



UW-MADISON

2012

APPLIED MATHEMATICS, ENGINEERING, AND PHYSICS

ANNUAL NEWSLETTER

INSIDE THIS ISSUE:

STAFF SPOTLIGHT: PROFESSOR DANIEL KAMMER	2
ALUMNI NEWS: PROFESSOR NELSON TANSU	3
FEATURED STUDENT: ANTONIO PUGLIELLI	4
FEATURED STUDENT: GREG SMETANA	5
QUICK NEWS AMEP TRIVIA CROSS- WORD	6
CONTACTING AMEP	7

A LETTER FROM THE AMEP COORDINATOR

Dear AMEP Alumni, Students and Friends,

These are turbulent times for the World, for Wisconsin, and for the AMEP program as well. As you may know, Paul Milewski has left UW-Madison and he is now Professor of Mathematics at the University of Bath in southwestern England. Paul served the AMEP program as a faculty advisor for 15 years and as coordinator of the program for over a decade. He did much to revive the program with the help of AMEP alumnus Dan Koellen. Together, they created the AMEP leadership prize, initiated once-a-semester AMEP get-togethers and created this newsletter. Paul also developed a more attractive and informative website for AMEP, sorted out and updated the curricular requirements and advised many AMEP students one-on-one. Yet, AMEP was only one of many activities for Paul. He has a world-class research program focusing primarily on waves in fluids, he taught many excellent undergraduate and graduate classes at UW-Madison and he is active on many National, International and University committees. Paul was instrumental in bringing Leslie Smith (current chair of the Mathematics Department and former AMEP advisor) from Yale to UW-Madison, Jean-Luc Thiffeault (AMEP advisor featured in the 2010 newsletter) from Imperial College, and myself from MIT where I first met Paul when he was visiting as a prospective graduate student. You can find Paul on the web at <http://people.bath.ac.uk/pam28/>. Thanks for all your contributions to UW-Madison Paul, and ... Wavespeed!

We miss Paul but AMEP lives on and I am happy to pick up the baton. I have been AMEP advisor since I joined UW-Madison in January 1998 and served as AMEP coordinator in 2000-2001. I created the first pre-historic AMEP webpage in 2000 and wrote a report on AMEP for the Dean of Letters and Sciences that made me realize the importance of Math 321 and 322 for the mathematical education of Applied Mathematicians, Engineers and Physicists. Much of my under-

graduate teaching activities since 2005 have been devoted to redeveloping and redefining Math 321. With Jean-Luc Thiffeault's help, we are expanding these efforts to Math 322 and 320 and these three courses will provide a solid, coherent sequence of courses for physical mathematics, more on that in a future newsletter.

This 2012 newsletter was written by AMEP student Jasmine MacLaughlin, with funding from the AMEP support fund. Jasmine did a great job and I am sure that you will enjoy reading her articles on AMEP advisor Professor Dan Kammer, AMEP alumnus Professor Nelson Tansu and AMEP leadership prize recipients Antonio Puglielli and Gregory Smetana, as well as trying to solve her AMEP trivia crossword! I would also like to thank Kate Bartlett and all the AMEP faculty advisors for their efforts in managing the program, and Sara Nagreen, Senior Information Processing Consultant for the Mathematics Department, for helping me set-up the new AMEP website <http://www.math.wisc.edu/amep/>.

Best wishes,

Fabian Waleffe

Professor of Mathematics

Professor of Engineering Physics



QUICK NEWS:

MORE ON PAGE 6

- AMEP annual get-together December 6, 2012
- Professor Cary Forest's lab on the verge of creating a plasma dynamo in the lab
- Professor Spagnolie announces 2013 Mathematical Contest in Modeling
- UW-Madison scientists model Hurricane Sandy

