997 I had the opportunity to call *Car Talk* from space." Grunsfeld then talked about the Mars rover Curiosity and the direction NASA will be taking in the future.

“ Many different fields of science were being utilized together at NASA to further human space exploration. ”

The next few days were full of fun, food, and most importantly, physics. There were many more great speakers who delivered talks on a broad range of subjects. We attended interactive workshops focused on how to better connect science with the rest of the world. On Friday and Saturday afternoon there were poster sessions; six people from our chapter presented posters. There was even a dance party Friday night sponsored by the American Physical Society. I was very surprised and impressed at the turnout and dance skills of an all-physicist dance party. Overall we had a great time with wonderful weather and accommodations. We were all sad to see the conference come to an end Saturday night and face the piles of homework we let stack up.



Benedictine University

2012 Quadrennial Physics Congress of Sigma Pi Sigma

Orlando, FL November 8-10, 2012

By the Benedictine University SPS Chapter

Wednesday Highlight: We arrived in Florida!

Thursday Highlight: NASA Tour



A student programming the Mars Rover on the NASA Tour.

The first item on our itinerary was to visit NASA's Kennedy Space Center. A few of us were able to go on a special tour of the space center where we heard many interesting talks and saw demonstrations by scientists who work there. It was really strange to think that objects just an arm's length away from you could be used to put machines on moons and other planets. One of the demonstrations was of a device used with lenses, clothing, and other objects that need to be free of dust. The device used magnetic fields to create a force that repelled the dust from the surface.

In the Applied Physics Lab we saw a demonstration of the schlieren effect and how it can be used to determine the quality of glass. The scientist held a standard window pane in front of a camera and the image of the pane on a television screen showed a white box. Then he held up a piece of glass used in one of their rockets, and it appeared clear on the screen. The ordinary window showed up white because it had many more imperfections than the rocket window. The schlieren effect is a way to visualize imperfections that may not be visible to the naked eye. In another lab, we saw a rover that will be used to collect soil samples on Mars. The rover will be launched in a few years. It was odd to see such high-tech machinery look almost normal when placed in a regular lab instead of on a foreign surface. A highlight for the rest of our group was the NASA Visitor Complex, with its exhibits and gift shop.

Friday Highlight: Breakfast with the Scientists

We were exhausted from the amazing day at NASA, but woke up extra early to make sure we got to sit and speak with a scientist at "Breakfast with Scientists." We were privileged to meet Dr. Fred Dylla who spoke with us about



his life experiences and how he became a scientist. Many members of our chapter felt that this was one of the highlights of our experience and it was truly an honor to meet him.

“Opportunity knocked, and I swung open the door on the Florida trip to PhysCon. Throughout all the excitement, one of the highlights of this experience was meeting Dr. Frederick Dylla, Executive Director of the American Institute of Physics. We had a chance to inquire about his work during breakfast. My encounter with the inspirational scientist left me in awe of how driven passion can manifest itself in substance. His back-story was an autobiography of ambition led by an unorthodox path. As I recall, he started conducting experiments at the age of twelve and one of his most intriguing experiments involved his fascination with lasers. His love for lasers had an immense ripple effect in his profession, which is reflected within his published work. Certainly his great success paid homage to his childhood love. The old adage must be true: ‘choose a job you love, and you’ll never work a day in your life’”. -Joey Hua



Our group with Dr. Fred Dylla.

Saturday Highlights: Freeman Dyson and a Communications Workshop

On Saturday we woke up early to hear Dr. Freeman Dyson speak about his experiences and some of the interesting people he encountered throughout his career. He shared interesting advice such as: If you can avoid it, don't get a Ph.D. He also said that he thinks solar power is not an immediate solution to the world's energy shortage and is too expensive to be practical.

After lunch, we went to the workshop “Connecting Physics and the Public.” The speakers were Henry Reich, who creates YouTube videos called “MinutePhysics” for the public, and Gary White, a former director of the Society of Physics Students who talked about science outreach events. Presenting physics ideas to the general public requires creativity and passion.

Henry Reich talked about his success in educating the community through YouTube videos



Dr. Gary White during the communications workshop.

and shared his techniques for reaching people effectively. The workshop activities and his short talk summarized two main techniques for effectively connecting physics with the general public: 1) be creative and 2) avoid using physics jargon. He began by showing us some of his videos, which are very popular on YouTube even though they feature complex ideas and use simple drawings instead of extensive animations. He then had us participate in several activities to get in the mindset of speaking to someone who does not have a science background. He had us practice writing descriptions for mundane items such as a pencil or coffee cup, and then he increased the difficulty by having us describe special relativity and our research experience. We were able to communicate well with our team members and see how others

viewed objects differently. We realized that even complex ideas could be explained with pictures and simple words. Even if we couldn't explain the minute details, the basic idea and its application could be explained simply. If people understand science, they will gain a greater appreciation and



understanding of the world around us.

Gary White spoke to us about using hands-on activities to get the public thinking and hypothesizing about simple ideas that may not be obvious initially. He had us roll dice numerous times and record our results to see if the dice were fair. When we saw they weren't, he had us discuss what could have caused these results. The purpose of the exercise was to get us observing physical behaviors and thinking about their implications. This can all be done without a heavy background in science.



A student examining the unfair dice.

Sunday Reflections

On the plane home, we had time to think about the amazing experience we just had. We got to hear remarkable individuals speak about their work. These people were no longer names from the science headlines, they were living, breathing individuals with a great deal of passion for science. Not only did we meet some incredible people, we also got closer as members of the Benedictine University chapter of SPS.



Davidson College PhysCon Reflections

2012 Quadrennial Physics Congress of Sigma Pi Sigma

Orlando, FL November 8 – 10, 2012

By Jessie Barrick, Ashley Finger, Jacob Simmonds and Chris Trennepohl, Davidson College

When one is asked by friends and colleagues about weekend plans, the usual answer does not involve driving nine hours to Orlando, Florida to join the largest gathering of undergraduate physicists the world has seen. Yet it was with this intention that our brave troop of proud and “self-Alpha-aware” Sigma Pi Sigma members voyaged down to Orlando and courageously weathered unfeasibly early wakeup times. Pride at such a feat is a natural phenomenon, though it was slightly diminished by the fact that every single student fell dead asleep mere minutes after entering the car driven by our chapter advisor, Dr. Mario Belloni. Yet still: pride.

The Davidson chapter of Sigma Pi Sigma is the Alpha chapter of Sigma Pi Sigma, established in 1921. This title gave us a certain degree of smug superiority, but the ephemeral feeling extended barely past our chins. When our chapter, the founding chapter of Sigma Pi Sigma, was first introduced at the Congress, the only reactions were suppressed whoops and squints of “should we really cheer for our chapter?” After the explosive self-applause from the other schools, it’s fairly safe to say we are a quiet bunch.

Of the 650 or so undergraduates, four of us were from Davidson, and we were immediately impressed with what we saw. The speakers were far and away the most compelling part of the Congress. We arrived with high expectations for them—in fact, hearing a Nobel laureate speak was one of the ways we promoted PhysCon to our peers at Davidson. However, the selection of speakers far exceeded our anticipation. Each speaker was a leader in his or her respective field, a leader that opted to take time out of his or her busy and important schedule to speak to a group of undergraduates.



The Davidson College SPS chapter with Dr. John Johnson: (L-R) Jacob Simmonds, Ashley Finger, Dr. John Johnson, Chris Trennepohl and Jessie Barrick. Credit: Mario Belloni

John Grunsfeld kicked off the Congress with an engaging and suspenseful account of one of his missions to repair the Hubble Space Telescope. We were literally on the edge of our seats during some parts, and by the end of his talk, we think he imparted in us all a secret desire to become an astronaut. Later on, we found out that Dr. Grunsfeld had



to fly out immediately upon completion of his talk in order to name a satellite. This is just one example of the prestige of our speakers, of the dedication they showed to SPS and Sigma Pi Sigma, and of the inspiration that we all felt. The fact that the speakers were willing to travel from distant locations such as California and England and that many gave up an entire weekend truly speaks to the far-reaching influence of the societies.

Meeting Highlight: Exoplanets with Dr. John Johnson

Dr. Johnson's talk focused on exoplanets—planets outside of our solar system. First, though, he spoke of his interesting start in physics. While at University of Missouri, Rolla, he switched majors several times: from aerospace engineering to mechanical engineering and finally to physics. From there, he applied to the University of California, Berkeley astrophysics program on a whim after looking through a telescope only once. It was there that he received both his masters and PhD in astrophysics.

Dr. Johnson presented his exoplanet research in the context of three goals: to understand our origins, to provide a galactic context, and to discover life external to our planet. His research group analyzes data from the Kepler mission and the Keck Observatory to observe the Doppler “wobble” of stellar systems (the pull on stars by their unseen planets) and track changes in starlight output due to planetary transits. Specifically, Dr. Johnson delved into his personal interest in red dwarfs (also called M dwarfs in reference to their spectral classification), stars more plentiful and long lived, but harder to find because of their low light output. As of PhysCon, Dr. Johnson had been the first author on papers that announced a total of twenty-two exoplanet discoveries.

To conclude his discussion, Dr. Johnson listed three take-away points about his field of research: first, there are many more small planets than large planets; second, researchers have made a strategic shift from hunting for exoplanets blindly to predicting where to look before gathering data; and finally, thanks to, among others, the Kepler mission and the Keck Observatory, current data is much more sensitive and detailed, allowing for better conclusions.

To each of us, the 2012 Quadrennial Physics Congress represented an opportunity to listen and learn, to share and teach, and to delve into the larger community of ours peers. We would like to thank SPS, Sigma Pi Sigma, and the other organizations that made this collaboration between successful and aspiring physicists possible.

“ To each of us, the 2012 Quadrennial Physics Congress represented an opportunity to listen and learn, to share and teach, and to delve into the larger community of ours peers. ”



WILLIAM & MARY

The Journey to PhysCon, Chapter Reflections and Highlights

2012 Quadrennial Physics Congress of Sigma Pi Sigma
Orlando, FL November 8-10, 2012

By Jeni Hackett and Elana Urbach, College of William and Mary

Attendees: Reed Beverstock, Rachel Hyneman, Will Bergan, Paulo Black, Jesse Evans and JJ Hoo

The College of William and Mary began its PhysCon journey bright and early one Wednesday morning as the eight attendees met outside of Small Hall, the College’s physics building. As a chapter that is particularly dedicated to community outreach, we were thrilled to be attending PhysCon to hear ideas from other chapters and the various speakers. We were particularly thrilled since our chapter has been striving to become more of a force on our campus, so the opportunity to connect with other SPS chapters and participate in the workshops was one we did not want to miss.

With a thirteen hour drive ahead of us from Williamsburg, VA to Orlando, FL, we prepared ourselves accordingly—with classical mechanics and quantum homework, naturally. Our intent was to caravan from Virginia to Florida, but due to differences in driving techniques and varying needs for food amongst the students, the two vans ended up largely traveling separately. We did try to meet up for dinner around Jacksonville, but our lack of knowledge about the area ended up making that a bit of a bust. Still, as this was our first multi-state trip, the drive went about as well as we could hope.

Our chapter truly enjoyed how the speakers from the Congress attended events and talks alongside the students. Being able to randomly bump into speakers and ask them whatever question you had was a high point for Reed Beverstock. It really made the conference feel like a meeting of the minds for all stages, rather than a series of talks that separated the students from the professionals. Paolo Black was reduced to childlike glee at the chance to run into Freeman Dyson among the crowd, and Elana Urbach happened to run into renowned physicists Jocelyn Bell Burnell and Mercedes Richards prior to an unrelated talk and couldn’t resist asking for a photo. “It was great to see how much everyone loved their jobs,” Elana elaborated. As communication is a vital but often overlooked part of a physicist’s job, the fact that the conference facilitated discussion amongst students and speakers alike was fantastic and fascinating training.



Elana Urbach (left) and Jeni Hackett (right) stand on the crawler path leading to the shuttle launch pad.

The topics for the workshops were particularly



interesting, especially the workshop on science policy. That one certainly got a roaring debate going as it cut to the heart of a very pressing issue that every scientist has to grapple with: funding. I know my table had some sparks fly when a comment I made was misinterpreted, but it was resolved quite nicely, again stressing the importance of being able to communicate one's point clearly!

Another group favorite was the fantastic Kennedy Space Center tour. We would be lying if we said we weren't geeking out in the extreme as our bus drove up to the famous shuttle launch countdown clock by the press site or when we got out on the crawler path leading up to the launch pad (you could see the burn marks on the signs from shuttle launches!). For me, having grown up watching the shuttle launches, crying unabashedly during STS-135, and finding my love of science through the shuttle program, standing at the base of the path leading to the launch pad was a truly powerful moment. So, too, was talking to the scientists currently working to continue the study of our universe and beyond. I again had a personal connection as Bob Youngquist, a scientist in the Applied Physics Laboratory at NASA, demonstrated a schlieren system to us for visualizing the quality of glass, the development of which I had studied over the summer via an internship at NASA Langley.

