Department of Chemistry & Physics ✦ 100 Campus Drive ✦ Weatherford, OK 73096-3089

PHYSICS ALUMNI NEWSLETTER

Spring 2016

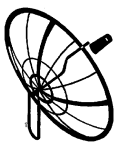
http://swosu.edu/academics/physics ✦ physics@swosu.edu ✦ Terry Goforth, Editor

Come Fly With Us

Come one! Come all! The 2016 edition of the SWOSU Physics Alumni Banquet will be held on Saturday, April 2, 2016, at the Stafford Air & Space Museum in Weatherford. **Preston Barber** ('82), Airport Radars Systems Manager for the FAA in OKC, will be our speaker this year. We will be inducting the newest class of students into Sigma Pi Sigma and honoring several students for their hard work and service.

Dinner will be served at 7 pm, but the museum will be open early, so come on out ahead of time. Your banquet ticket includes a chance to walk through the museum and see what AAA has designated as a "Gem" in western Oklahoma. You'll definitely want to see the Mission Control exhibit honoring several of our own alumni.

The museum is located at 3700 E Logan Rd in Weatherford. If you need directions, just ask. Tickets are $20 each, and may be paid for in advance or at the door. We will need an accurate head count by Wednesday, March 30, so if you plan to attend, please let us know how many will be in your party by then. You can contact us by email (physics@swosu.edu), phone (580/774-3109), FAX (580/774-3115), snail main (c/o Terry Goforth, 100 Campus Dr, Weatherford, OK 73096), or just come by in person!



Preston Barber

Preston Barber ('82) is the Airport Radars Systems Manager for the Federal Aviation Administration (FAA). Preston manages and leads a team that provides worldwide engineering support for 200 radar-based surveillance systems operated by the FAA and Department of Defense.

Preston was born in Weatherford, OK, and grew up in Oklahoma City. He graduated from Putnam City High school in 1973 and spent four years in the US Air Force where he repaired automatic pilots and compasses. After leaving the Air Force he attended SWOSU, graduating with a BS in Physics in 1982.

Following college he managed the Electronics Technology Laboratory at OSU and worked at Boeing Military Airplane Company and Frontier Engineering. Since December of 1989 he has worked for the Federal Aviation Administration in Oklahoma City and Washington, DC. He has worked on, led, and managed teams deploying the following surveillance systems: ASRS-4: A 3D, 250 NM Air route Surveillance radar; ATCBI-6: A modern Air Traffic Control Beacon Interrogator with Mode-S capability; ASR-11: The FAA's newest Airport Surveillance radar; and ADS-B: Automatic Dependent Surveillance Broadcast, a GPS based surveillance technology.

Preston's FAA career has taken him to destinations in Italy, England, Scotland, Brussels, and Amarillo, Texas. He now lives in Oklahoma City with Letricia, his wife of thirty-seven years. They have two daughters Kelly and Tracy.

What is a scientist after all? It is a curious man looking through a keyhole, the keyhole of nature, trying to know what's going on. ~Jacques Yves Cousteau

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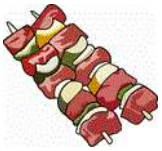
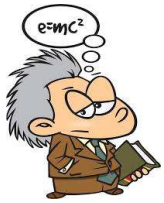


A Chance to Relax

If you close your eyes and concentrate, you can almost smell the charcoal and the aroma of

meat and vegetables being grilled. Hungry? This year's Physics Shish-kebab will take place on April 30 at Crowder Lake. As usual, we'll have an abundance of good food and plenty of good company. The food should be ready to eat around 6 pm, but be sure to come early to take in all Crowder Lake has to offer. Whether you prefer fishing, canoeing, hiking, or just sitting and watching, it will be a great opportunity to relax and enjoy. We'll headquarter at the Crowder Lake classroom building. If you need directions, just give us a call or drop us an email.

We can lick gravity, but sometimes the paperwork is overwhelming. -Wernher von Braun



Physics and Engineering Club Officers

President:	Connor Holland
Vice-Pres:	J.P. Woods
Secretary:	Garet Crispin
Treasurer:	Brennon Cupp
Sponsor:	Dr. Wayne Trail

The saddest aspect of life right now is that science gathers knowledge faster than society gathers wisdom. ~Isaac Asimov

Graduates

The 2015 SWOSU Convocation took place on May 9, 2015, in the Pioneer Event Center. Two Engineering Physics students walked across the stage and received their *bona fides*. Congratulations to **Amy Fields** (Seiling) and **Blake Scott** (Greenfield)!

