University of Mary Washington
where great minds get to work

Physics Department Newsletter 2017-2018

Departmental Updates:

Dr. Ibrahima Castillo Diallo joins the department as an adjunct professor. Ibrahima earned his PhD in nanoscience and nanotechnology from Virginia Commonwealth University in June 2017. He has M.S in Applied Physics from Virginia Commonwealth University, 2013. As an undergraduate, Ibrahima earned B. A. degrees in Physics Commonwealth University, 2011.

More Departmental Updates:

- Dr. Maia Magrakvelidze presented her work at the 48th Annual Meeting of the APS Division of Atomic, Molecular and Optical Physics held in Sacramento, California, on June 5-9, 2017. Her presentations, in the Time-Resolved Electron Dynamics and Attosecond Spectroscopy, were titled "Attosecond relative delay among xenon 5p, 5s, and 4d photoionization," and "Time-dependent local density approximation study of iodine photoionization delay." These results are very important for current experiments for investigating the time delay in photoionization processes of different systems.

- Dr. Maia Magrakvelidze co-authored an article with Himadri S. Chakraborty titled "Attosecond time delays in the valence photoionization of xenon and iodine at energies degenerate with core emissions" in the Journal of Physics: Conference Series 875, 022015 (2017), Published online: 18 August 2017.

- Dr. Hai Nguyen attended 2017 PICUP Summer Faculty Development Workshop at UW River Falls.

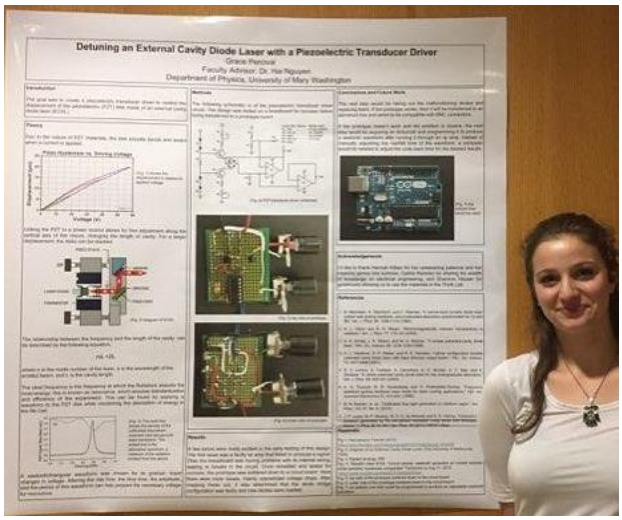
- Dr. Hai has been selected as the 2018-2019 American Association for the Advancement of Science (AAAS) Fellow. The idea of the Fellowship is that it promotes and defends the integrity of science and its use in the Executive Branch of our government. It also seeks to provide a voice for science on societal issues and promote the responsible use of science in public policy. AAAS runs SCIENCE Journal and Science and Diplomacy.

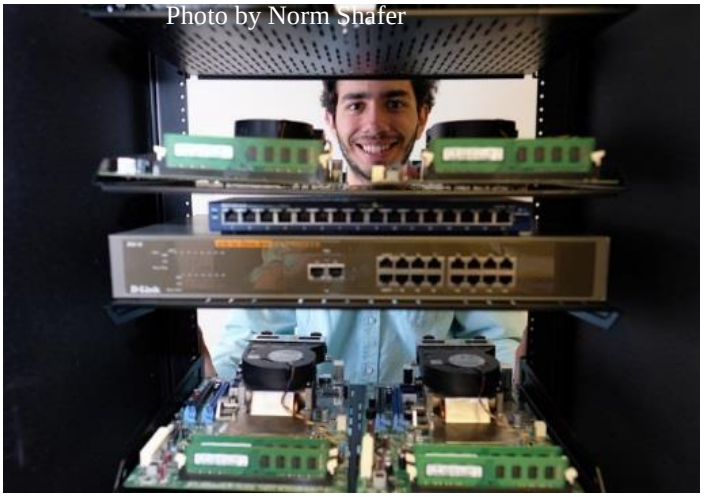
Jepson Science Center Expansion

Constructions have started in Fall 2017 and are planned to continue till Fall 2019.