It's impossible to gush about every talk as we would love to be able to do, but a few talks definitely stood out to our group. Jocelyn Bell Burnell's was particularly fantastic. We loved, in Rachel Hyneman's words, "listening to nearly every single 'end-of-the-world-in-December' theory destroyed with science." Burnell talked about several ill-founded theories, things that some of our peers may honestly put some faith in, and it was refreshing to be able to joke about the theories with other physicists. Burnell's talk felt very at home with the talk by *MinutePhysics* creator Henry Reich, as both talks sought to address how science is communicated to the public. For Burnell, the focus was on how misinformation becomes popular and deconstructing those incorrect arguments; for Reich, the focus was on doing scientific outreach in a way that is accessible for all. David Saltzberg, a physicist and consultant for the "The Big Bang Theory," also gave a great talk on communicating science. See the final section of this article for more on his talk.

We were able to get travel funding from our college and physics department by presenting posters, and we have to admit that motivated several of us to present posters. However, we found the poster session to be particularly valuable once there. One of our Friday poster presenters and



From left to right: Jesse Evans, Paulo Black, JJ Hoo and Will Bergan examine the spherical star map at the Visitor Center of Kennedy Space Center. Credit: Reed Beverstock

reporters, Elana Urbach, explains, "It was a lot of fun talking to different people who visited my poster because they were interested in the subject, or it just caught someone's eye. I had a great time doing my research project over the past summer, and it was nice to be able to share my excitement with others. It was also fun talking with the people [presenting] on

“I had a great time doing my research project over the past summer, and it was nice to be able to share my excitement with others.”

either side of me. Some people came who were presenting on Saturday, so I got to visit their posters the next day, which was really fun and informative.” Being able to share our research and learn about

the research being carried out by our peers around the world was fascinating, and a great way for younger physics students to be exposed to the possibilities awaiting them in the world of research. Actually, that really sums up our experience at the conference: it was just incredible to be surrounded by people of all ages who shared our love of physics.

Meeting Highlight: “The Big Bang Theory” with David Saltzberg

Our chapter is incredibly passionate about outreach. As science consultant for the immensely popular sitcom “The Big Bang Theory,” David Saltzberg is also passionate about outreach, although he does outreach in a different manner. It’s a more passive form than what we do; he does outreach by ensuring that the science on the show is correct and highly relevant (he actually incorporated a whiteboard on graphene a year before it got Andre Geim and Konstantin Novoselov a Nobel prize!). Saltzberg peppers the show with concepts that an uninterested viewer can just gloss over, but an interested, curious viewer can latch onto and look into, exposing them to modern physical concepts and possibly inspiring a love of physics.

David Saltzberg is a high-energy physicist who participates in Antarctic research. He’s quick to note he doesn’t write jokes or have a hand in characterization, but instead serves as a link between the writers and the scientific community.

Listening to his talk it became clear just how much effort goes into the sitcom to make it not only scientifically accurate, but full of background nods to the scientific community. The whiteboards covered in accurate equations are just the tip of the referential iceberg. One of the things that particularly stood out to us was that all the posters and materials stuck to the bulletin boards on the show are actual scientific materials. Saltzberg encouraged us to send in our posters, and they might end up on the show! We also caught him later taking material about PhysCon with him...

perhaps we’ll see a flier for PhysCon sneak its way into the show?

Saltzberg found himself working as science consultant by chance through “a friend of a friend”, as the writers knew from the start that they wanted a scientist on-hand to ensure they did it right. “The writers are big geeks,” he reiterates, who want to make an entertaining show first and foremost but strive to never let bad science slip in. “Every science show has that one character that isn’t a scientist, so they can turn to that character to explain what’s going on,” he continues, and it’s this arrangement that enables “The Big Bang Theory” to be a tool of science outreach. The physicists have to learn to communicate with the girl-next-door Penny, and in so doing they gradually expose her to scientific ideas. By explaining it to her, they also explain the science to the audience.

“For people to tune into a sitcom, they have to like the characters,” Saltzberg reiterated throughout his talk and our interview. The fact that “The Big Bang Theory” has become such a hit indicates a shift in the perception of scientists in the popular media; they’re no longer relegated to lab coats (another of Saltzberg’s touches, as he took the writers on lab tours at the University of California, Los Angeles where they saw that none of the physicists wore lab coats) and background characters, but are instead brought to the forefront as the main characters.

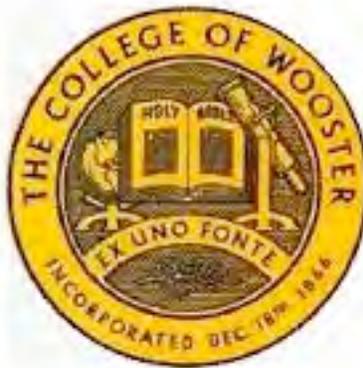
It provides a point of reference for the general audience as to what a physicist is. Saltzberg went on to explain how the four core characters, particularly the leads Sheldon and Leonard, enable the “representation of an inner dialogue by breaking one personality into two characters that can bounce off one



David Saltzberg during our interview.

another” according to the show’s producers. “That’s the way it was explained to me” stated Saltzberg. “Like I said, I’m not a writer,” he’s quick to reiterate, though.

Something the PhysCon audience of students found a bit troubling about “The Big Bang Theory” is its lack of a female physicist (all the main female characters that are scientists are in the life sciences) and the lack of diversity represented. These are valid criticisms, however Saltzberg has no control over the characters or storyline. He urges anyone with concerns about that to contact the writers of the show! It’s something he’d like to see as well, so hopefully we can help convince the producers to introduce a few new characters (there’s 800 of us, we’ve got a shot!).



Physics Congress : A Way to Make Connections

2012 Quadrennial Physics Congress of Sigma Pi Sigma

Orlando, FL November 8-10, 2012

By the College of Wooster SPS Chapter

So how did SPS members of the College of Wooster, hailing from a small liberal arts college in Ohio, end up at one of the largest conferences for undergraduate physics majors? Passion, hard work and organization! We gathered a group of seven diverse physics majors: four seniors, two juniors, and one sophomore, who were all interested in a variety of fields of physics and were extremely committed to attending the Congress. In May, planning began for various aspects of the trip including transportation, lodging, and funding. We were fortunate to receive the SPS Reporter Award, along



Wooster attendees in front of the countdown clock at NASA.

with a vocational grant from the College of Wooster to help with our expenses. The Wednesday before the conference, we hit the road, driving 1009 miles from the small town of Wooster, Ohio to sunny Orlando, Florida.

As a whole, the Congress was compelling for one simple reason: it reminded us of and reinforced our drive to join a professional scientific community. While there, we were able to communicate with many influential people and have productive interactions with other students, scientists, and representatives. Although individually our chapter members may have found one speaker or event more compelling than another, the tours of the NASA research labs stuck out in our minds, making the trip something truly special.

Through the SPS Reporter Award, two of our members were able to take part in a unique behind-the-scenes tour of the research labs at Kennedy Space Center. This tour allowed them to relate to the scientists working there, as attendees were able to hear about current research and have meaningful conversations with specialists. In particular, our members noted an inspirational discussion with Dr. Metzger, the lead research physicist and founder of the Granular Mechanics and Regolith Operations Lab. A simple conversation about a white board drawing made the attendees realize they could see themselves holding a position similar to this man in the future. Dr. Metzger explained that the solar

system drawing on the white board, of planets and moons riddled with icons of outposts and colonies and mining facilities, was simply a doodle he and his colleagues had done during a break in their day of research, something they had done for fun, just a rough “plan” to colonize our solar





Hanging out at PhysCon.

system. It reminded our two members that even once you have a professional job, you don't have to lose your excitement about physics. This particular event is one of many that has motivated members of our group to continue pursuing their interest in physics and has reinvigorated their drive to join the physics and science community.

Meeting Highlight: “Connecting Students with Careers” Workshop

This workshop was led by Roman Czujko, representing the Statistical Research Center at the American Institute of Physics. Before even beginning

the workshop, we were instructed to sit by individuals who did not come from our school. As a result, we found ourselves seated with a mixture of other undergraduate students, graduate students, professors, and other professionals.

Mr. Czujko began the workshop with an overview of the paths physics students take after graduation. For example, he presented charts detailing the number of individuals who pursue the field of engineering versus those who actually enter into a field of physics. He then went on to discuss particular jobs that exist in each of the areas previously shown. Next he presented an overview on tailoring resumes and cover letters for a job in the field of science. Since we are all at a point in our lives where beginning a career is a fast-approaching reality, this workshop proved to be both interesting and beneficial.

For the interactive portion of the workshop we brainstormed skills and qualities of typical physics students. These included things like problem solving abilities, laboratory skills, ability to work as a team member, and modeling/simulation knowledge. We then discussed which of these skills were resume-worthy and how they should be presented in a resume or cover letter for a job in science. This information will be extremely useful for us as we leave the academic world and enter the working world. Each of us will, one day soon, need to apply the knowledge we gained from this workshop either in applying for internship positions, graduate school, or a position in the workforce.

Overall, we felt the Congress was a truly positive experience, we each made memories that will last a lifetime. Hearing the wonderful speakers and having personal conversations with individuals who have accomplished so much really helps us to stay motivated and continue pursuing physics, knowing one day we each may be standing where they are. Much of what we experienced will help us in the future, whether we go directly into the workforce or pursue further learning in graduate school. Wherever our knowledge of physics takes us, it will always be an honor for each one of us to say we participated in the 2012 Quadrennial Physics Congress.

“ As a whole, the Congress was compelling for one simple reason: it reminded us of and reinforced our drive to join a professional scientific community. ”





Highlights of Our PhysCon Trip

2012 Quadrennial Physics Congress of Sigma Pi Sigma

Orlando, FL November 8 – 10, 2012

By the Eastern Michigan University SPS Chapter



Students from Eastern Michigan University in front of the launch pad at NASA's Kennedy Space Center.
Credit: Justin Hodges

Going to the 2012 Quadrennial Physics Congress is something our Society of Physics Students chapter has been talking about for the last four years. However, we are a small chapter with limited funds so we planned several activities to raise money for our trip to Orlando, which included scooping up fun and cool treats at Cold Stone Creamery through a profit-share fundraiser and helping freshman move into the dorms. These activities also helped us increase awareness of SPS on our campus and in the community. Our department and student government greatly helped our fundraising efforts as well.

For those of us who have dreamed of going into space ever since we were young children, visiting NASA's Kennedy Space Center (KSC) was the most exciting part of the 2012 Quadrennial Physics Congress. A few of us were able to go on a special press tour of KSC, which included tours of exciting labs. At the Applied Physics Lab, we were shown a camera capable of imaging air currents, an ultrasonic leak detector, and a vacuum cleaner designed to suck water out of shuttle tiles, among other items. We visited a lab dedicated to the design of a mass spectrometer for the Canadian Space Agency's lunar rover, and heard about the difficulties of designing instrumentation capable of performing the intended task and surviving the harsh realities of space. We visited the Granular Materials and Regolith Operations Lab, where Dr. Phil Metzger told us about his work developing an autonomous mining system and designing methods to build launch pads and roads out of lunar soil.

After the lab tours we set off for launch complex 39A, where Apollo 11 set off for the moon those 43 years ago. We saw the Vehicle Assembly Building, the mobile launch pads, the Crawlerway, and most exciting to us, the landing strip where the shuttle and shuttle carrier landed. As the bus turned the corner to the visitor's center, we saw the tail end of Atlantis peeking coyly out from its new home.

Later that evening, we went to the PhysCon Exhibit where many different organizations and graduate schools provided eager physics students with information on research, graduate, and professional opportunities in fields such as biophysics, astrophysics, medical physics, physics teaching, optics, acoustics, high energy physics, particle physics, and many others. Some tables had games and were raffling prizes. One of our students even got a QR code tattoo on her forehead courtesy of the "SPS Jobs" booth. Getting involved





Students in awe posing with Dr. John Mather (5th from left) and Freeman Dyson (6th from left). Credit: Justin Hodges

in professional societies like those exhibiting at the Congress is a great way to stay connected throughout a physics career.

Following the exhibit hall, we attended the opening plenary talk given by John Grunsfeld. He had never thought about being a physicist until he was assigned to write a biography on Enrico Fermi and his life was forever changed. John Grunsfeld has a PhD in physics and has been on five space shuttle flights. As physicists, one of the most important things we learn is how to troubleshoot, which is also one of the coolest thing Dr. Grunsfeld

spoke to us about while discussing the spacewalks where he upgraded the Hubble Space Telescope. But when you are working on a sensitive space telescope orbiting the Earth with limited resources and time, troubleshooting is a little different than in class. He had to work with NASA to come up with new repair methods while on a spacewalk. Sometimes it is hard to imagine applying what we have learned to the real world, but Dr. Grunsfeld was able to help bridge the gap.