Research is what I'm doing when I don't know what I'm doing. -~Wernher von Braun

Summer Research and Internships

Last summer, four intrepid engineering physics majors from SWOSU set out for a variety of locations to take part in summer research. These students choose to forgo much larger summer wages in order to gain valuable lessons. (This is made possible because of scholarships which reduce the need to earn as much as possible over the summer before returning to school.) Here is a summary of what our students did.

Connor Holland (Jr/Sr, Duncan) I was involved in a research project at the South Dakota School of Mines and Technology (SDSM&T) over the past summer. This ten-week program at the Security Printing and Anti-Counterfeiting Technology (SPACT) center was funded by the National Science Foundation. I worked with a post-doc researcher for the SPACT center in characterizing the properties of Polyaniline (PANI), an organic compound that is conductive if synthesized as nanofibers (NF). PANI-NF's, however, become non-conductive if exposed to high intensity infrared light. I was able to characterize all of these properties of PANI while also creating printable patterns. During this project I also worked with a professor from SDSM&T on technical presentations. At the end of the program I was able to present my research at a poster conference with other participants who worked on similar projects from the surrounding area. The overall experience was definitely eye opening as well as incredibly fun!

J Paul Woods (So/Jr, Weatherford) Last summer, I was one of ten students accepted into the University of Oklahoma School of Community Medicine (OUSCM) Undergraduate Summer Internship. The internship was six weeks long, and consisted of the following five activities: community service, didactics, physician shadowing, medical research, and office help. I'll give a couple examples, but there was too much going on to mention it all.

For community service, we helped with a summer camp that introduced underprivileged teens to different careers in the medical field. Furthermore, I helped raise funds for a community-wide baby shower that was to be put on by a Tulsa based charity. Our didactics consisted of weekly lectures given

by different physicians at OUSCM, and covered topics such as electronic medical records, medical disparities, the role of fMRI in studying depression, and much more. As another part of didactics, we were able to spend time working with standardized patients (actors who portray different medical needs). In regards to shadowing, I was able to spend a considerable amount of time with doctors in pediatrics, family medicine, surgery, pulmonology, and psychiatry.

In closing, the summer was very productive, and it helped solidify my goal of seeking a career in medicine. Also, I was able to see how beneficial a diverse or nontraditional background can be. My engineering physics major helped to set me apart from the crowd, the normal pre-med, in that I was able to bring a unique set of problem solving skills to the group, and an overall different way of looking at things.

Garet Crispin (So/Jr, Thomas) This summer I interned at the University of Texas in Austin as a student researcher. The graduate research group I participated in was in the chemical engineering department that had recently transitioned from UC-Berkeley. They made for an incredible learning atmosphere. My research involved synthesizing a nanocrystal and sol-gel composite, to be used as a transparent conducting oxide (TCO). After synthesizing this compound, my task was to create a spray coating deposition method that provided high transparency and conductivity. The final goal of the group was to make high-efficiency, smart windows using this TCO and others, that were developed in the group.

Brennon Cupp (So/Jr, Woodward) Over the Summer I worked at OSU in the Helmerich Research Center in Tulsa, Ok. There I worked with a number of people including Dr. Ranji Vaidyanathan in the Engineering department. I worked there on a project funded by NASA to research the ability of thermo plastics mixed with other compounds to protect against radiation and to test their mechanical strengths. My work was centered on making the thermo plastic mixtures and helping design and build a mold to mold the plastics for testing. *(Ed. note: This work was part of a NASA grant awarded jointly to OSU and SWOSU to involve SWOSU students in research.)*

The fewer the facts, the stronger the opinion. ~Arnold H. Glasow

On and Off the Field

Engineering Physics Major Kaleb Prough (Jr, Edmond) was one of two SWOSU Football players honored as CoSIDA (College Sports Information Directors of America) Academic All-District this year. Kaleb has maintained a 3.95 GPA while starting every game for the Bulldogs at right tackle. We all know this is no small feat. Way to go, Kaleb!

No amount of experimentation can ever prove me right; a single experiment can prove me wrong.~ Albert Einstein

Physics Club Activities

The Physics Club has been busy (as usual) with a variety of projects and activities. Following the well-attended Welcome-Back Hamburger Fry, the physics students got to work evaluating and learning to explain a variety of demonstrations that were planned for Physics Day. The club members run a hands-on room where the visiting high school students can “get their hands dirty” with angular momentum, standing waves, non-Newtonian fluids, and many other activities. Later in the semester, they took time to relax before finals at the annual Physics Christmas Party. The spring semester has provided an opportunity to look at projects they might build just for fun. On movie night they watched *The Martian* and discussed the science (good and bad) that was presented in the film. Of course, later this spring they will be planning the Spring Banquet and the annual Shish-kebab.