Summer Science Institute (SSI) Presentations

Grace Percival presented poster on – "Detuning an ECDL with a Piezoelectric Transducer Driver" – the goal of the project was to create a piezoelectric transducer driver to control the displacement of the piezoelectric disk inside of external cavity diode laser.





Brandon Rozek gave a talk on – "Coherent Control of Atomic Population Using the Genetic Algorithm" – the goal of the project was to develop the Genetic to find the set of parameters that will transfer the desired amount of population to an upper state of Rubidium-87 (^{87}Rb).

Physics Department hosted solar eclipse party on August 21

Visitors from Dahlgren

Allen Parks, Willie Catoe, Lorraine Harting, John Gray, and David Fallest, from Naval Support Facility Dahlgren visited Physics Department on August 28th. They met with our students and discussed the research projects students are involved and potential summer internships for them in their research units.

https://www.cnic.navy.mil/regions/ndw/installations/nsa_south_potomac/installations/nsf_dahlgren.html

Invited Talks

Dr. Bob Jones – Francis H. Smith Professor of Physics, Department of Physics, University of Virginia, Charlottesville, VA, gave a talk on April 12th (HCC 329, 2:00 pm) on:

Probing Matter with Attosecond Photo-Electron Wavepackets*

Electronic processes and electron-driven reactions in atoms, molecules and condensed systems can proceed very rapidly, with relevant time-scales in the attosecond (attosecond=10^{-18} s) regime.

When activated by the photoabsorption of extreme-ultra-violet attosecond laser pulses, the electron dynamics can be probed in real time by employing the coherent optical field of an additional infrared laser to mark time during the system's evolution. While temporal resolutions on the order of 10 attoseconds have been demonstrated in such measurements, the physical insight which can be directly gleaned from these experiments has been limited, relying on extensive numerical simulations for interpretation. Now, a team from the University of Virginia and the Ohio State University has demonstrated a new technique that utilizes quantum interference in attosecond photoionization to directly reveal explicit information on an electron's local environment, captured within a brief time interval (~ 1 femtosecond) following its emission. Initially applied to investigate the effects of electron correlation within atoms, the method should be applicable to molecules, and perhaps condensed systems as well. **Nature Physics,* **volume14**, pages68–73 (2018)

Alumni Visits

One of our recent graduates stopped by the department to say "Hello!!" **Vincenzo Giambanco** is now a High School Physics Teacher in Northern Virginia. We always love his attitude and positive outlook in Physics as well as in life. He's doing what he loves. We hope to develop closer working relationship in teaching physics both at the high school and college levels.

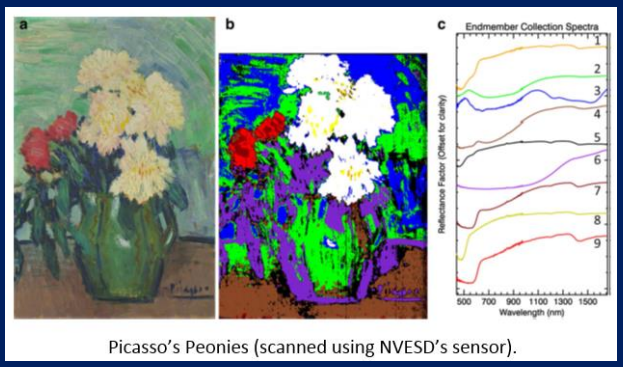
Stephanie Tobler – physics graduate 1994 visited Dr. King Fall 2017. She currently studying conflict resolution, peace and justice in order to work in the international peace building community.

We are always happy to see our alumni and hear about their success stories.

Join us on Facebook

Alumni Invited Talks

Mimi Huynh – UMW Alumna, gave a talk about "Research and Development in Advanced Sensors for Military Technologies and Imaging Famous Art Pieces" on October 9th, 2017.



Picasso's Peonies (scanned using NVESD's sensor).