“ Getting involved in professional societies like those exhibiting at the Congress is a great way to stay connected throughout a physics career. ”



Eastern Michigan University students eagerly waiting for Dr. John Grunsfeld to impart some of his wisdom in the first plenary talk, as they show off the cool swag and QR code tattoos from the exhibit hall. Credit: Justin Hodges

The vast size and diversity of the physics community that gathered for PhysCon was surprising. Many of us never thought we would be a part of the 2012 Quadrennial Physics Congress, but attending PhysCon was a wonderful experience that gave us great opportunities to develop and bond with each other, as well as develop ties to other chapters and physics professionals. As one scientist impressed upon us, “Make sure that you are always doing what you love. If you do what you love, the rest will fall into place.”



FLORIDA STATE UNIVERSITY

Student Posters at PhysCon

2012 Quadrennial Physics Congress of Sigma Pi Sigma

Orlando, FL November 8 – 10, 2012

By Ashley Huff, Florida State University

The Society of Physics Students at Florida State University has 50-60 active members, and we sent 19 students to the 2012 Quadrennial Physics Congress. The highlights for us were the tour of NASA's Kennedy Space Center, the workshops, and Jocelyn Bell Burnell's talk on the end of the world.

It is probably very difficult to find a physics major who does not find space fascinating, and it was a real treat for us to see what NASA has been doing since the government shut down the space shuttle program. Those of us on the press tour especially enjoyed touring various labs around Kennedy Space Center. Most of the labs were working on ways to create sustainable environments on other planetary bodies for longer space missions.

The workshops gave students many good tips on being successful physicists. We left the workshops with new ideas to bring back to our department that will hopefully make the department more diverse. Our department does a very good job helping students who want to follow the academia career track; however we do not have a very good system in place for students who want to enter the workforce right after obtaining their bachelor's degree. The workshops inspired us to try to add classes that lean toward applied physics.

Meeting Highlight: Saturday Poster Session

Undergraduate students were able to present their research during one of two poster sessions during the Congress (one on Friday and one on Saturday). All the other conferences I have been to have had only one student poster session, which made it difficult for me to see what my peers were doing if I was also presenting my work. This layout is definitely one I would suggest to other conferences. There were almost 200 posters in total, highlighting research on a wide variety of physics topics. There were posters on condensed matter physics, nuclear physics, high energy physics, astrophysics and outreach programs, to name a few. Here are a few highlights from Saturday's poster session:

Ayrea Hurley from Abilene Christian University

presented a poster about their Society of Physics Students chapter outreach program called *The Physics Community Roadshow*. Each year 10-20 students from their SPS Chapter visit local middle and elementary schools and present 60-90 minute science shows.



Ayrea Hurley from Abilene Christian University and her poster. Credit: Alicia Gomez



They recently acquired a trailer that allows them to take their demonstrations to schools that are farther away so they are hoping to move to schools outside their city. This program is funded through their SPS chapter because they feel that it is a good opportunity for the students to gain teaching experience.

Pragalv Karki from Minnesota State University presented his senior project. For his project, Pragalv created a Helmholtz coil and quantified the magnetic field. He used knowledge he gained from his electricity and magnetism class to employ the Biot-Savart Law to derive the expression for the magnetic induction along the central axis. Pragalv had an error with his setup because the coils were right next to each other, but he fixed this by moving them a distance apart that was equal to the radius of the coil. Pragalv was able to calculate the permeability of free space to within 3.9% error.

Zhicheng Lui traveled all the way from China to attend the Congress with some members

“ There were posters on condensed matter physics, nuclear physics, high energy physics, astrophysics and outreach programs, to name a few. ”

from his SPS chapter.

Zhicheng’s poster talked about SPS chapter activities at Southeast University. During their regular SPS meetings, the students spend the first half of the meeting having an informal

discussion with a professor. Then, for the second half of the meeting, the professor gives a lecture on a topic of their choice. The chapter has also organized an open lecture course at night. They use the MIT free software and lectures to learn electricity and magnetism and linear algebra. There has been a decline in the number of students going to these meetings however, so the chapter is trying to get some feedback about why this happened and fix the problem. Students are also encouraged to read articles from *Science* and *Nature* and present what they have learned to the other students in the chapter. The chapter has set up a special program to help freshman with their calculus skills since these are often lacking when students enter the university. And finally, the chapter has social events where they try to incorporate physics into the food, such as with making liquid nitrogen ice cream.

Marc Doyle from Drexel University presented his work on electron flow in a 2-D semiconductor. During this study his group imaged a three atom thick layer of semiconducting MoS₂, which is similar to graphene. Marc used a scanning electron microscope. The electrons from the microscope cause a current through the material that the camera can image. Marc was able to study the flow of the electrons through the material by studying the dark and light spots on the image, called a current intensity map. In the future Marc plans to add additional layers to the MoS₂

to create a more complete current intensity map.



Zhicheng Lui from Southeast University and his poster. Credit: Alicia Gomez



Pragalv Karki from Minnesota State University and his poster. Credit: Alicia Gomez





Becoming Aware

2012 Quadrennial Physics Congress of Sigma Pi Sigma
Orlando, FL November 8-10, 2012
By Jennifer Rehm, Georgia State University



NASA Kennedy Space Center.

The SPS Chapter at Georgia State University worked very hard to send six of its members to the 2012 Quadrennial Physics Congress, and after bypassing some funding hurdles and booking hotels, the 3-day conference in Orlando, Florida was well worth the effort. The visit to Kennedy Space Center was spectacular, and seeing the famous Vehicle Assembly Building in the distance as we approached seemed to recapture every childhood dream of becoming an astronaut.

The “Connecting Scientists and Science Policy” workshop was a favorite among our group, highlighting the ongoing need for more real scientists to influence Congressional decisions on science policy. Still, the process proved difficult as students were asked to emulate the Congressional budgeting process and agree on cuts to various physics programs in order to adhere to a strict budget. “I have a lot more respect now for the hard decisions about what gets funded and what doesn’t,” says SPS officer Maria Rusert. Other Georgia State favorites included talks by Freeman Dyson, David Saltzberg, and John Grunsfeld, as well as the informative graduate school tables where students could talk to representatives from many graduate programs around the country.

The 2012 Quadrennial Physics Congress had an amazing turnout of physics majors from all across the country. I was impressed to see a much more diverse group of students than I expected swarming through the banquet halls eagerly awaiting talks by Freeman Dyson and Jocelyn Bell Burnell. In fact, I considered one of the workshops, “Connecting Diverse Perspectives in Science,” to be an ultimate highpoint at this gathering of minds, for it encompassed one of the most important issues facing this next generation of physicists.

Dr. James Stith, Vice President Emeritus of the American Institute of Physics, opened the workshop by calling everyone’s bluff: “My experience says that most of you believe the discussion on diversity is something that somebody else needs.” He was absolutely right. I suppose embarking upon change of this caliber instinctively unleashes some sort of denial within all of



us. Dr. Stith named some of the many forms in which this refutation thrives: extreme defensiveness, blaming the victim (i.e. “minorities and women are just too sensitive”), and a pestering request for more data - scientists are great at this. The bias is to be proven without doubt and the data is attacked. “They present a logic which would never be accepted by themselves,” says Stith.

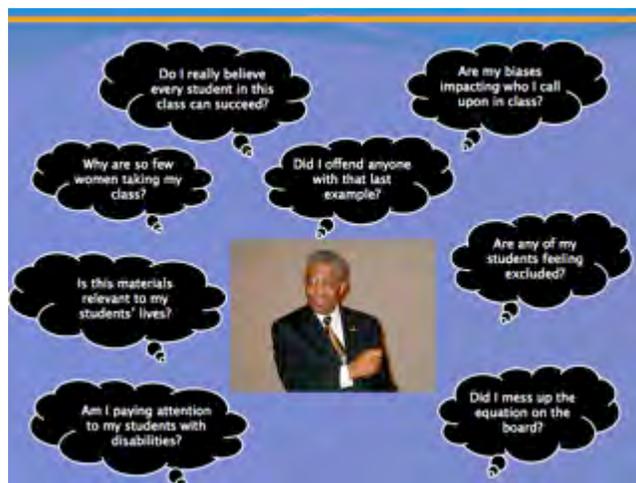
The workshop examined many studies on unconscious bias, and the findings were quite astonishing. During blind, randomized trials, evaluators assigned the exact same job performance a lesser score if told a woman, rather than a man, completed it. Also, the verbal skills were rated lower if told an African-American wrote a text as opposed to a white person. In another study, employers were more likely to hire an applicant if the name on a CV was male. In every study, there was a significant bias due to race or gender, but most interestingly, the race and gender of the evaluator from which the bias came did not play a significant role. Dr. Stith embodied this concept using a story told by one of the great civil rights leaders, Desmond Tutu. Archbishop Tutu boarded a plane in Johannesburg one day and, upon noticing that both of his pilots were black, felt so proud to see the day where this equity was possible. As the plane later hit turbulence, he found himself wishing that his pilots were white. “At that point he realized how damaged he was,” said Stith, “and the amount of work he needed to do in order to become color-blind or gender-blind. The subject of race and gender is systematic in our community. We all show it.” According to Stith, there is also a deflection of sorts that tends to take place when confronted by these statistics: “Not here. It’s like that at some other university, but not mine. It’s like that at some other department, but not mine.”

From the studies highlighted in Dr. Stith’s workshop, some positive solutions were also brought forth. For instance, it was shown that exposing evaluators beforehand to images of successful African-Americans dramatically decreased discrimination, as well as simply asking the selectors not to express any bias. “Just by leaders being proactive and responding to the issue, it’s amazing what can happen,” says Stith.

“ We must all step out of our comfort zones (and our privileges) to solve this great issue together. One that, if untouched, can truly affect the fate of science and the many brilliant minds that are turned away.”

Discrimination in science can take a myriad of forms, whether it involves unconscious prejudice or more overt verbal bullying. Both can accumulate over the course of a career and have severe impacts. In a later interview, Dr. Stith emphasized the importance of discussing diversity among colleagues and the roles all members of a department should take (students and faculty alike) to ensure their environment is growing toward a diverse perspective. “There should be at least one person in every department to whom reports of discrimination can be made;

this should be known by everyone,” says Dr. Stith. If someone is in a position of power or equal footing, they have nothing to lose professionally, they should speak up and empower those that feel powerless. “Not saying something is a way of condoning the behavior. We need to create a culture



A slide from Dr. Stith’s workshop presentation.

of openness. Students and faculty need to have these conversations.”

We must all step out of our comfort zones (and our privileges) to solve this great issue together. One that, if untouched, can truly affect the fate of science and the many brilliant minds that are turned away. There is a vast, valuable, and untapped resource out there waiting to help contribute the next big ideas in science; ideas that will propel us all forward, better and more luminous than we are now.



Grove City College Takes on PhysCon

2012 Quadrennial Physics Congress of Sigma Pi Sigma

Orlando, FL November 8 – 10, 2012

By Matthew Goszewski and David Lewis, Grove City College



Grove City College PhysCon attendees. Credit: Glenn Marsch

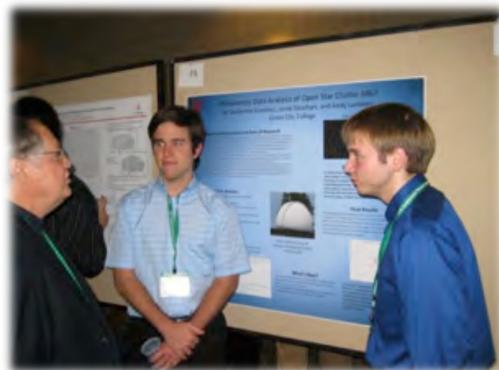
Grove City College (GCC) had a strong presence at the 2012 Physics Congress with 36 people attending, 33 physics students and 3 physics faculty! Over the last four years, our chapter has been eagerly anticipating this year's Congress because current alumni who attended the 2008 Congress shared how exciting and unique that experience was for them. We were excited to not only visit Florida and attend the Congress, but also to simply enjoy the company of other physics majors and continue our college experience off-campus.

rake leaves or do odd jobs in exchange for a donation to the club – this is a surprisingly successful and dependable fundraiser for us. Each year we saved a portion of this income for the Congress, yielding four years' worth of funds to help alleviate the travel expenses for students. In addition to the Rent-A-Student fundraiser, we also received a generous donation supporting the trip from KEYW Corporation, where one of our members interned last summer. The combination of this donation with alumni donations, partial support from the college for the students who were presenting at the meeting, an SPS Chapter Reporter Award, and the results of our annual fundraiser significantly reduced the out-of-pocket costs for our club members. Three members also received funding from outside sources.