The distance between insanity and genius is measured only by success. ~Bruce Feirstein

ABET Assessment Workshop

by Tony Stein

In the fall of 2015 I attended a fundamentals of program assessment workshop for ABET (Accreditation Board for Engineering and Technology). This workshop was designed to help engineering programs do self-assessment both for themselves and for ABET accreditation and renewal. A three-year self-assessment of an engineering program is a necessary first step for ABET accreditation and continuous improvement is a cornerstone of maintaining ABET accreditation.

Recent policy changes by the state licensing board have made the path toward a professional engineer (PE) licensure more difficult for graduates of non-accredited programs. Being a PE is not necessary for a being successful engineer and many engineering graduates do not even take the first step by taking the fundamentals of engineering exam. Nonetheless, having our program ABET accredited would still be useful for some students.

The workshop was useful both in giving a better idea about what ABET is looking for and for giving ideas about how to develop a useful program of assessment that can be implemented with a small number of faculty. It will still take a lot of work to develop, implement, automate, and improve. We will likely need help from alumni in various roles as well.

Science is a way of thinking much more than it is a body of knowledge. ~Carl Sagan

Flipping the Classroom

by Wayne Trail

In March of 2015, I attended a Transformative Learning conference at University of Central Oklahoma. I had been trying to incorporate new teaching techniques into my classes, especially Basic Physics (the algebra/trigonometry based Health Sciences sequence). For example, I had been creating short videos of me working typical problems and posting them on Canvas (an online learning platform), so the students could see how I solve problems in real-time (as opposed to the finished product in their notes).

The Keynote speaker at the conference was Dr. Eric Mazur who was discussing the "flipped" classroom. Dr. Mazur has been teaching the Health Sciences Physics sequence at Harvard for a few decades. Early on he became frustrated that even his best students, who could grind out tough problems, were regularly tripped up by simple concepts: "What is the acceleration of the ball at the top of the trajectory?" "A metal plate with a hole in it is heated. Does the hole increase or decrease in diameter?" "A rowboat containing several bricks is floating in a pool. If the bricks are thrown overboard into the pool, does the water level of the pool rise, or fall?"

Dr. Mazur decided that even though his lectures were scintillating (just like mine!), the students were not learning in them, or at least not learning as well as he wanted. His solution was to flip his classroom. Students were assigned reading or videos to view outside of class, then class time was spent answering and discussing questions.

It works like this: a (usually) multiple choice question is posted on the screen in the classroom. Students have a minute, working by themselves to select an answer; they do this by connecting to a web-site with their cell phone or other wifi device. Once the answers are in, the instructor sees a distribution of answers (depending on the sophistication of the software, the instructor can view an "answer-map" of the classroom). If 80% or more of the students get the right answer, the instructor states the answer or gives a brief explanation (or, better, has a student do that), then goes to the next question. If fewer than 30% get the right answer some explanation from the instructor is required. If the percent correct is between 30% and 80%, the students are told to find a person with a different answer

than theirs and try to convince the person that they are right. This is what we want.

After a few minutes of discussion the students are allowed to resubmit their answers. The percent of correct answers almost always increases dramatically, even when another answer was initially more popular than the correct answer. The students, rather than learning passively in a lecture, are forced to defend their conceptions (or, more likely, misconceptions). The person with the correct answer usually has the better argument and will succeed even from the minority.

Another interesting aspect of it is that, at the end of the second round, the students still don't know *for sure* what the right answer is. They have now invested some time thinking about this question and discussing it. They *want* to know the answer. So you, as the instructor, have a few minutes of really focused attention from the class.

I am still a beginner at this, but the students really seem to enjoy it. (I do it about one lecture in four, and I grade them only on participation.) What I like most about it is that it really gets them to discuss physics. It certainly has improved class participation on the other days (they get used to talking in class and are less shy). Finally, I believe they are better at working together on (real) homework problems—I see them debating with one another while they work. It'll be a while before I can tell if it really affects their learning in a significant way (maybe I'll never know), but it has them smiling a little more while discussing physics. And that is good.

Retooling Experimental Techniques

by Tony Stein

One of the most difficult steps for an undergraduate to make is the move from being a student to becoming a scholar–someone who not only consumes knowledge but also creates it. This fall 14 of SWOSU's junior and senior engineering physics majors took a large step in that direction by designing, building, and implementing their own research projects. Their resources were limited both in money and in time as they only had about 8 weeks to complete the project. Not all of them were able to complete their experiments because of those limitations but all of them learned from this experience and had the pride of succeeding in a project that was entirely their own.