After graduated from UMW, Mimi works as a physicist and scientist for MTEQ, INC., who specializes in the development, integration, and testing of EO/IR sensors and systems. Her current work is located at the NVESD (Night Vision and Electronic Sensors Directorate) compound in Ft. Belvoir, VA, supporting the research and testing of EO/IR sensors, tactical lasers, signal processing, and hyperspectral imagers. She will talk about applications of these sensors, the kind of data they produce, and what scientists can extract from them. Applications and examples include not only military and defense purposes, but also includes images taken of famous art pieces for art conservation purposes.

A physics graduate from the class of 1994, **Stephanie Tobler**, who had conducted undergraduate research on the effect of spin on a falling sphere with Dr. George King III, gave talk on April 19th about her career in physics beyond her time here at UMW. Ms. Tobler worked for 11 years at Lockheed Martin, a large defense contractor in aviation and space systems, in various capacity. After leaving the corporate world and spent time in Switzerland to connect with family and her cultural heritage, she returned to the U.S., she taught English to immigrants and refugees in Philadelphia. Looking to fulfill her passion to positively impact the world, she was a Peace Corps volunteer in the Republic of Macedonia in 2014. She currently studying conflict resolution, peace and justice in order to work in the international peace building community.

Dalton Echard, a rheology specialist at Anton Paar USA, graduated with a B.S. in Physics from the University of Mary Washington (2014) and an M.S. in Physics and Nano Science from Virginia Commonwealth University (2016) gave talk on April 26th on **Solids, Liquids and Everything In Between – Rheology and its Applications.**

Rheology is the study of the flow and deformation behavior of liquids and solids. Viscosity is often used to describe liquids, honey is more viscous than water, but this is only the tip of the iceberg that is rheology. Describing how materials physically change on a macro scale can often be best described on a smaller scale. The forces between molecules give materials structure and shape, given different conditions these interactions can change allowing a material to act differently on a larger scale. Rheology is a science often used in academia for high end research of materials as well as a wide array of industries including, coatings, cosmetic, adhesives, pharmaceuticals, food, soft matter, polymers, powder processing and more. This talk will go over what rheology is, how it can apply to everyday life and in the modern lab.

Anton Paar

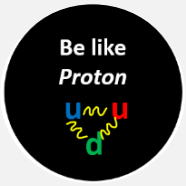
SPS CLUB (ΣΠΣ) The Society of Physics Students (SPS) is a professional association explicitly designed for students. Membership in this club is open to anyone interested in physics. Besides physics majors, our members include majors in chemistry, computer science, engineering, geology, mathematics, medicine, and other fields.

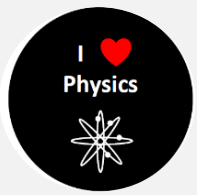
The SPS club at UMW exists to help students transform themselves into contributing members of the professional community. Course work in the major develops only one range of skills, however, an active SPS member acquires other skills such as effective communication and personal interactions, leadership experience, establishing a personal network of contacts, presenting scholarly work at professional meetings and outreach services to the campus and local communities. Members of the SPS at UMW meet once in every two weeks (every alternate Wednesday at 5:00 p.m.). At these meetings, the club officers discuss about the upcoming events (research talks, fundraising, telescope nights and so on) held by the club or by the Physics Department, and design T-shirts/buttons. This club also provides students an opportunity to have effective and fun conversations with their professors and fellow-classmates.

SPS hosted Standard Gravity Day this year on September 9th (9.8 m/s²)

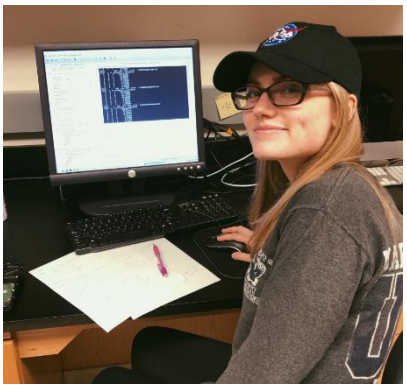
SPS at Club Carnival

If you are interested in joining SPS, please contact
Elizabeth (email: ekaiser@umw.edu),
Vidhya Cardozo (email: vcardozo@umw.edu),
Kayla Frye (email: kfrye3@umw.edu),
or Abigail Wigboldy (email: awigbold@umw.edu)