PhysCon 2012 afforded numerous opportunities for students to meet and interact with experienced physicists who have established themselves in the scientific community and have gained wisdom regarding the academic pursuit and life in general. The "Breakfast with the Scientists" event where a scientist "hosted" each breakfast table of attendees was one such opportunity.

Dr. Madhi Sanati, associate professor at Texas Tech University, told his table that

The primary fundraiser for our physics club is Rent-A-Student, where members of the club volunteer to go to the homes of professors and community members and



GCC students Andrew Lundeen and Jacob Gearhart present their research poster to Jack Hehn from the American Institute of Physics. Credit: DJ Wagner



undergraduates should enjoy all of their undergraduate courses and not hastily sign up for research during the semester because a strong academic foundation must be established in the undergraduate years. He also advised students to be intelligent in multiple fields and not confined to one exclusively. In addition to the wisdom students could gain from the scientists, it was equally valuable to see the interest that the scientists took in the lives of the students. The breakfast tables provided a level field where everyone took an interest in discussing and learning science.

Another highlight was a talk by Nobel laureate John Mather discussing the history of the universe, the origins of the earth, the foreseeable future for them both, and the experimental research devoted to investigating these topics. Starting with the Cosmic Background Explorer (COBE), he chronologically progressed from the Wilkinson Microwave Anisotropy Probe (WMAP) to the Hubble Space Telescope, and then to the James Webb Space Telescope (JWST). He thoroughly explained the intricate support structure of JWST, the onboard instruments, and launch procedure of the telescope.



Plenary speakers John Mather (left) and Freeman Dyson (right). Credit: Glenn Marsch

“ Our chapter absolutely enjoyed every detail about this year’s Congress – the talks, workshops, meals, and conversations all contributed to a synergistic atmosphere.”

The driving purpose for the JWST is its capacity for capturing the sky in infrared light without distortion from the Earth’s atmosphere. Creating computer simulations of a star’s development and future based only on current images, he said, is like going to a football game and trying to determine the life-story of the fans from a picture taken at only one moment in time. Together, all of these observatories provide additional details about the history of the universe that help us learn the rest of the story.

Throughout his talk, Dr. Mather also shared insightful thoughts from his years of experience, such as “If you do not test it, it will not work,” and “It’s worth working on if it’s impossible.” He also shared that reading, writing, and the art of persuasion are invaluable to him in his career as a scientist. He ended his talk by saying, “We have not come to the end of good ideas.”

John Mather’s talk was just one of many impressive talks that were presented at the Congress. Our chapter absolutely enjoyed every detail about this year’s Congress – the talks, workshops, meals, and conversations all contributed to a synergistic atmosphere. Club member and junior Allen Scheie, recipient of a first-place poster award, said



GCC student Mark Pilarski (right) talks with plenary speaker John Johnson. Credit: DJ Wagner

that it was “an incredible experience, and was by far the best conference [I have] ever attended.” Junior Libby Carbone summed up the student centered environment, “I loved that many of the speakers stayed around for the entirety of the conference so we were able to talk with them in a smaller



group setting.”

Beyond benefitting from the Congress itself, our chapter took advantage of the road trip to form strong bonds of friendship between upper and lower classmen within the physics department. “I am most glad I was able to go” says sophomore Jeremy Smith, “and would certainly go again if given the chance.” To say the least, we are excited for the future classes of physics undergraduates who will be attending the 2016 Physics Congress!



The Grove City College physics club begins the journey home. Credit: DJ Wagner



Idaho State University at PhysCon

2012 Quadrennial Physics Congress of Sigma Pi Sigma
Orlando, FL November 8-10, 2012

By the Idaho State University (ISU) SPS Chapter, with personal accounts by Kevin Rhine and Lwin Htun

Although we came from the other side of the country, we brought many students from Idaho State University (ISU) to the 2012 Quadrennial Physics Congress. We have a great physics department at ISU with students involved in many after class activities. It was amazing to be a part of this world-wide gathering of physicists; we had opportunities to hear talks from some of the leading minds of today, we got a tour of the Kennedy Space Center, and we were also able to get a glimpse of where our lives may take us if we continue to pursue physics.

Having the opportunity to talk with the physicists invited to give talks was amazing, but simply talking to physics students from around the country helped to open our eyes to the larger physics community. Many students, including several of our own, had the opportunity to present some of their research as well as look at what other students have been studying. The flights, the meals, the swimming, the motels, the talks, the workshops, the tour, and many other aspects of these incredible three days will be etched into our minds for many years to come, motivating us to continue working hard in school, pursuing our interests, having our fun, and expanding our minds. Many of us will certainly be attending more PhysCons in the future.

Account I: NASA a Place for Problem Solvers

By Kevin Rhine, Idaho State University

On November 8, 2012, roughly 800 physics students from all over the US enjoyed an unforgettable tour of the Kennedy Space Center as part of the 2012 Quadrennial Physics Congress. I found myself fortunate enough to be among these students, observing facilities and technologies involved in America's fascinating journey in space exploration. Better yet, I was one of around 40 of the individuals who received a more in-depth tour, complete with presentations from several NASA scientists.

As a child, I frequently heard about the achievements of our impressive space program, but found it difficult to imagine what was really involved aside from sending rockets beyond our atmosphere. However, after seeing it for myself, it all seems quite clear. NASA is a place for problem solvers. The reach of this organization is not only into the sky, but deep into the community. An extremely enjoyable and informative demonstration was given by a man whose decades-old job

was to find solutions to problems for which other NASA departments were not specialized. An example of one such problem stemmed from the need to closely examine a shuttle, the liquid fuel tank, and the solid rocket boosters pre-launch. If a blemish was discovered its severity could be



related to its size, but the size is difficult to measure on such a large structure from the ground. The solution our presenter came up with was to mount two laser pointers a fixed distance apart within a box such that their beams would be parallel. This box could be mounted on a camera, allowing a photographer to document any faults from the ground with two pinpoint laser dots to provide a sizing scale. This simple solution ended up solving issues beyond space exploration, and is now being used in areas such as crime scene investigations.



A NASA scientist explaining his work to SPS Reporters.

During another presentation we learned about a technology being developed that could clear sand and dust from a glass pane without the use of mechanical wipers, by embedding nearly invisible electrodes in the glass that would use electromagnetic waves to disperse the pesky particles. This would be especially useful for a camera on a rover exploring a planet with little or no atmosphere where dust interacts with other matter in ways it doesn't here on Earth. With a little more development this could be a technology used in vehicles and eyewear.

We also learned about a problem that arises in the pursuit of efficient lunar mining, where the low-gravity environment makes a normal dozer or drill design impractical, because the drill would need to be light enough to reach the moon, yet heavy enough to perform the task it was sent there for. The solution being developed is a lunar tractor that can lower counter-rotary drilling buckets at both ends, lifting the entire machine up so that all of its weight goes into the drilling process, rather than just some fraction. On earth, we can make tractors as big and heavy as needed, however this brute-force approach is not necessarily cost efficient. Also, due to buoyancy underwater robotic drilling can result in some of the same problems as in the lunar situation.

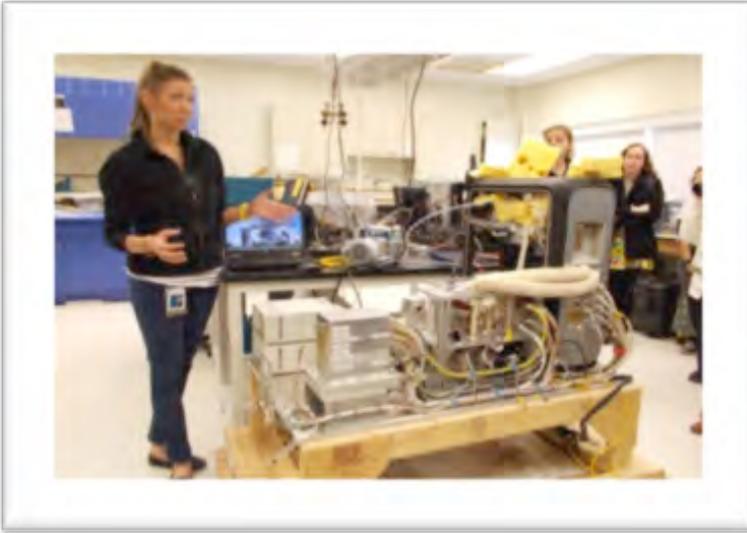
When asked what I took away from this trip to Florida, the list is far from short. But one of the most important items on that list is a renewed sense of clarity and motivation in the problems I sometimes face in my own life. In fact, during the final night of the conference, a friend and I found ourselves stuck in the sand in a rented jeep, without 4-wheel drive. After several hours of digging, lifting, and experimenting with various makeshift wooden ramps and levers, we might have lost morale. Fortunately, we were able to work with determination and deliberate thought inspired by the NASA scientists who spoke to us, and resolved our problem. To many, the technologies that come out of the NASA space program are indistinguishable from magic. To me, they are simply accumulations of concepts and applications we already have, constructed by people not much different from myself, and held together by ingenuity.

Account II: My PhysCon Experience

By Lwin Htun, Idaho State University

Though I am majoring in civil engineering at Idaho State University, my other passions are physics and astrophysics. When I heard about the Quadrennial Physics Congress, I was very excited and of course took the opportunity to go! I was informed that any school-related funding would be awarded to physics majors first, but I was not going to let that stop me. I decided that I would fund myself if necessary. Then I was





One of the scientists explaining the RESOLVE Project.

offered the opportunity to be an SPS Reporter at the meeting and I accepted gladly.

The trip to Florida was quite exciting for fellow student Brady Lowe and me, who traveled together. We took a red eye flight on Tuesday so we could spend time exploring the Orlando area before the meeting started on Thursday. Before our flight took off, a nervous passenger “lost her cookies” and delayed our flight a bit, and as we were ascending the gentleman sitting next to Brady started losing his cookies as well. The flight attendants had to make an announcement looking for a doctor on board. But besides the “losing of

the cookies” of those unfortunate people, the rest of our journey to Florida was quite pleasant. We landed in Orlando at about 9 am and rented a car to go sightseeing for the day while we waited for the rest of our chapter members to arrive in Florida.

On Thursday, two of my chapter members and I were on the designated bus for SPS Reporters, and we received an extended tour of the Kennedy Space Center that included presentations from NASA scientists. One project that really interested me was the RESOLVE Project (Regolith and Environment Science and Oxygen and Lunar Volatiles Extraction). The team is working on obtaining ‘ground truth’ to confirm the presence of hydrogen on the moon. NASA is developing a part for a rover that will analyze drilled moon content for the presence of hydrogen. Many other partners are involved in developing different parts for the rover. It’s amazing how different teams from different locations can work on the same project and make everything come together perfectly.



Dr. Freeman Dyson during his plenary talk. Credit: Ken Cole



Dr. John Johnson during his plenary talk. Credit: Ken Cole

The tour of the Kennedy Space Center was the highlight of my trip. However, the rest of the Congress was very interesting as well. I enjoyed Dr. Freeman Dyson’s talk and a compelling story that he told about Richard Feynman. Dr. Dyson told about a time when Richard Feynman took off into the woods with his suitcase because he did not like the hotel where they were supposed to stay for a meeting. As Dr. Dyson put it, he then returned in the morning, “Looking satisfied with himself.”

I also enjoyed Dr. John Johnson’s talk about tracking exo-planets around distant stars and some of the different

methods used to locate these exo-planets. Other speakers were John Grunsfeld, John Mather, Dan Green, Mercedes Richards, David Saltzberg and Jocelyn Bell Burnell.

The Congress also included several workshops. The one I most enjoyed was “Connecting Science and Technology,” where I learned about different types of technologies and new technologies being developed. There was an activity where small groups of attendees were challenged to use smartphones to predict what was in different boxes without actually opening them. I came out of the workshop wanting to learn more about new technologies on my own.





MARQUETTE
UNIVERSITY

The Need for Science Outreach in the Community

2012 Quadrennial Physics Congress of Sigma Pi Sigma

Orlando, FL November 8 – 10, 2012

By the Marquette University SPS Chapter

Due to the small size of Marquette University's physics department, we are a fairly close group. Sharing a common workspace stimulates cooperation and student involvement. This year, as we were struggling to pull together enough funding to attend the Quadrennial Physics Congress of Sigma Pi Sigma, we entered the *Radiations* magazine crossword drawing. After working together on some of the tougher clues and with a stroke of luck, we won a \$1000 physics crossword challenge offered by Dr. Diane Jacobs, a past president of Sigma Pi Sigma, to support chapter attendance at PhysCon. With her contribution and an SPS Chapter Reporter Award, we were able to pull together the rest of the funding required to send six students to the meeting.



Marquette students with Dr. Jocelyn Bell Burnell after her plenary talk "Reflections on the Predicted End of the World in December 2012." (L-R) Mike Nichols, Abigail Searfoss, Dr. Bell Burnell, Kyle Kimminau, and Justin Provance.