Before the building and research phase, each student created his own idea for a research project and then fleshed out the project enough to promote and defend it before his peers and to write a simple 'grant proposal' detailing the experiment and probable cost. From these projects the students selected only a handful and broke into small groups to finish them. Many of the ideas that were discussed but not chosen would still make very good research projects later. (One example is that in certain circumstances hotter water can freeze faster than colder water.) The projects that were chosen covered a wide variety of fields from classical mechanics to optics to particle detectors using modern electronics and computers.

One of the most ambitious projects was to recreate Cavendish's experiment that measured the density of the earth. (In modern parlance it measured Newton's gravitational constant G.) The torsion balance that Cavendish used and modified was extremely well designed and remained the state of the art for over a century. Cavendish's original paper had plenty of detail to help with the design, but finding a way to build one in the limited time and budget proved too difficult. One challenge which turned out to be insurmountable was the enormous mass needed. (Lead was the preferred material.) This limitation lead to a series of discussions about possible geometries which would work with the lead that was available. Though no solution was found, the students got a chance to do some basic building and design and became familiar with the trade-offs that are often necessary when making your own original experiment.

Another ambitious project was to build a cheap muon detector using basic electronics such as op-amp chips that interfaced to a Raspberry Pi through an Arduino processor. Both the interfacing of the circuit with the Arduino (and the Arduino with the Raspberry Pi) and the building of the electronics was challenging but the students were up to the task and completed it successfully.

One of the more immediately successful experiments was to build a

ping pong ball launcher that uses only a vacuum. A ball is placed at one end in a long tube that is sealed at both ends with aluminum foil and then evacuated. The ball is then launched by puncturing the foil on the end with the ball. The resulting rush of air accelerates the ball in the vacuum so that it easily punches through the foil at the other end. The students quickly figured out how to find and fix the inevitable leaks and were well on their way to being able to measure the speed of the ejected ball when they ran out of time.

There were many other projects as well. One student attempted to measure heat conduction using an inexpensive infrared camera. Another measured the fluorescence of colored paper using colored lasers. And another group was able to measure the acoustical properties of musical instruments by comparing the harmonic tones of high sound-quality and low sound-quality musical instruments.

Too often in educational laboratories students are given a project that is already mostly fleshed out, and they know that if they just follow the directions they will succeed. The real world is frequently the exact opposite of that. Life gives us limited instructions, and success is not guaranteed, even if we do everything right. Although small, these types of experiments, I believe, are very important for students because it challenges them to go beyond what they have learned and to take a risk.

The science of today is the technology of tomorrow.
~Edward Teller

Physics at the Lake

Take a dozen or so physics students. Add several faculty members, a few alumni, and lots of friends and family, then mix it all up at Crowder Lake and you have the ingredients for a great shish-kebab. May 2, 2015, was a beautiful day. Some attendees chose to go canoeing, while other played lawn games or took hikes. The food was, as always, worth the wait and in abundance. After dinner, the new Physics Club officers were sworn in with the usual creative, impromptu oaths, then several students were awarded with Iggies (Ignoble Awards). A favorite award was the boomerang, presented to all the students attending (to give them a head start in their preparations for Fluid Mechanics in the fall semester).

Touch a scientist and you touch a child. ~Ray Bradbury

2015 Banquet

April 25, 2015. The 2015 Physics Spring Banquet was one to remember. The setting was the Stafford Air & Space Museum, where a display honors the SWOSU graduates who worked at NASA through the Mercury, Gemini, and Apollo missions. Several of those honorees returned to listen to one of their own, Ron Toelle ('63), who spoke about his experiences in the space program and shared a few memories along the way. And it was a night to remember Dr. Benny Hill and to share our memories of his guidance and leadership.

The fun started early when Bob Culpepper ('63) and his wife Norma and Jim Bates ('62) and his wife Rosalee showed up early to have lunch with Ron Toelle and his wife Gale and the physics faculty. We all had a wonderful visit.

The evening began with tours of the museum and a chance to socialize with old friends and make new ones. After a delicious dinner was served by SWOSU's Food Services, and we then settled down to the evening's business, inducting three new members into the SWOSU Sigma Pi Sigma Chapter, bringing our total membership to 198. This year's inductees were Garet Crispin (So, Thomas), Brennon Cupp (So, Woodward), and John Paul Woods (So, Weatherford). Joe Young (Fr, Duncan) was named the Outstanding New Physics Club Member, and John Paul Woods was honored as the Outstanding Midclassman in Physics. Luke Kraft (Sr, Hooker) was recognized for being chosen as a Who's Who scholar, and Amy Fields (Sr, Seiling) was presented with a medallion to wear at graduation denoting her status as an Honor Graduate (GPA 3.5 or better). Several scholarships were awarded. These will be detailed later. The presentation of our ultimate award, the J.R. Pratt Award for the Outstanding Student in Physics was actually

a dual award to Amy Fields and Connor Holland (Jr, Duncan).

