THE QUARK

Brought to you by the Society of Physics Students

Contents

About the Quark

The Quark is a monthly newsletter written by the members of the Public Relations Committee of the Society of Physics Students at Texas Tech University.

All questions, comments, concerns, or suggestions may be directed towards the current SPS Public Relations officer, Shanmuga Shivakumar (shanmuga.shivakumar@ttu.edu) and Editor in Chief, Colin Brown (colin.t.brown@ttu.edu)

The Event Horizon Telescope

By Colin Brown

The now famous image of the accretion disk surrounding a black hole. Captured by the Event Horizon Telescope. [1]

Most people are by now undoubtedly familiar with this image of a black hole, the first image of its kind to be taken. It seems that black holes are rather camera shy, and the fact that light cannot escape their gravitational forces makes them not truly possible to photograph directly. This means that what is being shown in this photo is the accretion of matter into the black hole. So how did astronomers manage to capture such an image? What telescope was capable of taking a picture of what had never been seen previously? That honor falls to the aptly named Even Horizon Telescope (EHT). While first part of the name is fitting for it's usage imaging black holes, it is not actually a telescope, but an array of telescopes from different parts of the globe, working in

conjunction to view the image.

The telescopes that make up the array are not what most people would think of as telescopes, but are radio telescopes which resemble large dish antennae. Some celestial bodies can be observed much more easily when using frequencies in the radio part of the EM spectrum, but radio telescopes often require large dishes in order to provide high resolution data. This problem is dealt with by combining multiple telescopes into an array using an imaging technique known as Very Long Baseline Interferometry. The EHT was an international collaboration to create a telescope specifically for the imaging of black

Event Horizon Telescope locations: green markers indicate current sites, purple markers indicate future sights. Telescope at the south pole not shown. [1]

holes. The collaboration has active telescopes in Arizona, California, Hawaii, Chile, Mexico, Spain, and the Antarctic. Future sites include locations in Greenland and France.

The famous image that they recently produced was of the Supermassive Black Hole at the center of the galaxy Messier 87, and is 6 billion times more massive than our sun. It is however, only 1500 times more massive than the Black Hole at the center of our own Milky Way Galaxy, named Sgr A* for it's discovery in the Sagittarius Constellation's portion of our sky. This much closer but smaller black hole

that has yet to be imaged by the telescope. Imaging of the black hole at the center of our galaxy has been a research objective of the EHT collaboration since its founding, and it may not be long until they release another image that will make astronomical history.

Professor Spotlight: Dr. Simone Scaringi

By Shanmuga Shivakumar

Dr. Simone Scaringi is an up and coming professor who joined the Physics Department in Fall of 2018. He graduated from the University of Southampton in the UK where he received his bachelor's in Mathematics and his Master's and PhD in Physics. He worked very closely with the Astronomy group during his years at Southampton.

Ever since he was young, Dr. Scaringi had an interest in Astronomy and Cosmology, always curious about the heavens above us and how our universe came to be. However, during his time in school, he struggled with learning math. Though, with some dedication and help from a really good high school math teacher, he improved his skills, which sparked a new interest in mathematics.

One little known fact about Dr. Scaringi is that he loves heavy metal. He says "The faster, the screamier, the better." One of his favorite pastimes is to head to the garage and just rock out to some heavy metal on his drum set. Another one of his favorite pastimes is to spend time with his wife and 2 kids, who he loves dearly.

After he got his Bachelor's and was a grad student at Southampton, Dr. Scaringi gained an interest in machine-learning

Physics Banquet 2019

Last Friday, the Physics & Astronomy Department held their annual Physics Banquet where the department hands out scholarships and awards to Physics Students who go above and beyond what they are asked of in class.