Throughout the Congress, it became increasingly obvious that SPS has an extremely cohesive, encouraging, and helpful group of leaders, members, and volunteers. For example, during a workshop activity we were given a scenario in which each group had to decide how to implement cuts to the federal science budget. Despite the groups being composed of a variety of ages and backgrounds, many of the groups were able to reasonably discuss and come to some kind of an agreement on which cuts would be the most logical. Volunteer "Workshop Wizards" aided the few groups that struggled to come to a conclusion, and in the end believed that given more time the groups would have arrived at a consensus. Looking at society as a whole, and especially considering governmental bodies, this level of collaboration and compromise is atypical, yet throughout the conference this was commonplace. With the positive meshing of the attendees' scientific backgrounds and the cordial attitude of the conference, this made for a pleasant experience.

During the Congress, we appreciated how much effort SPS put into making participation in the Congress both enjoyable and helpful. Each of the scientists that participated was exceptionally involved and made it a priority to provide the students with useful and relatable information. During "Breakfast with the Scientists," the undergraduate and





Kyle Kimminau and Wei Wu with the whole universe in their hands at Kennedy Space Center.

graduate students ate at tables hosted by professional scientists, which opened us up to many career paths we had not considered. For example, as a result of this breakfast one of our members is now looking into the possibility of an internship at the Department of Intelligence.

Other volunteers led workshops to help us prepare for the workforce and engage in public outreach. A favorite workshop among our group was led by Henry Reich, creator of “MinutePhysics”, a series of YouTube videos that discuss physics topics. In one exercise, we were given the challenge to describe a pencil in five words. It reminded us that we do not fully understand a concept until we can explain it simply to someone else.

After seeing the effort put toward bringing so many undergrads together and the positive outcomes from this, our chapter decided we need to be more active in outreach. In his workshop, Dr. Gary White provided insight into fun projects that are easy for SPS chapters to bring into schools in their local communities. In particular, his suggested model for the warping of space time seemed to attract a large amount of interest, no doubt due to its use of spandex. Dr. White’s presentation and learning about the diversity of outreach programs at other schools has compelled our club at Marquette University to grow in this area of service. Furthermore, once these experiments and demonstrations are initially constructed, they can last for years, ensuring that the next wave of SPS students has the material and lesson plans to continue the outreach activities.

As a spectacular finish to the Congress, Dr. Jocelyn Bell Burnell discussed the most popular theories for the end of the world in her plenary talk, “Reflections on the Predicted End of the World in December 2012.” While she presented the myriad of 2012 scenarios, the room was often filled with laughter. Many of the theories violated the laws of physics so absurdly that it was hard to believe anyone could take them to be possible. For example, one theory was that the magnetic poles of Earth would switch, causing the planet to come to a complete stop and reverse its rotation about its axis. Dr. Bell Burnell’s initial response to this was: How do you even stop the Earth from spinning, without inventing a god or something like that? Another theory claimed that an alignment of the planets would cause a gravitational pull on the earth strong enough to rip the planet in half. In response, a student sarcastically remarked, “That’s totally how gravity works.” The audience was rather pleased with Dr. Bell Burnell’s analysis of current 2012 theories, however the unfortunate fact is that a large number of people actually

“ It is our duty as a scientific community to reach out and aid in providing a stronger foundation of public education. ”

believe these developments could happen. While quite amusing to a room full of physicists, it was also a clear and frightening statement about the lack of scientific understanding in our society.

One point Dr. Bell Burnell made was that most of these ridiculous theories are actually grounded in some scientific fact. Clearly people are misconstruing scientific knowledge and arriving at impossible conclusions. Nonetheless, the point is that people are trying to use science to understand the world. Therefore, if all scientific programs put more effort into bettering the scientific education of the general public, people could better discern scientific truth from fiction, mitigating beliefs in such impossible theories. It is our duty as a scientific community to

reach out and aid in providing a stronger foundation of public education.

Throughout the conference, one theme surfaced repeatedly in almost every lecture and workshop. Outreach to the public is crucial for the mutual advancement of physics and the general population. Education and outreach are means by which we can spread scientific interest and ensure that the field prospers in the years to come. An informed public is less likely to cut spending on a program when they can grasp the long-term effects that may arise from it. As Dr. Bell Burnell indicated, when scientific education is not encouraged in schools, we raise a population that is scientifically illiterate and cannot distinguish between reliable information and false premises presented under the guise of scientific fact. This in turn circles back around to hurt the scientific community, for when persons masquerading as true scientists make such outlandish claims others shy away from the field. The credibility of real science is hurt and the literacy of the public continues to drop.

Outreach is an obvious solution. If the physics community begins attracting students at a young age and can keep them interested, we will not only attract new faces but also begin a trend that can spread through more outreach, education, and the students themselves. Even as we attempt to unravel the universe, it is evident that we have a long way to go, and to ensure that our goals do not die with us is to bring in a new wave of minds, curious and interested in the same phenomena that intrigue us. Therefore, we must step out of our offices, classrooms, and laboratories in order to share our work and scientific interests with not only our peers in the field but with the general public.





Stories from the Stockton College PhysCon Trip

2012 Quadrennial Physics Congress of Sigma Pi Sigma

Orlando, FL November 8 – 10, 2012

By the Richard Stockton College of New Jersey SPS chapter

HOW WE GOT THERE

MIA'S PERSPECTIVE

Eight of my fellow physics students and I had to travel quite a distance to attend the Congress. Our trip was only partially funded by our college, so we chose to travel by train and bus to save money. This meant that we had a twenty hour train ride to Florida and a twenty-four hour bus ride home. On the way to Florida, we barely slept because of the excitement and anticipation of the Congress. We played cards and chess, watched movies, and some of us studied for the physics GRE.

Hurricane Sandy had just hit our homes in New Jersey before we left, so the beautiful weather in Florida was a welcome sight. Unfortunately, two of our classmates did miss the Congress because of the hurricane. I am really glad that I did not miss the Congress; I knew that I wanted to attend from the first time I heard about it from our SPS chapter president, Jen. The impressive list of speakers at the Congress was my initial reason for deciding to attend. Then some of my classmates decide to present their research and I thought it would be a great opportunity to discover what other students were researching. I would have attended the Congress whether or not there was a tour of NASA's Kennedy Space Center, but it was definitely a very exciting part of the whole Congress.



Stockton College students at PhysCon.

CHRIS'S PERSPECTIVE

It's another late night study session, and the squeak of markers on a white board gives the evening a familiar feel. I sit across a table from my friend and fellow college senior, Roy, working through a set of practice problems. This time, I do most of the talking, explaining the thought experiment of Newton's Cannon. As I do, a young boy walks past, pretending not to stare at us. The train jolts and he instinctively reaches out to steady himself. Roy laughs as Newton's cannonball leaves its orderly orbit and traces out an erratic path toward deep space, outlined in the green marker that I've just lost control of. In our twenty hour train



ride from New Jersey to Florida, Roy and I remained a fixture at that table in the dining car, drawing diagrams and stares alike. On that Florida-bound train Roy and I were looking forward, not only to the conference itself, but to the Physics Graduate Record Examination (PGRE).

Our journey, unusual in the eyes of the other passengers on that train, was only one of dozens just like it for students from across the country. Among the hundreds of physics students traveling to Florida last November were a number of students like Roy and me, senior students looking to our future. Roy and I both desire a PhD in physics, and for that we needed to take the PGRE on November 10th. Of course, we couldn't let an exam stop us from attending the Quadrennial Physics Congress, so we, like so many others, decided to simply take the exam in Florida.

ROY'S PERSPECTIVE

Our SPS chapter comes from a medium-sized liberal arts school near Atlantic City, NJ. As far as we know, our participation in PhysCon was the first such event organized in our chapter's history. Recent history, anyway. This is largely (actually, almost entirely) due to the dedication and determination of our chapter president Jen Allen. Jen spent much of her time during the summer organizing our trip and making sure every detail of the arrangements was covered. She worked very hard to secure funding from the Student Senate of Stockton College and kicked-off what all of our members know as the first "Physics Club (Galactic-Themed) Bake Sale." Stockton College and its SPS chapter would not have been represented at this Quadrennial Congress if its president hadn't taken the bull by the horns in the way that she did.

For most of the members, the trip started out at the Egg Harbor Train Station. From there it was a pleasant hour's ride to Philadelphia and then 1600 km after that: Orlando, Florida. To spare the details between would be a tremendous oversight. Two of our senior members (Chris Bailey and myself) worked it out to take the PGRE in Florida a day or two after we arrived. The choice to do this boiled down to either attend the conference, or miss out; either study for an additional month, or be ready in October. So Chris and I decided to schedule the exam for November, in the sunshine state.

As you might imagine, there was little time spent by Chris and I on this trek that did not include: (1) studying for the exam, (2) freaking out about the exam, (3) FREAKING OUT about the exam. No time was wasted. We studied on the train ride to Orlando going over practice exams and quizzing each other on equations, concepts, and strategies. When we finally got to Orlando (some 24 hours later) we checked in to the Caribe Royal, checked into the conference, set our belongings down in our room, got some food, and then continued studying.



Physics on the train.

MEETING HIGHLIGHTS



MIA'S PERSPECTIVE

I knew that other physics students were going to be at the Congress, but I did not realize what a great opportunity it

would be for connecting with my peers from all over the country. During the NASA tour, I met a group of physics students from Minnesota. We had a lot of fun talking about our favorite physics professors and the long trips we had getting to Florida. I did not see them as much during the rest of the Congress, but I did sit with them for a few of the talks and I really enjoyed getting to know them.

On the other hand, the Congress was also a great place to really get to know my fellow classmates from Stockton College. Six days can be a very long time to spend with certain people; luckily, we did not have any problems within our group. We actually had a lovely time cooking breakfast and dinner together a few of the days. The other meals we attended at the Congress and all the food was delicious. I recommend, however, that the hotel stop using butter patties that look like seashells because one of my classmates accidentally ate the butter thinking that it was white chocolate. We were laughing about it all weekend.

The biggest highlight of the Congress was hearing Freeman Dyson speak. He is a very captivating storyteller and it was a huge honor to listen to him. My classmates and I got Freeman Dyson to sign a Congress shirt for our physics professor. He was unable to attend the Congress and Freeman Dyson is one of his role models. Our professor was astonished when we gave him the shirt.



“Of course, the PGRE took back seat to NASA. I mean, come on, it’s NASA.” -Roy

JARED’S PERSPECTIVE

The speakers were a major factor in our attendance, namely Mr. Freeman Dyson. When he signed a PhysCon t-shirt for us, I felt like I was in the presence of a rock star. Mr. Dyson’s open discussion on his life and work was inspiring, and after a couple of stories about his adventures with Richard Feynman, everyone hoped his talk would never end. The other talks were fascinating too. A lunch talk given by Dr. David Saltzberg about his role in the popular television sitcom “The Big Bang Theory” sparked my interest in outreach to the public. This came up again when I tracked down “MinutePhysics” creator Henry Reich after his workshop about engaging the public and discussed physics and mathematics education with him. Reich said that he tries to do topics not typically taught by the core curriculum, as “the typical curriculum is boring.”



Stockton College student Jovian Yoh with his poster at PhysCon.



The other workshops were also worthwhile, particularly the budgeting exercise where we had to debate which science programs should suffer funding cuts in order to attain an overall 8% cut. Instantly, a debate over the importance of each research field and its projects ensued, but in the end there was nearly a consensus over which programs to reduce.

The PhysCon Exhibit featured programs as diverse as they were interesting. All types of graduate programs were represented, from physics education to applied physics to theoretical and computational work. I learned a lot about what to expect when conducting original research, including the fact that it is normal to learn about a topic primarily while doing research on that topic.

ROY'S PERSPECTIVE

Visiting Kennedy Space Center was definitely one of the highlights of the trip. Our Stockton College group split into different subgroups, but we all shared an awesome experience. Some of us chose to spend time in the Rocket Garden, while others chose to spend their time in the IMAX theater. Of course, the PGRE took back seat to NASA. I mean, come on, it's NASA.

Even though Chris and I attended each session with at least a legal pad and a practice test, our attention was always captured by the excellent speakers and workshops. One that I know had an impact on our chapter was the "Connecting Scientists & Science Policy" workshop. Even today I recount the information gleaned there in conversations about NASA and science funding.

Although Chris and I missed Freeman Dyson, David Saltzberg, and Henry Reich on account of our PGRE, the rest of our group took no shame in telling us how awesome the talks were by these esteemed scientists.

A few of us also presented posters on our undergraduate research. Jen and I presented a poster on atmospheric research and traded off explaining it to passers-by. Another Stockton College student, Jovian Yoh, presented his poster on more efficient automotive power. We met previous SPS National Council presidents and some famous scientists, and fostered a few new friendships with the physics students around us.