STAFF SPOTLIGHT: PROFESSOR DANIEL KAMMER

Professor Daniel Kammer is a professor in the Engineering Physics department, and the AMEP advisor for Engineering Mechanics & Astronautics. Professor Kammer has deep-rooted ties with UW-Madison, as he earned his bachelor's, master's, and doctorate degrees from the UW. He originally chose Wisconsin without being aware of its prestige and value, but quickly grew to appreciate the fortune of having such a great university so close to his home town of Fort Atkinson, WI. He recalls fond memories of being a coxswain on a successful Crew team while he was an undergraduate. Through crew, he was given the opportunity to go to England and row against the Soviet Union. Although not an AMEP alumnus himself, Professor Kammer made the connection between math and the physical sciences as an undergrad. He began his education with the intention of studying astrophysics, due to a keen interest in astronomy. He quickly realized that he only needed three more math courses on top of those required for astrophysics to obtain a double major with mathematics. After some soul searching, he dropped astrophysics degree, and graduated with a Bachelor of Science in Mathematics. He recalls a feeling of uncertainty after this abrupt change of degrees, and is thankful for seeing a flyer for Engineering Mechanics on the wall in Chamberlin Hall. He was hooked, and soon began pursuing a master's degree in Engineering Mechanics. He remarks "I had never even thought of being an engineer before that." The correlation between engineering, math, and physics is strong, though, and Kammer completed his graduate de-

gree and then began pursuing a career in Aerospace Engineering. After graduation, Professor Kammer began interviewing with companies like Boeing, McDonnell Douglas, and General Dynamics. He landed a position working in San Diego for General Dynamics, the largest defense contractor at the time, during the "golden age" of aerospace. He recalls the excitement of working on Secret projects. After spending two years in San Diego, Professor Kammer decided to go back to Madison to pursue his doctorate degree. After obtaining his PhD, he returned to San Diego, this time working for a small consulting business. He did not feel fully satisfied in this position, and realized he had the urge to try academia. After applying at numerous universities, Professor Kammer was lucky enough to return to his Alma Mater as a professor at UW-Madison.

Soon after returning to UW-Madison, Professor Kammer's background in math and passion for engineering mechanics were a perfect fit to succeed the current AMEP Mechanical Engineering/Engineering Mechanics advisor, who was retiring. He remarks that advantages of the AMEP program are its diversity and flexibility, along with the chance it offers to view how problems, research, and vocabulary are different between disciplines. It is invaluable to get exposed to the three disciplines and learn the basics in order to be able to communicate effectively with mathematicians, physicists, and engineers. He suggests that AMEP is the perfect fit for someone who is not afraid of math and interested in going to graduate school. He advises "Take as

much math as you can, it's just tools in your toolbox!"

Professor Kammer is passionate about his research in mathematical models. His work allows mathematicians, physicists, and engineers to understand and use phenomena that cannot be reproduced in the laboratory, such as lift-off, separation, and re-entry. The numbers generated from the models he makes can sometimes be the sole basis of decisions for a project. His models focus on predicting vibrations and frequencies generated through external forces. He has done a lot of work in the interface between analytical and experimental results. He remarks on comparing the two, and then fixing the mathematical model if the results don't match up. He has also done experimental testing with accelerometers and sensors on space vehicles. Though much of Professor Kammer's work is aided by a computer, he still solves problems on paper for his research on a daily basis. He jokes that he is "old-



school" but paper calculations provide a concrete, recorded, tangible way to solve problems. Computers have evolved immeasurably in the past 30 years, but paper calculations cannot be dismissed.

Maintaining the history of AMEP Faculty Profiles, Professor Kammer says the equation he would have tattooed on himself is " $F=ma$," true to the fundamentals of his work.

"Take as much math as you can! It's just tools in your toolbox."

DR. NELSON TANSU: LIGHTING THE WAY

Dr. Nelson Tansu (AMEP '98) has recently been awarded the prestigious "Forward Under 40" award by the Wisconsin Alumni association. This award is presented each year to University of Wisconsin alumni under the age of 40 who are making a difference in the world through the Wisconsin Idea. Tansu is the youngest tenured professor at Lehigh University in Bethlehem, Pennsylvania. His ground-breaking research in semiconductor nanostructures is making an impact in the world, and we are proud to claim him as an AMEP alumnus.

Professor Tansu is originally from Indonesia, and growing up he knew he wanted to be a professor of science and engineering in the United States. He enrolled at the UW at the age of 17 and quickly found his place in the AMEP program. Tansu went on to obtain his PhD in Electrical Engineering with a concentration in Applied Physics from UW-Madison in 2003.

Today, Dr. Tansu is the youngest tenured professor at Lehigh University in the Electrical and Computer Engineering (ECE) department. He is highly respected by students for his commitment to education at both the undergraduate and graduate level. His passion for his field and genuine care for the education of students shines through his teaching. Professor Tansu has taught advanced classes such as Applied Quantum Mechanics for Engineers and Physics of Semiconductor Devices along with introductory courses including Introduction to Engineering Electromagnetics.