A few attendees took advantage of the opportunity to reminisce about they experiences with Dr. Benny Hill, who served as Chairman of the Department of Physics for 25 years. All agreed: he was demanding, but he cared about his students, and he shaped the department, the physics program, and the future of many of us who studied under him.

The highlight of the evening was a presentation by Ron Toelle ('63) titled "From Okie Dirt Farmer to Rocket Scientist." We followed his rise from an Oklahoma farm boy who wanted to fly for the US Air Force, through his years at Southwestern under the tutelage of Benny Hill and J.R. Pratt to his years working first as part of a five-man team lead by Dr. Werner Von Braun and eventually as chief engineer in charge of his own team. He recalled many of his classmates and the influence they had on him, and noted the importance of these connections in securing first an internship and then a job with NASA. Ron made his career by emulating Dr. Von Braun's management style: hire the best people, and then let them do what they are good at without getting in the way. He also noted that progress requires a broad range of talented individuals–from those who dream and take chances to those who meticulously check details.

Following the formalities, there was time for one more quick look at the museum, hugs and handshakes, and a moment to reflect on the joy of coming together to celebrate the past and the future.

It is a good morning exercise for a research scientist to discard a pet hypothesis every day before breakfast. It keeps him young.
~Konrad Lorenz

2015 Scholarships

Through the generous support of our alumni, family, and friends, we were able to present $9,074 in scholarship support to several grateful and deserving students. The awards included the Arts & Sciences Dean's Undergraduate Scholarship for $324 to John Paul Woods (So, Weatherford), and three Physics Alumni Scholarships in the amount of $1,000 each to Sushant Bhatta (Fr, Nepal), Dakota Davis (So, Woodward), and Joe Young (Fr, Duncan). Garet Crispin (So, Thomas) received the Arthur McClelland Memorial Scholarship in the amount of $1,000, and the Ray C. Jones Scholarship for $1,000 was presented to Brennon Cupp (So, Woodward). This year's Benny J. Hill Scholarship went to John Paul Woods in the amount of $1,250. Finally, Connor Holland (Jr, Duncan) was awarded $1,500 for the J.R. Pratt Scholarship. These students work very hard (hey, they are Engineering Physics majors) both in and out of the classroom. Most hold jobs, some on campus and others off campus, to help pay for their education. The money you generously donate to keep these scholarships coming means our students have more time for study. The assistance is greatly appreciated by these young scholars.

You Can Make a Difference

Free tuition for all! Lower interest rates on student loans! Forgiveness of student loans! We're hearing all kinds of things on and off the campaign trail this year. One thing that everyone can agree on is that a college education is expensive, and it's getting more expensive every year. The cost of tuition and fees has been rising rapidly for many years at a rate that far outpaces inflation. Public education today rivals the cost of private education 30 years ago. State support of public education continues to lose ground relative to the full cost, leaving students (and their families) to pay the majority of the bill. For the 2015-2016 academic year, the cost of tuition and mandatory fees at SWOSU is $195 per credit hour. For 30 credit hours (two semesters), the mandatory cost is $5,850, and that's before lab fees,

text books, and supplies are added on, (never mind room and board).

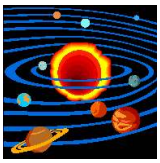
Most of our students hold down part-time jobs to help pay for their schooling. Some are even trying to work full-time while going to school. Needless to say, time spent at work is time that is not available for study, and you know from experience how much study time is required for the physics, math, and chemistry classes that our students are taking. Any assistance we can provide these students is an investment in the future. By reducing the financial load on them, we can help them succeed in school, and by extension, help them succeed in the careers ahead of them. And I can assure you that they are grateful. Every year, after the scholarships have been awarded, I have students coming by my office the next week to express their genuine gratitude. They know you don't have to give. They appreciate your generosity and support. And so do we, because we know how much of a difference it can make. So THANK YOU for your kindness and your support!!!

Men love to wonder, and that is the seed of science. ~Ralph Waldo Emerson

Einstein Revealed

Relativity Revealed: A Concrete Approach You Can Understand by Ray C. Jones, former professor of physics at SWOSU, is still available for purchase from Amazon at http://www.amazon.com/dp/1497522110. In the same clear, easy-to-follow style he showed in the classroom, Dr. Jones will walk you through Einstein's famous theory. All proceeds from sales of the book will be contributed to the Ray Jones Scholarship Fund to benefit SWOSU physics students.