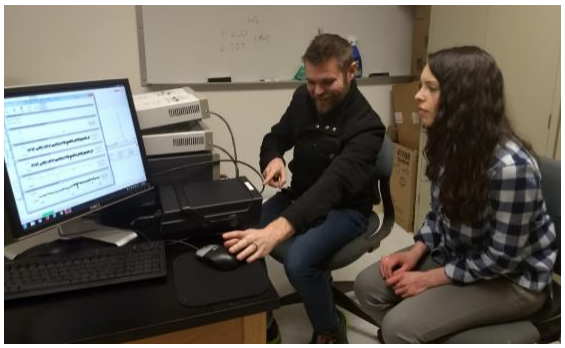
Student Research



Hannah Killian – "**Attosecond time delay in photoionization"** –The field of atomic, molecular, and optical (AMO) physics encompasses the study of interactions between matter and other matter, or the interaction of matter and light. Since the interactions are between single atoms, they occur very quickly. This research involves a theoretical laser-matter interaction, during which the energy from the laser interacts with a valence electron in the atom. The electron becomes separated from the atom, which is referred to as photoionization. This process occurs very quickly, on a time scale of 10^{-18} seconds. The main purpose of this project is to determine the amount of time it takes for the photoionization process to occur during the ionization of the valence electrons from bromine and krypton atoms. The difference between the duration of time it takes for electrons in different energy levels to ionize is referred to as the relative time delay. Several theoretical models exist in order to calculate the delay. This research makes use of the time dependent local density approximation (TDLDA) specifically, with FORTRAN software. We optimize the input for the method in FORTRAN and calculate the relative time delay for the *4p*, *4s*, and *3d* electron energy levels for bromine and krypton. (by Hannah)

Margaret Gregory and Melody Sepehrar – "**Setup for Saturated Absorption Spectroscopy of ^{87}Rb"** – We investigated the atomic structure of ^{87}Rb using saturated absorption spectroscopy. In order to observe the hyperfine levels of ^{87}Rb, the laser must be locked at a frequency of 780.241 nm. To ensure accuracy in our findings, a reliable voltage of ±15 V must be supplied. Our voltage supply proved unreliable and as a result our investigation was halted. Thus, we started to reconstruct this equipment. Once this setback was resolved, it was also discovered that the gain and offset controls that we were using also required modifications, in order to ensure accuracy. With the improvement of these pieces of equipment, we can now assess the hyperfine structure of the ^{87}Rb atoms with increased precision and accuracy. (by Margaret and Melody)

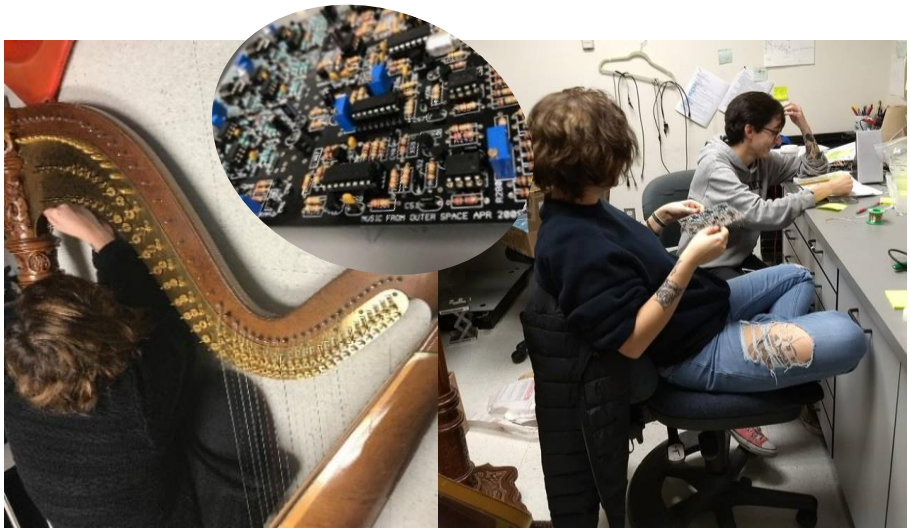
Sterling Heyns – "**Molecular Dynamics**" – Computer programming is an invaluable tool of physics, allowing us to perform theoretical calculations quickly and in-depth. One of the most important parts of designing a successful simulation is how the data is presented, which was the focus of our project. Dr. Magrakvelidze designed a program to simulate the process of atoms in molecules moving further apart when being exposed to laser light, which output its data in the form of a three-dimensional file. Our job was to take these data points, printed in lines that each represented a time step, and create a moving graph. By the end, we had created a program that parsed the three dimensional data into rows, turned the individual data into points on a graph, then updated the positions of those points with each incoming row. While this sounds simple from a human standpoint, computers have much less of a free-form thought process and the act of parsing the files alone was a considerable task. The work is challenging, but using computer science to transform data into understandable visuals makes it one of the most valuable tools when marketing science to the public. (by Sterling)