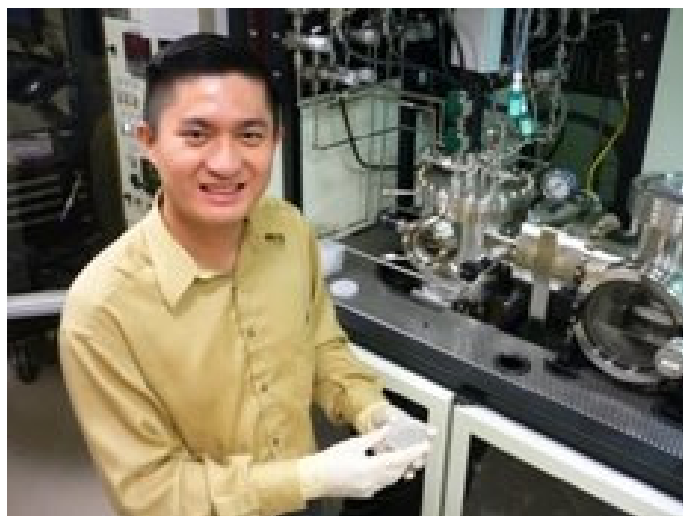
Professor Tansu started work in the field of Applied Physics at UW-Madison as an undergraduate. He continued to

work in MOCVD epitaxy, device fabrications, and device physics of lasers under Professor Luke J. Mawst. Today, Professor Tansu's group, the Tansu Group, at Lehigh University conducts research on semiconductors and nanotechnology. Their primary research field is Applied Physics and Electrical Engineering, both of which Tansu studied at UW-Madison. The group focuses on applying both theoretical and experimental physics to real-world problems, such as energy conservation, communication, and biological and chemical sensors. The Tansu Group uses fundamental physics in the fields of quantum mechanics, quantum electronics, optics, solid-state physics, semiconductors, and electromagnetism to design and engineer materials and devices for optical communications, solid state lightings, solar cells, THz optoelectronics and thermoelectric applications. Tansu has been published in international journal and conference publications almost 200 times. He also holds 4 patents and 4 invention disclosures. In addition to his own work, Dr. Tansu has regularly reviewed for some of the leading research publications in Applied Physics.

Dr. Tansu was recently featured in *Resolve*, a magazine dedicated to research and educational innovation in the P.C. Rossin College of Engineering and Applied Science at Lehigh University for his futuristic work with Light-Emitting Diodes (LED's). LED's are already widely used in automobiles, home lighting, traffic signals, and advertising, among many other applications. In the article, Tansu explains that LED lighting is the way of the future, and urges everyone to con-

sider using LED lighting versus traditional incandescent bulbs, which only convert 5 percent of their energy usage to light. Tansu goes on to elaborate that developing countries, including his home country of Indonesia, will be burdened by lack of energy to power their development if they continue to use incandescent bulbs. Dr. Tansu is currently working on designing and building new LED's that improve the efficiency of light generation, develop better light extraction from the semiconductor, and cut costs to make LED lighting more practical for consumers. Dr. Tansu's passion for energy conservation coupled with his broad background in Applied Physics and Electrical Engineering are changing the world as we know it.

His ground-breaking research in semiconductor nanostructures is making an impact in the world, and we are proud to claim him as an AMEP alumnus.



SCHOLARSHIP WINNER: ANTONIO PUGLIELLI

Antonio Puglielli is a current AMEP student, and a recent recipient of the AMEP Leadership Prize. He plans to graduate from UW-Madison with a degree in AMEP in May 2013. Antonio attended high school in Madison, and is thankful for the opportunity to attend classes at the UW while still in high school. He was aware of his interest in the physical sciences early, taking Physics 247 and 248 along with math classes before officially graduating high school. Antonio stumbled across AMEP in the Physics handbook and was instantly drawn to the unique combination of physics and engineering offered by the program. Although he would have been satisfied with a degree in either physics or engineering, he is particularly satisfied with AMEP because of the flexibility of the program and the ability to bypass duplicate introductory courses in engineering and the sciences, therefore leaving more time for higher level study. He also remarks on the utility of the integration of mathematics into the degree, "it gives you a different perspective on how things are done in physics and engineering." He recalls the challenge presented by taking Math 321 first semester Freshman year, but looks back on it fondly, remembering the valuable knowledge gained.