Only two things are infinite, the universe and human stupidity, and I'm not sure about the former. ~Albert Einstein



Gravity Waves!

by Stan Robertson, Emerti Prof. of Physics

Einstein's general theory of relativity has shown that gravitational effects can be considered as distortions of spacetime. In simple words, masses tell spacetime how to curve and curvature tells masses how to move. They follow the warp and ruts of spacetime. One of the consequences of the Einsteinian view of spacetime is that gravitational waves should exist. If the fabric of spacetime were to be disturbed by some very compact masses being accelerated, then that disturbance should be propagated through spacetime as waves of some sort. A distant mass might respond to the disturbance by being set into some sort of vibrational motion. It has recently been claimed that such motions have been detected and that they were caused by the merger of two massive black holes located far away in the universe. To understand the basis for such a claim, it is necessary to understand the gravity wave detectors. They are conceptually simple but very, very complex in detail. The basic detector is a Michelson interferometer. It has been designed to respond to a change of length of an interferometer arm of about one part in 10 to the 22nd power!

The interferometer laser beam passes through a beam splitter and into two perpendicular arms of 4 km length. After traversing optical cavities in the arms hundreds of times, the beams are recombined at the photodetector. There are test masses located in the arms of the instrument. Their motions in response to gravitational wave disturbances change the length of the interferometer arms and thus modulate the interference pattern observed at the photodetector. The instruments themselves explain why the project is known as LIGO – Laser Interferometer Gravitational-Wave Observatory. There are two such instruments, one located near Livingston, LA, and the other at Hanford, WA. In addition to each confirming the other's signal detections, the time interval between arrivals at the two detectors provides a means to determine the direction from which

the signal came. The original article can be found here: http://journals.aps.org/prl/abstract/10.1103/PhysRevLett.116.061102

So finally, after many years of effort it seems that we now have the ability to detect gravitational waves. If so, this opens a new window on the universe and ushers in an age of gravitational wave astronomy. The potential for new discoveries is probably as rich as that provided by the first optical telescope. This is brought home by the first gravitational wave detection being attributed to the merger of two black holes of thirty some solar mass each! It is not difficult to imagine that an immensely rich era of discovery lies before us. For example, it might be possible to examine mergers of some of the earliest stars formed in the universe. Or we might be able to correlate gravitational disturbances with other events such as gamma ray bursts or fast radio bursts.

It is easy to get swept up into the excitement over both new prospects and apparent confirmations of foundational theories, such as general relativity. But it might be worthwhile to examine some of our assumptions. First, general relativity is conceptually elegant, but not at all necessary for understanding this new era.

Second, although many objects that are massive and compact enough to be black holes have been observed by astronomers, there have been no observations that confirm them as black holes. Two types of black hole candidate objects seem to exist; some of about ten times the mass of our sun and galactic nuclei of millions to billions of our solar mass. The objects that produced the apparent detection of gravity waves are very uncomfortably large. Black hole candidate objects of thirty solar mass have not yet been found in our galaxy or other nearby galaxies, but that is what would be required to produce the observed acoustic frequencies. Binary neutron star mergers should be observed every few days, but at higher acoustic frequencies and much weaker signals unless very nearby. It is difficult to construct a scenario for a progenitor binary system of thirty solar mass stars. One would expect such a close binary system to simply merge into a single 60 solar mass star and then go supernova.

Third, there are some additional mundane reasons for being cautious about accepting the gravity wave claims. Acoustic frequency disturbances in about the right frequency range might be created by a geological event within the earth. The collapse of a magma chamber somewhere might be detected by both interferometers. The signals detected were, if anything, too perfectly like those produced by simulations of a merger of binary black hole candidates. The recent retraction of the BICEP2 claim to have detected both B-mode polarization of the cosmic microwave radiation background and the simultaneous confirmation of both cosmic inflation and gravity waves tells us that scientists sometimes go overboard in reporting their discoveries. The gravity wave detection is similar to the BICEP2 result in that both experiments were looking for needles in a haystack, but the first thing found by both was a crowbar! In this regard, when you are digging out a signal which is deeply buried in the noise, you will eventually find random noise that matches your filters. Once in a while both detectors will find a match with plausible timing. The only cure for this problem is to wait until enough events have been detected to allow for statistical tests to be applied. It needs to be remembered that this is still a single event. Lastly, I am dubious about a signal discovered immediately upon completion of the last upgrades to LIGO. After more than twenty years, a billion dollars spent and a lot of that very recently, there might have been some pressure to rush to publication.