Andrew J. Rasure and Shannon Brindle – "**Exploring Parameters for Up-converting Nanoparticles**" –This is an ongoing research project to compare the performance of wavelengths around 980 nm and 915 nm as they excite NaYF4 nanoparticles and the effects that this will have on biological tissue such as overheating due to water absorption of said wavelengths. The experimental setup of this project references many previous experiments on up-converting nanoparticles using laser beams of 980 nm wavelength. The advantages of using 915 nm laser includes lower water absorption and deeper tissue penetration, which is ideal for medical applications. It was recognized that nanoparticles have the potential to facilitate research of biological processes at the molecular level. The benefits of using nanoparticles include orthogonal bio-imaging and photo-modulation which removes the potential tissue damage that results from radiation while optimizing penetration. The tracking of drugs through the blood-brain barrier when receptors are present for the nanoparticles is also one of the many applications of studying UCNPs. (By AJ and Shannon)

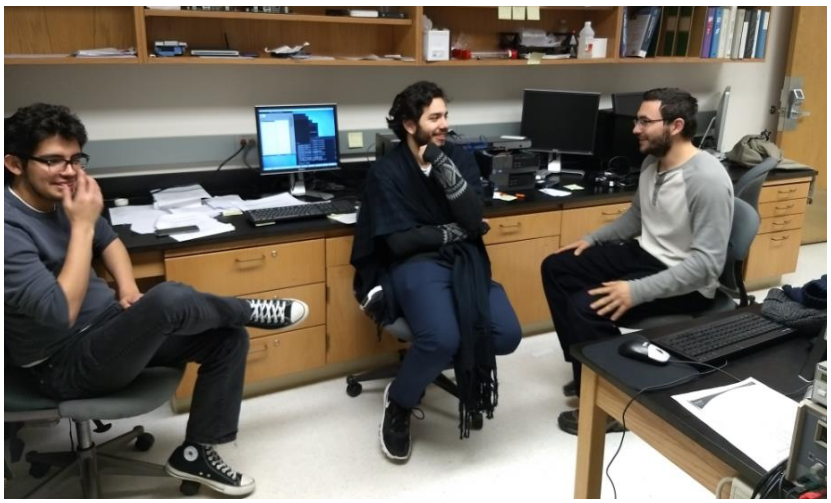
Interdisciplinary Research Projects

☼ **Physics and Music ♪×♫** – *Rebecca Callaway (Double major in Physics and Music) and Mary Dye (music major)*



"Laser Harp: Restoring a Classic Instrument with Modern Technology" – Working in conjunction with the music department, we decided to use our knowledge in physics as well as music technology to create a digital synthesizer, a synthesizer that uses digital signal processing techniques to make musical sounds, that utilizes lasers and photo-resistors as an interface instead of the common keyboard. With the gracious donation of an injured harp by Dr. Brooks Kuykendall and the music department, we were able to repair and refurbish what we could of the original concert grand harp and input almost two full octaves worth of lasers, photo-resistors, and the required circuitry. When a laser is blocked, the frequency that is assigned to the given laser/photo-resistor pair is then played through the attached speaker.
Mentors: Dr. Hai Nguyen (physics) and Dr. Michael Bratt (music technology) (By Rebecca and Mary)

☼ **Physics and Computer Science** – *Brandon Rozek, Stefano Coronado, Ethan Ramirez* **"Beowulf Cluster for Research & Education"**