In Summer 2011, Antonio earned a great opportunity to intern with

National Instruments, a world-wide company specializing in data acquisition, modeling, and instrumentation. In 2012, he interned with QualComm, a company that designs and builds wireless telecommunication products, among others. He plans to work with that company again in summer 2013. Antonio has worked with Robert McDermott since his freshman year, doing research on superconducting quantum computing. This experience has provided him with invaluable knowledge and the chance to attend conferences that would not normally be available to an undergraduate student. Antonio values his research experience highly; he remarks that research can provide a bridge to the gap between theoretical learning in the classroom and real-world applications. He says that research also solidifies the correlation between math, engineering, and physics, specifically exemplifying that he does a lot of electrical engineering work while doing research in his physics lab. Antonio has fond memories of a particular experiment that involved building a faraday cage and building a LabVIEW program to take and analyze data. This experience led him to an interest in electrical engineering, the focus of the engineering aspect of his AMEP degree.



When asked what advice Antonio would give to an incoming AMEP student, he said "be prepared to work hard," but the benefit of understanding physics at a more technical, in-depth level is well worth it. He also suggests that an AMEP student should have a broad set of interests and be prepared to be exposed to many different disciplines in the physical sciences. He recalls his own experience of fearing "categorizing" himself as a physicist or engineer too quickly, and thereby ostensibly missing out on experiences outside of his discipline. AMEP is a great resolution for this issue.

Antonio decided to use this year to continue working on his bachelor's degree, especially to solidify his education in electrical engineering. He is currently applying to graduate schools and plans to get a PhD in that field. After completion of his education, he plans to do work with semiconductors, specifically research and product development for a company like Intel, Qualcomm, or IBM. He is grateful for the AMEP Leadership Award, and excited to embark on the next chapter of his life, well-prepared with an AMEP degree.

PAST AMEP LEADERSHIP PRIZE WINNERS

- 2003 – Kyle Mandli (AMEP '04)
- 2004 – Lyuba Chumakova (AMEP '04), Jeremy Hanson (AMEP '04) and Andrew Huening (AMEP '05)
- 2005 – Jeffrey Noel (AMEP '05) and Christopher Yu (AMEP '06)
- 2006 – Doug Lipinski (AMEP '07)
- 2007 – Li Jiang (AMEP '09) and Zac Labby (AMEP '07)
- 2008 – Erick Butzlaff (AMEP '08) and Nick Ballering (AMEP '08)
- 2009 – Matt Harrington (AMEP '10)
- 2010 – Yaroslav Vergun (AMEP '11)
- 2011 – Greg Smetana (AMEP '12) and Antonio Puglielli

SCHOLARSHIP WINNER: GREG SMETANA

Greg Smetana is a recent graduate of the AMEP program and a 2011 recipient of the AMEP Leadership Prize. Greg attended high school in Eau Claire, WI, and jump-started his college career by taking college math courses at UW-Eau Claire while still in high school. Greg first learned of AMEP from an advisor during his SOAR session before beginning coursework at UW-Madison. He was immediately enthralled by the program, drawn especially to its flexibility compared to a strictly engineering major. He said, "Strangely enough, the relatively high number of math and physics classes appealed to me, because I've always been a bit more abstract than most engineers." While many people cringe at the thought of taking more math and physics classes, most AMEP students and graduates share the same feelings as Greg toward this challenging curriculum. Greg was a peer mentor tutor with the Physics Learning Center for two years as well. As an undergraduate, Greg really enjoyed attending Badger games. Some of his favorite memories are the Badger victory of number one ranked Ohio State in 2010 and road tripping with friends to Pasadena for the Rose Bowl. He also remembers enjoying Wisconsin's own old-fashioned at The Old-Fashioned. He adds, "Spending time on the terrace, learning to sail with Hoofers, and having cookouts on Picnic Point are all highlights of my undergraduate career that I will remember for a lifetime." In addition, Greg was elected president of the Physics Club while he was an undergraduate at UW-Madison, exemplifying his deservedness of this leadership award.