“ I learned a great deal from the speakers at the conference, but it was this sense of solidarity and friendship that truly made it a valuable trip. ”

CLOSING THOUGHTS

MIA'S PERSPECTIVE

The Congress was an invaluable experience that I will fondly remember for the rest of my life. I highly recommend attending the event to anyone interested in physics. The events of the Congress were extremely well planned and the interaction with other physics students encouraged us to learn more about physics. Also, the Congress really gives physics students access to the different paths and resources available to them.

JARED'S PERSPECTIVE

The conference gave me the chance to meet some very interesting people, notably a group of students from Tennessee. I spent a great deal of time with people I met at the conference (partly because our time was limited, but mostly because I had an over twenty hour train ride to Florida with



my schoolmates.) I hope to see my group of new friends at future conferences such as the American Physical Society meeting in March, or perhaps even graduate school.

Overall, the Congress was well worth the time and missing classes. After learning about astrophysics and particle physics and meeting new companions, one is left satisfied, but with a burning desire to meet other physics students and physicists and attend future conferences (hopefully sooner than four years from now!). If you can spare a week away from the books, I highly recommend attending the next PhysCon.

CHRIS'S PERSPECTIVE

Like other students, we absorbed riveting talks and attended some very informative poster sessions. Like others, we thoroughly enjoyed a guided bus tour of NASA's Kennedy Space Center and met friendly faces from across the country. We discussed the U.S. national budget with students from China and spoke with representatives of schools and labs across the country. But unlike most, Roy and I spent our nights with books and a whiteboard, grabbing last minute study time alongside seniors from Virginia, New York and California. On the morning of the tenth, we arrived at the University of Central Florida to see a flood of familiar faces, others from the conference who would take the PGRE alongside us. For me, it was a unique experience, for underneath the already stimulating conference, I found camaraderie among a select few. I learned a great deal from the speakers at the conference, but it was this sense of solidarity and friendship that truly made it a valuable trip. On the long ride back to New Jersey I couldn't help but wish luck to all the others I met in Florida who would be applying to graduate programs in the coming months.

ROY'S PERSPECTIVE

All in all, the entire experience was excellent, and I know of no person in our chapter that disagrees.

PhysCon Report

2012 Quadrennial Physics Congress of Sigma Pi Sigma
Orlando, FL November 8-10, 2012
By the Roberts Wesleyan College (RWC) SPS Chapter



Figure 1: Fundraising physics games at RWC Homecoming. The dunk tank and the marshmallow shootout were two of the most popular games. Photo courtesy of the RWC SPS chapter

Though our SPS chapter at Roberts Wesleyan College in Rochester, NY was inaugurated in 2009, we are just getting started making our way into the SPS community. This year we have a renewed interest in SPS and the ambitions of our members have driven us to seek out new ways to get involved. We saw PhysCon as an opportunity to network with physics majors, alumni and scientists that we would never have otherwise had the opportunity to meet. Having set our sights on the goal of getting seven SPS students from Rochester, NY to Orlando, FL for PhysCon, we began to brainstorm ways to raise the much needed funds. We received a startup donation from a very generous alumnus, and we continued

our efforts at homecoming with games, challenges and demonstrations.

We set up a variety of physics games for people to play, including a projectile-motion dunk tank, stocked with SPS members and professors who were willing to donate their time to the cause (Figure 1). Though it was cold that day, three professors and a resident director were willing to take the “polar plunge” with us and it certainly paid off. We also did some fun physics demonstrations and generated interest in our physics program and SPS, which will hopefully keep our chapter alive as some of us move on to the next phase of our education. In the end, through generous donations and our fundraising efforts we were able to bring the cost down to a reasonable level and our excitement about the trip grew.

The day finally came for us to leave and we boarded the plane with our SPS advisor to

make the 1200 mile trek to Orlando, FL. Filled with anticipation, we looked forward to all of the events that were planned for us, especially the trip to the Kennedy Space Center. For the two of us that were able to go on a press tour, the most amazing part of the entire trip had to

be the tours of the labs at NASA. It was exciting to see how physics can be applied in such incredibly interesting ways. The lab that stood out most was the engineering lab that housed much of the equipment dealing with regolith technology (Figure 2). The materials testing department that deals with creating possible Lunar and Martian landing pads was quite impressive. The scientists and engineers in both the engineering and applied physics labs showed us just how much



Figure 2: Inside the engineering lab at NASA, we take a close look at the lunar regolith mining machine. Photo courtesy of the RWC SPS chapter

can be accomplished through science and technology. Whether it was detecting gas leaks using a schlieren scope, cleaning dust via magnetic fields created by running current through carbon nanotubing, or mining the regolith of the moon with a mobile mining robot it was exciting to see that the possibilities of science are virtually endless. NASA is continually innovating and pressing the boundaries in science, and it was motivating for students to see what kinds of exciting things can be yielded from a hard earned education in physics.

As the conference went on, we enjoyed the talks and workshops and were inspired by all of the amazing things that physicists have done. We only hope that someday we can contribute to the physics community in equally important ways. The closing ceremony was undoubtedly the culmination of the conference; it was a time of celebration and thankfulness for being able to gather as a scientific community and learn from each other. Awards were given to the top five posters and art submissions, and as their owners walked up we could see many people nodding their heads as they clapped, remembering how impressed and intrigued they were by the awardee's work. As a group we were very glad to have the opportunity to present our research because it

“The scientists and engineers in both the engineering and applied physics labs showed us just how much can be accomplished through science and technology.”

allowed us to make others aware of our work as well as to get feedback.

Besides the speakers, an incredible number of people were thanked for their efforts and contributions towards

the conference, without whom the event would have been mediocre at best. We were aware that PhysCon was a large and thoroughly planned production, but hearing all the names of the people who made it happen caused us to feel even more grateful for our experience. Judging by the frequent and enthusiastic applause that filled the room, it was obvious that the other eight hundred conference attendees felt the same appreciation we did.

As a group we are very thankful for the opportunity to be able to attend the Congress. We grew closer as a chapter, and were encouraged to continue pursuing the study of physics in its various forms. Overall, it was a privilege to be part of PhysCon 2012. We hope that those that

come after us will follow in our footsteps and be part of the 2016 PhysCon in San Jose.





PhysCon Challenges, Opportunities, and Inspiration

2012 Quadrennial Physics Congress of Sigma Pi Sigma

Orlando, FL November 8 – 10, 2012

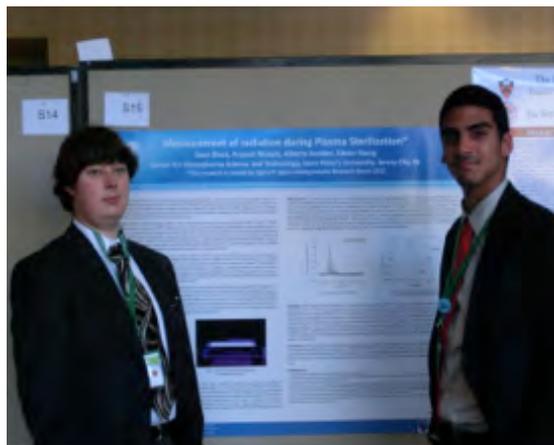
By Prajwal Niraula, Sean Block, Alberto Bodden, and Edwin Young, Saint Peter's University

Getting to the Congress

We could feel the excitement as PhysCon 2012 drew near. Yet, we were afraid that we might not be able to make it. We had various hurdles to face; most serious was the financial. Traveling from New Jersey to Florida was proving to be expensive, and missing the classes on top of that was an added sacrifice. Yet we were all excited. It was the opportunity of a lifetime, and we were hoping for things to happen. The first rays of hope came with an SPS Chapter Reporter Award, which would help us cover some major expenses, and it gave us encouragement to look for other financial resources. Our university generously covered the remaining transportation expenses, and we covered the rest of the meeting expenses personally.

After registering, we started to work with reinvigorated strength on the experiment that we wanted to present at the PhysCon poster session and our art contest entry. The art contest entry was a picture of a plasma plume, and we took many images because the more pictures we took, the greater the probability that we would capture something interesting.

Just the week before our trip, hurricane Sandy struck the Northeast coast. We had been working on our experiment and had just gotten results the week before, but still had to prepare the poster. However, after Sandy struck we did not have power for a week, and our university was closed. Fortunately for us, we still had one day to work on our poster and picture. The day the college reopened we were on our way to Florida. Even that day, it was snowing heavily. Our flight was the last one to leave the airport; all the following flights were cancelled. When we left the ground, we knew we had crossed our last hurdle. We were flying to Florida.



St. Peter's SPS Treasurer Sean Block (L) and President Alberto Bodden (R) during the poster session. Credit: Edwin Young

Meeting Highlight: The Friday Poster Session

There were a number of fantastic speakers and events at PhysCon, including lectures from renowned scientists. The Kennedy Space Center tour was also a once-in-a-lifetime event. However, one of the more noteworthy sessions was



actually the session that wasn't so renowned and exclusive, or at least is not usually considered to be. On Friday afternoon, many of the conference-goers tacked up large posters detailing their research to share with attendees. Artists also set up their work, several images and photographs commemorating physics concepts, theories, and subjects of experiments. Though such an event seems ordinary and simple, something you can see in any collegiate-level conference, and might even seem boring compared to a talk from an astronaut, in truth it was far from that. If anything, it was possibly the most valuable part of the conference for us as students.

We had our own research to present in a poster session – but our session was on Saturday, leaving us free to walk through the exhibits and examine the work of other students on Friday. What impressed us most about the exhibits wasn't necessarily the people speaking, or even specifically what they had done, but the fact that they had been able to accomplish this work as students. This is evidence of what we, students, can accomplish, what we are capable of, and what we can look forward to in our future careers. Many students presented research done through the physics departments at their respective institutions. It's amazing to see the technology that some institutions have, and what research can be performed there. Several presentations covered not just the results, but the applications and importance of the research, and covered issues that were being looked at by NASA, the Department of Energy, and other prominent research groups. Through events like these, students can get new ideas, new directions, and a stronger drive to contribute. They can also hear about institutions that may have work in which they would be interested in participating.

There were a wide variety of projects presented: Research on astrophysics involving optical examinations of spectral emissions from stars, medical and biophysics research on how to determine the proper dosage of medicine for patients, mechanical research on new technology and devices for private and public use, and even research into the physics learning process... The list goes on, and varied with the next day's poster session. The presenters were comfortable and eager to explain the research they had accomplished, and were even able to anticipate future considerations and research that might be needed, as well as snags that could occur.

If there is any take-home message from this session, it is that students are capable of great things, and should be encouraged to pursue these opportunities. This research is a taste of what we can expect in the future, as these students become fully-qualified scientists. Sessions like this are also critical in stressing the importance of maintaining educational research opportunities, both by supporting research at individual institutions and by offering internships through external research groups. In a Congress that covered a fascinating wealth of information about past advancements, it was this session that demonstrated hope for the future. It was this session that reminded us that it is our time to step forward, and reaffirmed what is yet to come.



St. Peter's students (L-R) Prajwal Niraula, Edwin Young, and Sean Block with Freeman Dyson (front). Credit: Alberto Bolden

Other Highlights of the Conference

The members of our chapter were eager to meet people from other organizations and schools.



One of the main worries that we, undergraduate students, have is deciding what exactly to do with our lives after graduating from college. Especially now that the economy is not the best, we ask ourselves whether we should go straight to graduate school or if we should just find a job and start a career. At the PhysCon Exhibit, our chapter was given the

opportunity to talk to representatives from organizations and schools, allowing us to interact with them face-to-face. Also, we had the chance to contemplate the many career paths that are available to physics majors for becoming successful professionals in the future. One of these options is a career in education, specifically teaching.

At the exhibit, various organizations such as Teach for America and the American Association of Physics Teachers (AAPT) shared with attendees the great demand our nation has for science teachers. The teaching organizations also emphasized how the United States needs to create more scientists and mathematicians to lead a technological revolution, which would benefit the country and its economy. This change in our society has to start in the classrooms of schools, where the next generation of Americans start to show interest in subjects such as physics, mathematics, and the arts. By having a degree in physics, not only are we able to take advantage of this need and start a teaching career right after graduation, but we can also influence the future great minds of our nation.

The exhibit also provided our Society of Physics Students chapter with an opportunity to interact with graduate school representatives. At the event there were well-known institutions, such as the University of Pennsylvania, Massachusetts Institute of Technology, and the University of Central Florida. There were representatives from graduate programs in fields ranging from optics to atomic physics. We were able to compare and contrast institutions according to the programs they offer, and therefore have a better idea which institutions to look into for graduate school.

Feedback from Chapter Participants

For a small physics department like ours, the conference provided a great opportunity for networking. Many of the other young aspiring physicists were more than happy to exchange information with us. There were also many students from different countries who widened the threads of networking. International students helped to alleviate some of the fears our members had about studying abroad. A new member in our chapter, Edwin Young, took advantage of the opportunity to make international friends, and was particularly excited about this. He collected contact information for most of the people he met. “Wow! I made friends with students all the way from China. I never thought I’d make friends who live that far away,” he said. He added, “They were all unexpectedly nice. They even offered for me to come and stay with them for a while whenever I visited China.”