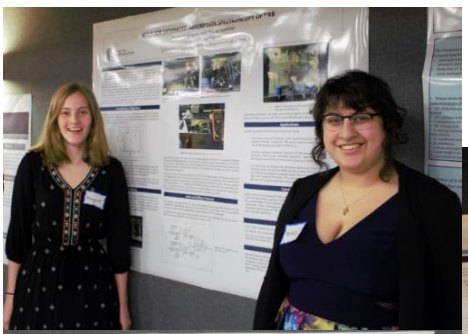
As theoretical simulations become more complex, the amount of computational power needed to solve the models increase proportionally. Thus in order to keep up with the trend, we set out to design and construct an array of computers, called a Beowulf cluster, to serve the need by using a scheduling service to break apart large computational problems and distribute a piece of it to each computer in the cluster. As each computer solves its piece of the problem, it sends it back to the master where it recombined and presented to the user. This principle of parallelizing serves to cut down the total computational time, enabling the user to build more complicated and physically accurate models. Our cluster is designed with modularity and usability in mind so that additional computers can be added to the cluster with minimal user configuration and researchers from any discipline can run the system without extensive prerequisite knowledge. Proof of concept has been demonstrated and future work will involve refining and optimizing the system; **L**arge **U**niversal **N**etworked **A**rray of **C**omputers (**LUNA-C**).

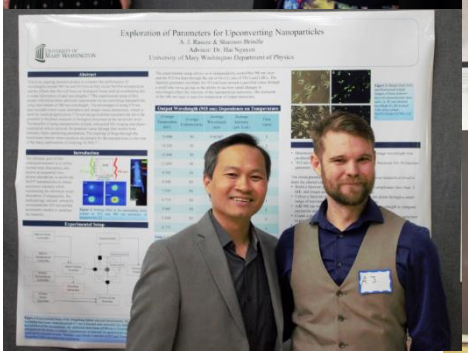
☼ **Physics and Psychology** – *Carlos Ramirez* –**"The development of a simple free-operant maze navigation apparatus"**

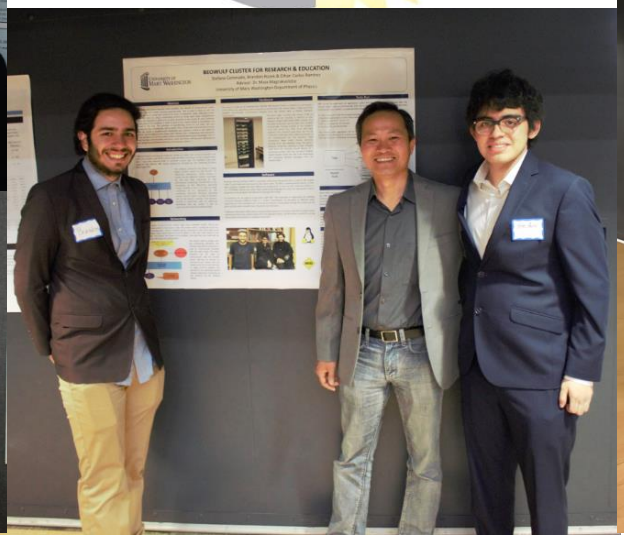
Traditionally, the collection of spatial navigation data in animal learning preparations has typically been some combination of arduous, inefficient, inflexible, and costly. Standard appetitive preparations involve conducting trials in a serial fashion, necessitating a great deal of handling on the part of experimenters. Thus an apparatus such as this allows for the implementation of a much wider array of conditions, including a variety of reinforcement schedules and controlled variation of the delivery of multiple reinforcers within a single session. This system can be installed in a variety of maze types, is highly modifiable, and dramatically reduces the need for handling individual animals, as iterative opportunities for reinforcement are automatically presented depending on the animal's performance.