Greg had the opportunity to work with Professor Thad Walker in the physics lab for three years as an undergraduate. He contributed to a project designing a spin-exchange-relation-free atomic

magnetometer (SERF) for bi-magnetic measurements. The goal of the project was to measure the electrical activity of a fetus, in hopes of finding a new way to diagnose arrhythmia. This project was particularly challenging because the disease only registers on the order of a femtoTesla (10^{-15} T). During this experience, Greg and his fellow researchers were able to use an incredibly sensitive magnetometer to successfully measure fetal signals. Greg is particularly grateful that he was able to work on the same project for three years, which meant he was able to really contribute to almost every aspect of the project, learning more every step of the way. He remarks that although the project was done for the physics department, he learned an incredible amount about optics, electronics, computer programming, vacuum systems, machining, and data analysis. Greg remarks, "Doing research was one of the most positive, most rewarding experiences of my undergraduate career."

Greg shares that one important characteristic that all AMEP students possess is a passion for learning. He exemplifies, "An AMEP student would never ask 'why do I have to learn this?' There are very few topics that don't have an important application in some field. Finding unexpected connections between subjects was one of the most exciting things about having such a broad background." Greg also believes that perseverance and passion are more beneficial qualities than sheer

intelligence. He acknowledges that no one immediately understands everything, and it is the determination to overcome setbacks that differentiates between successful and average. Finally, Greg advises AMEP students, "Get out there and take some risks. Don't not take a class just because you think it will be hard or because you will earn a bad grade...if you're motivated, you can learn whatever background you need on the fly." That is good advice and a powerful challenge.

Currently, Greg is attending graduate school in aeronautics at Caltech. He admittedly has always had a passion for things that fly, even earning his private pilot license this summer. He said, "I hadn't considered aeronautics as a course of study until taking aerodynamics, flight dynamics, and aerodynamics lab from Professor Bonazza. He is a fantastic professor and really cares about his students." Though the UW does not offer a graduate aeronautics program, Greg is confident that his AMEP background is a good fit for a smooth transition into the program at Caltech. Greg chose

graduate school over entering the workforce right after graduation, because he wants to be a grad student. He explains, "Getting paid to go to class, learn new things, and do research in a lab just sounds like a great opportunity." Graduate school also provides a great path into research, which Greg is very passionate about. "Being on the cutting edge of a field, solving problems that no one else has had to solve before, is really exciting." He is currently taking classes at Caltech and will probably decide on a project to work on by the spring. He plans to earn his PhD in the future doing research in experimental fluid dynamics. Greg would like to have a career in research and possibly be a professor in the long run, but he says, "At this point it seems I am equally likely to end up in academia or industry." One of the great things about AMEP is it prepares you adequately for both! Congratulations Greg on your AMEP Leadership Prize and the exciting things you are doing with your AMEP degree.



QUICK NEWS

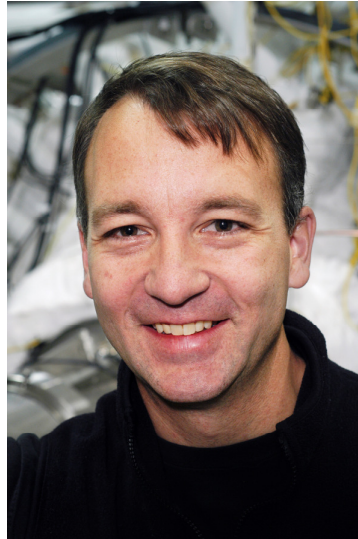
Professor Cary Forest, an AMEP Physics advisor is on the brink of a cosmic discovery: creating a plasma dynamo in the lab. Astrophysical dynamos, which create electric and magnetic fields from fluid motion, generate the magnetic fields of the Earth, Sun and planets and stars. Professor Forest's lab has created a device lined with rare-earth magnets that has been able to create a series of brief plasma events. This may be the first step to better-understanding the important field of dynamos. See more at

[http://www.news.wisc.edu/21198?](http://www.news.wisc.edu/21198?utm_source=iUW&utm_medium=email&utm_campaign=iUW2012-10-25)

[utm_source=iUW&utm_medium=email&utm_campaign=iUW2012-10-25](http://www.news.wisc.edu/21198?utm_source=iUW&utm_medium=email&utm_campaign=iUW2012-10-25)