Never in our lives have we met so many people who shared the same interest as us. We were in awe and didn’t know who to talk to first and what to talk about first. The sense of knowing that there are others who have the same goals and problems made us feel connected with all SPS students, even those from different parts of the country or world. Our chapter really appreciates the love and support we received from SPS. Attending the conference for us was like meeting a long lost family. The love, support and friends that we made during the conference will last with us forever.

“ The sense of knowing that there are others who have the same goals and problems made us feel connected with all SPS students, even those from different parts of the country or world. ”





The UCF Quadrennial Physics Congress Experience

2012 Quadrennial Physics Congress of Sigma Pi Sigma

Orlando, FL November 8 – 10, 2012

By Brett Barin, Christopher Frye, Evelyn Strunk, and Christopher Tiller, University of Central Florida

How excited we all were at the University of Central Florida to find out that this Quadrennial Physics Congress would be just thirty minutes away in Orlando! For this reason, twenty-three of our members were able to attend. We all struggled through the grueling process of applying for student government funding to cover our registration fees, but we came out successful, ready to enjoy an exciting physics conference.

The first day of the conference we enjoyed a trip to NASA's Kennedy Space Center. Though the majority of our group have been central Floridians our entire lives, this was the first NASA tour for many of us. Those of us on the press bus actually got to see the inner workings of NASA. We toured several labs, listening to scientists explain each individual project to us. Something became apparent after moving through all of the tours: the group of employees at NASA is akin to an "assembly line", where everyone has a different expertise, and each scientist is working within that particular expertise to make a single, perfect component. A perfect component that will, of course, eventually be put towards the final product.

“ Those of us on the press bus actually got to see the inner workings of NASA. ”

Friday morning, many from our group participated in the workshop on connecting scientists and science policy at the federal level, which focused on general and fiscal management. The given scenario was that under the Budget Control Act of 2011, all non-defense programs (yes, including science) would have to be cut by 8 percent in 2013. We, as a group, had to figure out what we could do to get that 8 percent. There were no real limitations on where or how we could cut that funding; we just had to cut it. It sounded simple enough, until we realized we only had twenty (taken down from thirty, originally) minutes to make a decision.

As it turns out, being pressed for time makes all the difference. We had a substantial amount of information directly in front of us, essentially the "Cliff's Notes" for each program: what they do, how important they are/potentially can be, and a further breakdown of each individual program's budget requests. Yet we simply didn't have enough time to run through all of that information, understand its importance, and come to a decision on where to allocate budget

cuts. Also, while we had a good summary of the available information, there was still plenty missing. For instance, why has a particular budget request changed? Did they simply finish a project? Are they starting a new project? Are they being fiscally responsible/irresponsible? Did the



costs of some particular component suddenly inflate?

Simply put, we were given too large of a task with too few resources. We all came to a general consensus to cut education the least, but that was made because everyone was pursuing their own interests (we all were students). We were given little information about how the money itself is being spent and next to no time to take in all of the given information, talk with our group members, discuss why we should cut these particular programs, and come to a consensus.

What does this say about the job of the U.S. Congress, though? Only a very small number of people in Congress are actually scientists. How can we expect Congress to work in favor of science when many members are even less familiar with it than we are? Keep in mind that the inadequate amount of time and information applies to Congress as well. This was fine for us because we're doing a workshop, but what if we were making huge decisions about actual money allocations? These are choices that can send a program to a screeching halt or put large numbers of people out of jobs.

Throughout the remainder of the conference, we found the talks very interesting, particularly because they were directed to our level of study. This allowed us to learn a great deal. Other workshops were especially helpful for students looking for advice on applying for jobs. The graduate school tables at the exhibit were extremely helpful; they provided us with information on which graduate programs schools offered, as well as REU programs that offer students great opportunities to gain experience in research over the summers of their undergraduate careers. One of the coolest aspects of the conference was the "Breakfast with a Scientist" event. This gave students a great opportunity to ask scientists about their specific fields of study, the schools they do research at and their lives as scientists. It was surprising to see the diversity at the conference. Freeman Dyson even noted that there were nearly 50% women!

“ It was surprising to see the diversity at the conference. Freeman Dyson even noted that there were nearly 50% women! ”



The products of extraordinary innovation and teamwork at NASA.



Young physicists determining which science funding to cut during a workshop exercise.



UNIVERSITY OF LOUISVILLE

“It’s Just Been Great!”

2012 Quadrennial Physics Congress of Sigma Pi Sigma

Orlando, FL November 8 – 10, 2012

By the University of Louisville SPS Chapter

“ The theme for 2012 was “Connecting Worlds.” For nine UofL students, the theme actually came true! ”

“That’s all I have to say. Thanks a helluva lot!” Dr. Freeman Dyson expressed his enthusiastic appreciation at the end the 2012 Sigma Pi Sigma Quadrennial Physics Congress. “It’s just been great!” After four packed days of tours, lectures, seminars, workshops, and mingling, the University of Louisville (UofL) contingent felt the same. The theme for 2012 was “Connecting Worlds.” For nine UofL students, the theme actually came true!

When arriving at the Orlando airport, Jennifer Wojno, a first year graduate student, met a Brazilian student temporarily studying in the United States. Guilherme de Rosso Mancos was excited to be involved with SPS on a national scale as his local chapter was small and inactive. Travelling to Orlando on his own with no reservations, Mancos’ passion was clear. His short time in the U.S. was nearly over, and he was disappointed to be going home to a country with no national society like SPS to offer opportunities. As he explained his situation on the shuttle ride to the hotel,



Dr. Freeman Dyson poses with students from the University of Louisville at PhysCon. Credit: M.T. Nichols

Mancos caught the attention of Dr. Earl Blodgett, a professor at the University of Wisconsin-River Falls and a member of the SPS National Council’s Executive Committee. Blodgett went on to describe SPS’s international chapters and the process of creating a chapter. With the determination, passion, and luck Mancos clearly already possessed, there is little doubt SPS will be expanding to Brazil in the future!

The first official day of PhysCon began with tours of NASA’s Kennedy Space Center. SPS

reporters went into the labs of NASA scientists, finding gadgets for repelling dust, techniques for clean lunar landings without dust spray, and experts building lunar simulators. For Matthew Nichols, a first year graduate student, the most compelling lab of all was that of Dr. Bob



Youngquist, lead scientist of the Applied Physics Laboratory. Youngquist's love and enthusiasm for science was obvious from the beginning. Eager to show everything on the table and more, Youngquist talked about radar used to track flocks of birds, showed a detector for invisible hydrogen fires, and demonstrated how to dry off a soggy space shuttle. Many of the inventions that came out of his lab had applications elsewhere. After a hail storm knocked chunks of foam from the exterior tank of the space shuttle, NASA needed to know how to measure the size without being next to it. Scientists quickly put two laser beams on the bottom of a camera and instantly had a ruler that could be seen in every photo. This technology was passed on to crime scene investigators, who now use the lasers for scale instead of an actual ruler.



Dr. Bob Youngquist, lead scientist in NASA's Applied Physics Laboratory at Kennedy Space Center, excitedly shows how he took the guesswork out of putting screws in a femur rod. Credit: M.T. Nichols

Youngquist also demonstrated his kilohertz-sensitive microphone used in finding pipe leaks. "We didn't invent sonic leak detection," said Youngquist. "But we made it ten times better!" The pure enjoyment Youngquist showed while explaining how things worked was invigorating, and the myriad of inventions was a testimony to the far reaching influence of a single lab.

Alongside the NASA scientists, PhysCon featured a full lineup of respected speakers. From Dr. David Saltzberg's consulting work on "The Big Bang Theory", to Dr. Jocelyn Bell Burnell's humorous, though serious talk on the end of the world in 2012, to Dr. John Johnson's research on exoplanets, the speakers engaged the audience with presentations in a broad range of areas in physics. Among these talks, the one given by Dr. Freeman Dyson was perhaps the most personal. Touching on moments from his own life and career in physics, Dyson took listeners on a journey through the major scientific breakthroughs in the past hundred years in a talk titled, "Living Through Four Revolutions."

"With that button-down shirt, red tie, cardigan, and a suit over the top, I thought he seemed a bit like a fancy Mr. Rogers. And he was funny!" remarked Jamie Bougher, a fourth year graduate student from UofL. Pacing gently on stage and speaking candidly, Dyson guided 800 people through the knowledge revolutions that made history and brought humanity to where it is today. Beginning with the atomic revolution, Dyson touched on both the excitement of successfully splitting the atom and the devastation caused by the first nuclear bombs. Looking to get a start in physics, Dyson sought out the scientific minds who first worked on the bombs at Los Alamos, eventually becoming a graduate student at Cornell, where many had gone after the war. "Within one week, I hit the jackpot - I got to know Dick Feynman," Dyson recounted. "And it was obvious this guy was a genius; he was a

“The 2012 Sigma Pi Sigma Quadrennial Physics Congress has helped UofL's chapter become stronger than ever.”

marvelous guy, a clown, a buffoon, a great teacher." Dyson would later tell stories of how Feynman once learned never to care for another person's boa constrictor and refused to sleep in a tennis-themed hotel.

The second revolution also began with the second world war, but involved developments in the field of rocketry, which would eventually lead humanity into space. Dyson worked on Project Orion, a mission to use nuclear bombs as the launching mechanism for spacecraft that never quite took off. The bomb, which was once used solely as a means of destruction, would have been used for purposes of exploration and scientific advancement.

The second revolution also

Next came the biological revolution with the model of DNA established by Rosalind Franklin, James Watson and Francis Crick; the last two earned a Nobel prize for their work. It was at this point that Dyson warned the audience never to take his advice, as he initially tried to convince

Crick to stay in physics rather than become a biophysicist.

The most contemporary revolution described by Dyson is the computing revolution. Dyson's colleague John von Neumann advised the U.S. government that the country would never need more than 18 computers, an unfathomably low number from today's perspective, when considering that smartphones, graphing calculators, televisions, cars, and nearly every modern convenience runs on computers. The proliferation of computation has left humanity, in Dyson's words, "living on little islands of understanding in a sea of information," which is "cheaper to collect [...] than to understand."

More than just a history lesson, Dyson's talk was the personal story of a career physicist making his way to the top. When asked for advice on juggling career and family, he jokingly told everyone that he has lots of advice, "but you don't have to take it." Then he spoke briefly on the detrimental impact going through a Ph.D program has on one's personal life. If you don't need to get a Ph.D., said Dyson, don't. Flexibility and good fortune, according to the accomplished physicist, go a long way: "The important thing in life is to be lucky." Remaining on a single path limits options, claimed Dyson, citing software as an example of flexibility. The programming skills a student learns on one research project can be applied to future projects, and allows for respecialization down the line.

Dyson clearly struck a chord with the crowd as hordes of students mobbed him between sessions. Seeking photos, advice, opinions and stories from one of science's most esteemed figures, students lined the stage, preparing their questions. One student hoped to hear more about Dyson's views on the modern educational path for doctoral students. Another wanted Dyson's thoughts on the safety and practicality of using atomic bombs as fuel for rockets due to the environmental impact. Whatever the reason, students flocked to meet the living legend.

The SPS members from UofL found the whole experience enlightening. Watching and interviewing other students who were excited to meet the "man of the hour" gave a unique perspective on why over 800 people had gathered together in Orlando. When asked what she liked most about the conference, Jennifer Wojno said, "You got to meet people and establish both personal and professional relationships. I found this unique among conferences I've attended." David Warder was especially affected by Dyson's talk, commenting, "He taught us that we as physicists have our own revolutions to look forward to, to live through, and to learn from." Matthew Nichols enjoyed spending time thinking about physics as a career and a future rather than a set of course requirements for a distant degree.

UofL's members also brought back a renewed spirit of enthusiasm for physics. Not long after their return, the chapter met to discuss how both local SPS chapters and SPS National could better promote diversity, build a rapport with scientific and local communities, support those who seek jobs outside of physics, and represent science to policy makers. The sense of community has also led to the investigation of hosting a zone meeting in the near future and the development of a plan to seek out the hidden physicists among our alumni. The 2012 Sigma Pi Sigma Quadrennial Physics Congress has helped UofL's chapter become stronger than ever. The final verdict from the University of Louisville crew matches that of Dyson: It was just great!