I think that the correct way to regard this result is with a mixture of hope and skepticism. It will likely take a couple of years to let us know if we have opened a new era of discovery or have had another expensive disappointment. A new era might even bring some new ways to confirm some of my own theories on black hole candidates – or it might do some destructive testing of them. Either outcome would be good.

In all science, error precedes the truth, and it is better it should go first than last. ~Hugh Walpole

Who's the Boss?

After serving as chair of the Department of Chemistry and Physics for nine years, Dr. Bill Kelly returned to a full-time teaching position and turned over the reins of leadership to Dr. Jason Johnson last August. The transition has gone off without a hitch, and we have enjoyed working with Dr. Johnson this year. And to Dr. Kelly we say, "Thank you for you many years of support in maintaining a healthy physics program."

Science is the great antidote to the poison of enthusiasm and superstition. ~Adam Smith

Dr. Garabed Armoudian– In Memory

On February 28 we received the sad news that Dr. Garo Armoudian had lost his battle with cancer. Dr. Armoudian was on the physics faculty at SWOSU from 1968 until 2000, serving as the Chairman of Physics from 1990 to 2000. He was enthusiastic about everything he did. He loved physics. He loved SWOSU. He loved teaching. He loved his students and colleagues. In addition to teaching physics, he was a landlord and businessman in Weatherford. He was an avid cyclist, and encouraged others to join him. After retiring, he took up painting and enjoyed traveling the world with his wife. He is survived by his wife Aghavni of the home, daughter Maria of Aukland, New Zealand, son Antranik and his wife Marion and their children Nicholas and Sophia of Edmond, OK, and one brother, Ohan and his wife Roemary of Weatherford.

In lieu of flowers, the family has requested memorials be donated to the newly-established Dr. Garo Armoudian Physics Scholarship Fund at SWOSU or to the National Parks Foundation. Either of these will help sustain some of his deepest commitments: higher education, science, and preservation of nature for all of us to enjoy.

In science, "fact" can only mean "confirmed to such a degree that it would be perverse to withhold provisional assent." I suppose that apples might start to rise tomorrow, but the possibility does not merit equal time in physics classrooms. ~Stephen Jay Gould

Alumni News

This is the part of the newsletter that is written by YOU. We love hearing about your work and activities, and we hope you enjoy hearing about your friends and classmates as well.

Terry Cox ('86) Completed a graduate Certificate in Systems Engineering at Florida Institute of Technology in 2015.

Justin Silkwood ('10) is working at the Tulsa Cancer Institute as a Therapeutic Medical Physicist. He'll be taking his final board examination in May for certification by the American Board of Radiology. Justin works on a team with four physicists helping to treat cancer patients. He really loves his job, and that joy is a positive boost for the patients.

Gordon Gregg ('63) has retired after a long career as an educator and researcher. Gordon earned a M.S. in mathematics from OSU after which he taught for one year at Oklahoma Baptist University. He then attended Purdue University, completing all but a dissertation for a Ph.D. in mathematics. He worked at Los Alamos Scientific Laboratory for two years and then 33 years as Professor of Mathematics at Montgomery College in Rockville, MD.

Amy Fields ('15) is currently working for Crop Guard Research, Inc. in Hinton. The company does agricultural research, working with chemical companies to test their products on crops following the specified protocols. The job involves

making sure those protocols are followed, including proper mixing of the chemicals (which is where the math comes in). The goal is to make sure the chemicals are safe, do what they are intended to do, and determine some of the information that goes on the labels.

Royce Snider ('91) transferred from Flight Technology to the ODA (Organization Designation Authorization) / Civil Certification group at Bell Helicopter inearly 2014. He served as Certification Project Specialist for legacy Model 412EP helicopter upgrades from 2014-2016. In February 2016 Royce was delegated by the FAA as an ODA Unit Member authorized to perform functions necessary for Acoustical approvals at Bell Helicopter. More recently, he has been assigned Manager, Engineering Certification in the ODA.

Mike Moore ('13) is teaching physics, chemistry, and biology at the InterAmerican Academy of Guayaquil in Ecuador. The lessons are in English, and the school is a private, American-curriculum school.

Blake Scott ('15) works for Ckenergy out of Binger as a Technical Services Engineering Specialist. He works with engineers constructing new power lines and taking care of the engineering server model. He also runs data analysis on the power lines looking at load allocation, voltage drop, load balance, and so forth.

A scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die and a new generation grows up that is familiar with it. ~Max Planck

A new and startling revision of the old theories about electricity. John Kuivinen, chairman of an amateur radio group, had discovered what makes integrated circuits (IC) work. Every time smoke was let out of an IC it was found that the system ceased to function. He established in further testing that smoke is what makes all electrical circuits work. Many amateur car restorers have verified his findings. Remember the last time smoke escaped from your voltage regulator? It quit working, didn't it? The simple fact is that the wiring harness carries smoke from one electrical device to another in your car. When it springs a leak, it lets the smoke out of everything at once and nothing works. The starter motor requires large amounts of smoke to work properly, and that is why the wiring to it is so big. Electricity is smoke. In spite of decades of talk and speculation about electrons and such, the fact is that we can find no one who has ever seen an electron. That alone should be sufficient to throw doubt on what was the prevailing theory up to that time.

LET'S STAY IN TOUCH

In this age of connectedness, there's just no reason to lose touch. We send this newsletter out to let you know what we've been doing. Now it's your turn! We always enjoy hearing from you and learning about your activities and achievements. But we're not clairvoyant. You have to tell us yourself. And it's so easy! By email, by snail mail, by phone, by FAX, or in person, we want to hear from you! And you can also connect with us on Facebook at the SWOSU Physics and Engineering group, or on LinkedIn. We even have a place on the SWOSU website for you to update your address or other contact information (http://swosu.edu/academics/physics/alumni/alumni-update.asp). So no excuses! Let us know what you've been up to. Let's stay in touch!

Dr. Brian Campbell	(580) 774-3118	*brian.campbell@swosu.edu*
Dr. Terry Goforth	(580) 774-3109	*terry.goforth@swosu.edu*
Dr. Tony Stein	(580) 774-3107	*tony.stein@swosu.edu*
Dr. Wayne Trail	(580) 774-3124	*wayne.trail@swosu.edu*

You can also send your e-mail to *physics@swosu.edu* or drop us a card or letter to 100 Campus Dr., Weatherford, OK 73096. We'll see that it gets to the right person.

AND WE'RE ONLINE!

You can find us at www.swosu.edu/academics/physics. Click on the Alumni link for newsletters past and present, announcements, or to update your information.

SCHOLARSHIP FUNDS

If you'd like to donate to one of the physics scholarship funds, just go online to http://www.swosu.edu/alum-foun/foundation/scholarship/physics.aspx and click on *Donate Online*, or send your check (payable to *SWOSU Foundation*) to us (c/o Terry Goforth, SWOSU, 100 Campus Dr, Weatherford, OK 73096) or directly to the SWOSU Foundation (SWOSU, 100 Campus Dr, Weatherford, OK 73096). If you send a check, be sure to designate which fund you are giving to **(JR Pratt, Benny J. Hill, Ray Jones, Dr. Garo Armoudian, McClelland, or Physics Unrestricted**) to be sure the money is used for physics. All donations are 100% tax deductible. Check with your employer or organization about matching your donation. And **THANK YOU**!

ALUMNI EMAIL ADDRESSES

If you are a SWOSU Physics Alumnus, drop us an e-mail at physics@swosu.edu and we'll send you the complete list of physics alumni e-mail addresses that we have on file.

If your address is incorrect or if you prefer to use a different address, please let us know and we'll correct it.

If your address isn't on our list (you haven't received any e-mail from us in the last year) and you'd like for us to add it, let us know! We'll gladly include you.

Alumni attending the 2015 Physics Banquet

Back row: Dylan Frizzell, Tyler Overton, Ron Toelle, Jim Bates

Front row: Bob Culpepper, Terry Goforth, Scott Taylor

Back row: Bob Culpepper, Ron Toelle, Jim Bates

Front row: Norma Culpepper, Gale Toelle, Rosalee Bates

DID YOU KNOW?

The National Academy of Sciences provides concise definitions of these critical words: A *fact* is a scientific explanation that has been tested and confirmed so many times that there is no longer a compelling reason to keep testing it; a *theory* is a comprehensive explanation of some aspect of nature that is supported by a vast body of evidence generating testable and falsifiable predictions.

PHYSICS ALUMNI BANQUET 2016

Saturday, April 2, 2016 7:00 p.m. Stafford Air & Space Museum $20/person

Name _____ No. Persons Attending _____

Address _____ Phone _____

_____ Email _____

Please return to: Dr. Terry Goforth✧ 100 Campus Drive ✧ Weatherford, OK 73096

We need to provide a head-count to the caterers by March 30, 2016

SHISH KEBAB 2016

Saturday, April 30, 2016 6:00 p.m. Crowder Lake University Park

Name _____ No. Persons Attending _____

Address _____ Phone _____

_____ Email _____

Please return to: Dr. Terry Goforth ✧ 100 Campus Drive ✧ Weatherford, OK 73096

If you plan to attend, letting us know will help us in planning the food, but feel free to drop in!

Or... just give us a call or e-mail us to confirm for either/both event(s).