Research and Creativity Day Presentations

Margaret Gregory and Melody Sepehrar – "**Setup for Saturated Absorption Spectroscopy of ^{87}Rb"**
Andrew J. Rasure and Shannon Brindle – "**Exploring Parameters for Up-converting Nanoparticles**"
Rebecca Callaway and Mary Dye **"Laser Harp: Restoring a Classic Instrument with Modern Technology"**
Brandon Rozek, Stefano Coronado, Ethan Ramirez **"Beowulf Cluster for Research & Education"**



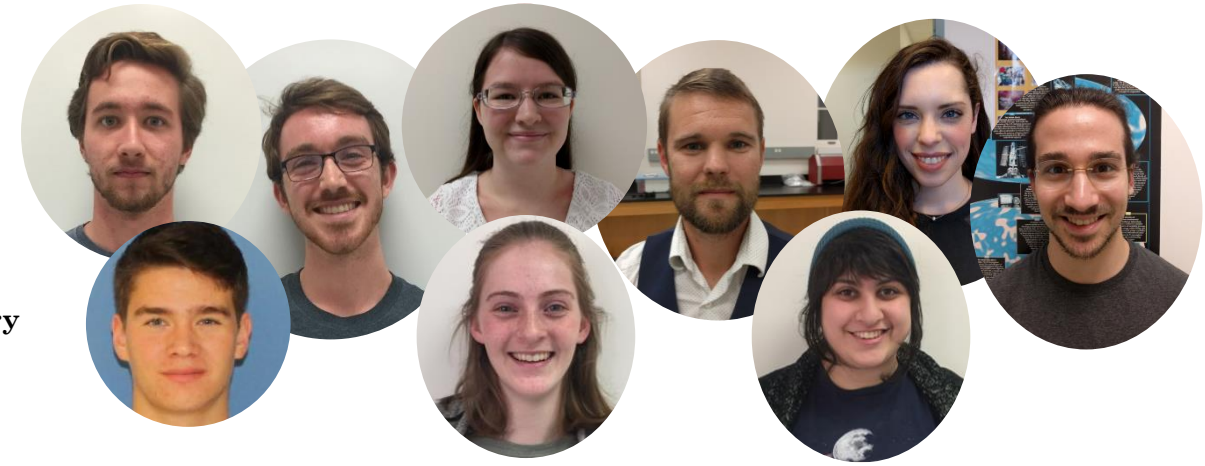




New Students

This year we had some new students declaring the physics major:

1. **Stephen Tivenan**
2. **William Filkoski**
3. **Reannon Mounie**
4. **A. J. Rasure**
5. **Shannon Brindle**
6. **Philip Sadighian**
7. **Melody Sepehrar**
8. **Margaret Gregory**
9. **Samuel Adler**



Welcome!

Congratulations Class of 2018!

1. **Kayla Frye** — Naval Support Facility, Dahlgren
2. **Kaela Gosdzinski** — Naval Support Facility, Dahlgren
3. **Terence McPhillips** — Naval Support Facility, Dahlgren
4. **Ethan Ramirez** — Lab technician UVA
5. **Eric Raterman** — Lab Tech Florida
6. **Nicholas Ryals** — Webmaster for a Defense Contractor in Northern Virginia

Einstein Prize Award an award presented to a graduating physics major for outstanding performance, qualities adjudged as academic excellence, leadership and overall contributions to the physics program. This award was established in 1995 and funded initially by Dr. Bulent Atalay. This year's recipient is: **Kayla Frye** for her tremendous input to Physics Department. Kayla is double major in Physics and Math.

Physics Faculty award– established in 2002 by the physics faculty, this award recognizes a senior for outstanding academic accomplishment in the physics program. This year's recipient is: **Terence McPhillips,** for his high academic performance.

Bulent I. Atalay Scholarship in Physics – given to rising junior or senior majoring in physics. This year's recipient is: **Stephen Tivenan**

Glenn and Mary Downing '59 Scholarship **$3,750** This scholarship is for students majoring in a Science, Technology, Engineering, or Math (STEM) related field and who are at risk of being unable to finish their undergraduate studies at UMW due to a financial setback. This year's recipient is: – **Kaela Gosdzinski**

Special THANKS to our recent program donors:

Pietro Perrino, and

Dr. Ellen Brown

We do appreciate your continuous support!!!

MARY WASH
GIVING DAY

Dr. Ellen with her dogs Gowkie and Spunky

University of Mary Washington
where great minds get to work

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Reaching out

Dr. Hai visited our recent graduate Mr. Giambanco teaching physics at Kettle Run High School.