Dr. Freeman Dyson talking with a student during Breakfast with the Scientists. Credit: Ken Cole



Connecting Our World to the Bigger One Around Us

2012 Quadrennial Physics Congress of Sigma Pi Sigma

Orlando, FL November 8 – 10, 2012

By the University of North Alabama SPS Chapter

Getting to the Congress

The Society of Physics Students chapter at the University of North Alabama is very small and close-knit, but when our group heard about the opportunity to meet hundreds of other undergraduate students just like us, not to mention a Nobel prize winner, an astronaut, and one of the most influential women in physics, there was no way for us to say no. Raising the money to get four members down to Orlando was a tedious and trying task. There was lots of fundraising, with late nights spent baking homemade doughnuts and handmade Star Wars shaped chocolates. On top of that, there were the countless hours organizing, planning, allocating, and then asking our university for funding. But in the end, the trip was successful and we were able to be strong and proud representatives of our university and its physics department.



UNA attendees pose with Dr. John Mather. R-L: Dr. Mel Blake, Dr. John Mather, Mary McDaniel Taylor Garber, and Christian Bayens.

“ Almost immediately, students and professors approached us from other universities around the nation and around the world. Our small, close-knit group grew exponentially. ”

When first arriving in Orlando, none of us knew what to expect. On registration day we entered the conference hall and were in total shock at how many students, students just like us, were there. Because of how small our department is, we all had this idea that for young-adults our age, we're few and

far between. Almost immediately, students and professors approached us from other universities around the nation and around the world. Our small, close-knit group grew exponentially. Everyone was extremely welcoming which made sharing this experience with over 800 new friends so much more enjoyable and rewarding.



That very same day we met all of our future colleagues, we had the chance to get the ultimate tour of Kennedy Space Center (KSC). It had always been on my personal bucket list to make a trip to KSC but I hadn't had the chance until the Congress. A dream of mine came true that day, and it is an adventure I will never forget. It was the exact inspiration our chapter needed and the perfect way to start the Congress.

Our group was constantly surprised at every new thing we experienced each day. From the talk by Dr. John Grunsfeld, our beloved Hubble Space Telescope hero, to the spunky and eye-opening talk by Jocelyn Bell Burnell, the inspirational female astrophysicist who gave the world pulsars; the saying "you learn something new every day" doesn't even begin to cover how much we all learned and gained at this conference.

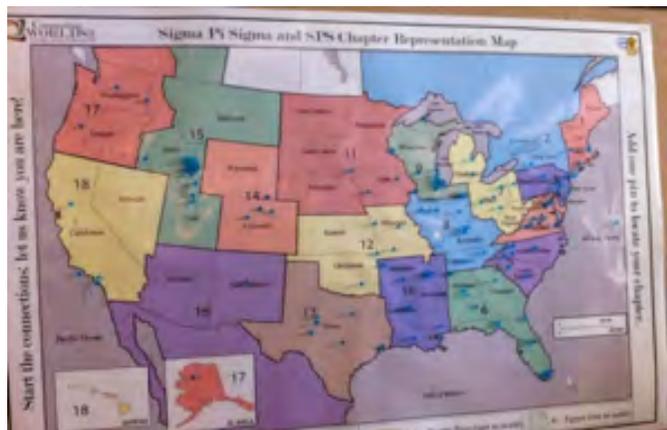
One of the most rewarding parts of the Congress for all of us undergraduate students was the PhysCon Exhibit. At this event there were multiple universities promoting their graduate programs and giving each of us valuable and priceless advice. Research opportunities for undergrad students could be found at almost every table in the room. Of course, there were plenty of free bags, pens, pads of paper, rattle backs, dancing robots, candies, tubes of chap stick, and tons of other trinkets. What college student doesn't appreciate free stuff?

On our last evening in Orlando, Dr. John Johnson gave a talk on hot stars and cool planets. We learned from Dr. Johnson how much patience is needed with our degree of study and that sometimes you don't necessarily pick where you end up in physics, it just kind of falls into your lap as you go. His research in extra-solar planets has given the world reason to believe in probable life outside of our own. We've gone from knowing about just 33 extra-solar planets to more than 3300 of them, some of which are not overly different from our own. "[Planets] are kind of like cockroaches, you see one..." Dr. Johnson said jokingly, implying that where there's one, there are many. His advice to new physics majors was to take any and all (if possible) astronomy courses. He told us that astronomy helps us to understand our origins. Physics courses like astronomy are where it all begins for each of us as undergraduates.

This was, to date, the single most rewarding experience our organization has had the privilege of being a part of. Each one of us gained multiple life tools and lessons from this trip. To quote Dr. Freeman Dyson, "Thanks a hell of a lot, it's just been great."



The Vehicle Assembly Building at KSC, the third largest building in the world by volume. Credit: Taylor Garber



Tacks represent all of the SPS chapters in attendance at PhysCon. Credit: Taylor Garber



UNIVERSITY OF WISCONSIN-RIVER FALLS

Connecting Worlds at 2012 PhysCon

2012 Quadrennial Physics Congress of Sigma Pi Sigma

Orlando, FL November 8 – 10, 2012

By the University of Wisconsin-River Falls SPS Chapter

Eight members of the SPS chapter at the University of Wisconsin-River Falls (UWRF) traveled approximately 1,500 miles to the Sigma Pi Sigma Congress in beautiful Orlando, FL, accompanied by our advisor Dr. Earl Blodgett. We were generously funded by UWRF Falcon Grants and UWRF physics alumni. We had worked to raise funds for nearly four years, after sending a group to the 2008 Congress. Our advisor is very active in SPS National, so we hear about how exciting and important the Congress is every year!

Upon arriving at the Orlando airport, we were driven by a taxi van service to the Caribe Royale hotel that hosted the conference. We had a bit of a catastrophe with the accommodations for half of the students – when we finally got to our room, it only had one bed for four women! We brought all of our luggage back down to the front desk and had to explain the whole situation to them. Finally they realized the mistake and set us up with grand accommodations that far exceeded our expectations – we had two separate bedrooms with their own bathrooms, a Jacuzzi, living room, dining table, and even a kitchen. We ended up with a great situation in the end, despite the initial confusion.

A major highlight of the conference was the NASA tour. Two students, Theodore McDonough and Katrina Hanson, served as SPS reporters on an extended behind-the-scenes tour of NASA. They visited labs, met NASA researchers, had photos taken next to the countdown clock, and stood by the Launchpad. The rest of us enjoyed the regular tour, which included some time at the Launchpad and the Visitor Center. Going to a facility so highly-recognized for its contributions to science and technology was inspiring.

There were several other memorable parts of the conference. We enjoyed listening to plenary talks by prominent scientists such as Dr. Freeman Dyson and Dr. Mercedes Richards (see the final section for more on Dr. Richards' talk). The workshops were informative, enjoyable, and thought-provoking. Students from our group were represented in all of the different workshops, so we discussed our various experiences with one another and learned even more.

“ Going to a facility so highly-recognized for its contributions to science and technology was inspiring. ”



“Breakfast with the Scientists” was also memorable, and several students in our group utilized the exhibit hall to explore graduate school opportunities and network with representatives from various physics associations. Two students, Charlotte Evans and Tyler Capek, presented their research at the poster session. Eating liquid nitrogen ice cream at a physics dance party was fun as well!

While we were in Orlando, many of us took the opportunity to venture around a bit. We enjoyed meals together at the Mexican and Chinese restaurants across the street. Seeing all the wildlife was an added bonus; in total, we saw several alligators, a dolphin (in the ocean!), an armadillo, lizards, pelicans, and vultures! The weather was also wonderful, especially when compared to our usual frigid Midwest environment. On the last night, several of us took a taxi to Downtown Disney to do some souvenir shopping and exploring. We even listened to a live band and ate fish and chips at an Irish-style pub!

When we reported on our experience at the weekly chapter meeting following the trip, Theodore eloquently described how it was reassuring and inspiring to see so many people doing physics, the same kind of physics that we work so hard at:

The SPS delegation from the University of Wisconsin-River Falls recently participated in PhysCon 2012 in Orlando, Florida. The experience was incredible. You see, during the drudgery of a typical physics undergrad’s semester, one often becomes overwhelmed and delirious with the exhaustion brought on by the many long hours spent pouring over the incredulous minutiae contained in the perplexing equations of the universe. PhysCon provided the inspiration to continue. The unique experiences at NASA, listening to all of the amazing presentations given by some of the heaviest hitters in physics today, then actually sharing a meal and rubbing elbows in personal conversation with such incredible people, reminded us of why we were going through the rigorous journey that is learning physics. The conference came at the perfect time in the semester: that time around the 10th week when typically “the wheels come off” for many students. Being reinvigorated by PhysCon has greatly helped me push through, seeing the very exciting light at the end of the physics undergrad’s tunnel.

Physics is worth the effort!

“ We were able to bond as a group as well as network with other students and professionals who share our love of physics. ”



Several UWRF students with Dr. Richards immediately after her presentation. From left to right: Wesley Barnes, Tyler Capek, Katrina Hanson, Dr. Richards, Alesha Radke, Samantha Oswald, Philip Middlemiss.



We thoroughly enjoyed our trip to PhysCon 2012 and we are very thankful that we had the opportunity to attend. The experiences we had were enlightening and enriching. We were able to bond as a group as well as network with other students and professionals who share

our love of physics. This was a very memorable event for all of the UWRF students who attended, and our advisor got to cross touring the Kennedy Space Center off his bucket list.

Meeting Highlight: Dr. Mercedes Richards Truly “Connecting Worlds”

What do chandeliers and extraterrestrial bodies have in common? Both are objects of interest to Dr. Mercedes Richards, whose childhood fascination with her neighbor’s illuminated fixtures was a mere antecedent to her preeminent knowledge of binary star systems and the gas flows between these stars. The Penn State Department of Physics and Astronomy professor joined us as one of PhysCon’s noteworthy plenary speakers to tell us more.

As Dr. Richards presented “The Incredible Tomography Imaging Technique”, it became evident that her topic and the woman herself truly embody the 2012 Congress theme: “Connecting Worlds”. A Jamaican native, Professor Richards completed her undergraduate work at the University of the West Indies, earned her master’s degree from York University, and completed her doctoral requirements at the University of Toronto. She is a living example of the importance of the unification of science and diversity.

Tomography itself is a technique which serves to connect and communicate. This approach to imaging relies on two-dimensional projections to fabricate 3D images. Dr. Richards pointed out that humans already use a form of tomography in our everyday lives: if we see the shadow of a wolf on a camping tent wall, our brains conjure up the animal’s real space stature. We immediately identify the flat “projection” as the symbol’s fleshed-out being. Science has adapted and advanced this natural survival skill into a relevant and useful imaging method.

The intrinsic value of tomography is being realized through major applications in the fields of medicine, oceanography, geophysics, archaeology, and even art. The healthcare industry relies on tomographic technology every time a CAT (Computed Axial Tomography) scan or MRI (Magnetic Resonance Imaging) is ordered. Artist Louis Tiffany incorporated layering of stained glass into his pieces to create a three-dimensional effect. Seismic tomography utilizes primary and secondary waves to scan the center of the earth with higher precision than that which may be accomplished with physical drilling. Radar (Radio Detection and Ranging) and sonar (Sound Navigation and Ranging) are critical technologies that incorporate tomography as they provide a means for mapping geological and oceanic Earth, and they even led to the rediscovery of the sunken Titanic.

Now scientists are applying the far-reaching abilities of tomography to yet another field: astrophysics. Aristotle’s rationalization of the Earth’s spherical shape based on the projection of its curved shadow on the moon’s surface may be considered an early application of tomography, but astronomy is regarded to be one of the last scientific industries to realize the imaging technique’s usefulness. Despite its belated introduction, tomography has become a staple within the astrophysics technological arsenal.

Dr. Richards works on the Doppler tomographical imaging of binary stars. Interestingly, around 70% of stars that appear to be single are actually binary or multiple star systems. If there is a rhythmic Doppler shift in the movement of a star, we can deduce that it may be moving about a binary orbit’s center of mass. In a binary system, wherein one body acts as the donor and the

other as the recipient, the sharing of gas is indicated by a teardrop shape. Lagrangian mechanics describes this transfer and the corresponding patterns of gas flow between the stars. The product of a typical system is the formation of a ring of gas around the recipient star.

In situations wherein white-dwarf, sun-like stars lose



their ring of gas, tomography may be used because orbital motion leads to cyclic Doppler shifts in the spectrum. This characteristic allows scientists to obtain views of the star from a vast range of angles and superimpose these projections into a resembling figure. Dr. Richards initiated use of this technique when she collaborated with Russian scientists to produce the first three-dimensional velocity images of magnetically threaded gas streams. This application of tomography is truly incredible, as the name of her plenary talk suggests.

The conference was brimming with inspiring moments and learning opportunities, but it was Dr. Richards who truly embodied the heart of PhysCon's theme. Not only did she connect worlds – she gave the next generation of scientists the courage to be fascinated with its own personal “chandeliers”.



2012 Quadrennial Physics Congress
Hosted by Sigma Pi Sigma, the physics honor society
November 8-10 • Orlando, FL

PhysCon



PhysCon attendees enjoy a moment of levity in front of the iconic countdown clock at NASA Kennedy Space Center. Photo by Ken Cole