And visit Professor Forest's webpage at:

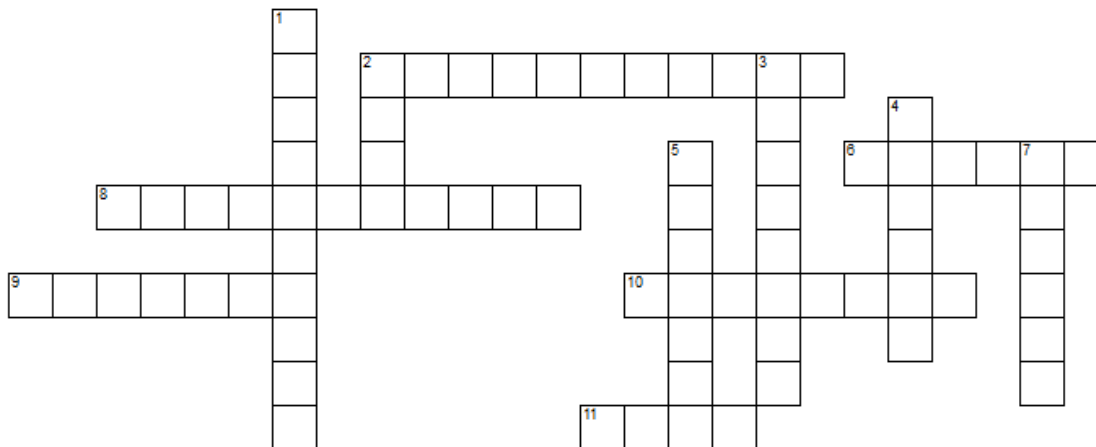
<http://home.physics.wisc.edu/~cbforest/>



Professor Cary Forest

Professor Saverio Spagnolie recently announced the chance for UW-Madison students to participate in the annual Mathematical Contest in Modeling (MCM), an international competition where students work in teams to solve a real-world problem. This will be the first time UW-Madison students will be participating in this contest. Teams are given an open-ended problem and have exactly 96 hours to best-design a solution to the problem. Previous problems include estimating the effects of a meteor strike and studying hunting methods of prehistoric animals. For more information see <http://www.math.wisc.edu/~spagnolie/COMAP/>

AMEP TRIVIA CROSSWORD



ACROSS

- 2 The year AMEP was first created at UW-Madison
- 6 Wrote three laws of motion
- 8 The UW-Madison mascot since the 1930's
- 9 The best city in Wisconsin
- 10 Month of the annual AMEP Get-Together
- 11 The abbreviation for Applied Math, Engineering, and Physics

DOWN

- 1 The year the United States put the first man on the moon
- 2 The equation Professor Kammer would have tattooed on himself
- 3 The author of the Special Theory of Relativity
- 4 Wrote three laws about gravitation
- 5 The last name of the current AMEP Coordinator
- 7 The team Wisconsin played in the Rose Bowl on January 2, 2012

CONTACTING AMEP:

For questions regarding AMEP

Page 7

Please contact the AMEP Coordinator:

Fabian Waleffe

Prof. Dept of Mathematics

Prof. Dept of Engr. Physics

Phone: (608) 263 3269

Email: waleffe@math.wisc.edu

GIVING TO THE AMEP PROGRAM:

If you would like to make a gift to support the AMEP program at UW-Madison, please consider giving to Fund number 12553426, the Applied Math, Engineering and Physics (AMEP) Support Fund.

Gifts to this Fund support AMEP, a unique interdisciplinary program. The fund supports:

Improving AMEP's ability to successfully mentor students

Fostering a sense of community among students and faculty

Enhancing the visibility of AMEP on campus and to prospective students and recruiters

You may make your gift online through the link provided at:

<http://math.wisc.edu/amep/news>

Or, you may send your gift to:

University of Wisconsin Foundation

US Bank Lockbox

PO Box 78807

Milwaukee, WI 53278-0807

Mark AMEP and the fund number 12553426 in the memo line of your check.

If you wish to speak with someone about your gift or other giving options, please

feel free to contact our representative at the UW Foundation:

Ann Lippincott

University of Wisconsin Foundation

Email: Ann.Lippincott@supportUW.org

Phone: 608-263-3604

<http://www.uwfoundation.wisc.edu>