Here are some members of SPS who received scholarships/ awards for the hard work this year:

- Bucy Undergraduate Scholarship in Physics
    - Cheslee Hibler, Madeline Lockhart, Sadman-Ahmed Shanto
- Michael Clingan Memorial Scholarship
    - Camryn McMullan, Eric Murray
- Gott Gold Tooth Award
    - Victoria Blackmon
- E. Roland Menzel Scholarship in Physics
    - Alexandria Clark, Robert Chambers
- Outstanding Graduating Senior in Applied Physics
    - William Milestone
- Also a big congratulations to our SPS Chapter who won an Outstanding Chapter Award from National SPS this year!

algorithms for large astronomical data sets and did research on accreting white dwarf stars, x-rays, and gamma rays and using what he learned from accreting white dwarves to understand supermassive black holes. After graduating, Dr. Scaringi did a Postdoc at Radboud University where he continued doing research on accretion and optical surveys. He was also a part of fellowships at KU Leuven in Belgium and at the Max Planck Institute for Extraterrestrial Physics in Garching, Germany and was an assistant professor for the University of Canterbury in New Zealand.

Currently, he is doing research using the BlackGEM Telescope Array in Chile to "find the optical counterpart to gravitational wave sources." The telescopes survey the entire southern sky and once the sky is surveyed, he uses machine learning to classify the billions of stars out there. The goal is to look for peculiar stars that can offer insight on new physics concepts and discoveries.

Check out BlackGEM's twitter account to learn more about the array. [2]

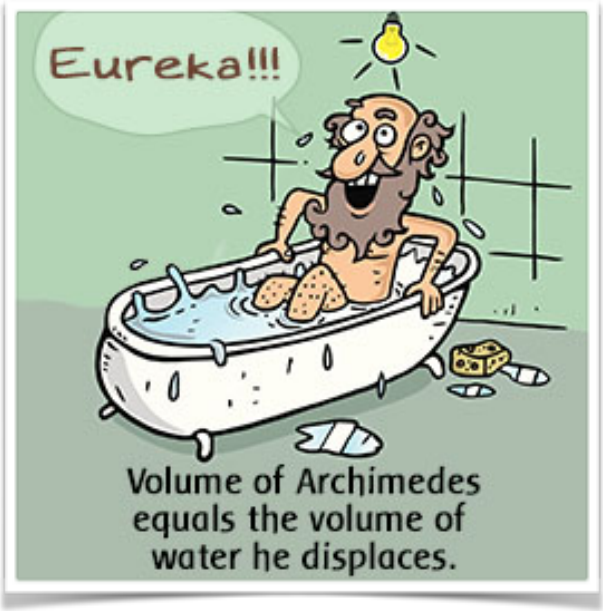
Dr. Scaringi says that "dedication is key." The trait he looks for in students is whether they are willing to put in the effort and work to achieve their goals and if they are passionate about what they are doing. He strives to create an informal environment that allows his students to not be intimidated by him and be able to come to him for help.

Archimedes Principle and Sea Level Rise

By: Akash Maheshwari

It should be of no surprise that Earth has already began to witness the devastating effects of a changing world climate. From severe polar vortices in winter and unprecedented levels of sweltering heat in summer to the phenological shifts made by many organisms, global climate change has began disrupting life for millions of organisms around the world. One of the primary concerns of climate change is the inevitable rise of sea levels which will undoubtedly have a drastic effect on the geography and biology of Earth as we know it. In order to further understand the rise of sea levels, one must take a detailed look into the beautiful physics principle of buoyancy.

Buoyancy is the ability to float on a fluid. It is the result of an upward pointing force called the buoyant force that is exactly equal and opposite to the gravitational force if an object is floating. One of the most important principles that is fundamentally related to buoyancy is Archimedes' Principle. Archimedes was a Greek scientist that was tasked with determining if the king's crown was made of pure gold or of some other material. In his bath, Archimedes noticed how as he submerged his body more and



more, the water level rose higher and higher. Realizing that the volume of water displaced was a measure of the volume of his submerged body, Archimedes had found a way to determine the volume of irregularly shaped objects. From this information, Archimedes was able to determine the volume and subsequently the density of the crown. Later a process was developed to determine the density of an object by weighing the object in air and then also weighing the same object immersed in water. The apparent weight of the object in water is the weight of the object minus the weight of the buoyant force. Archimedes' discovery had led to the principle that the buoyant force on an object immersed in a fluid is equal to the weight of the displaced fluid. In other words, the magnitude of the buoyant force is the product of the density of the fluid, the volume of fluid displaced and the gravitational acceleration constant. Since Archimedes had started scientific thought about buoyancy and properties of water, this principle is named in his honor.

Buoyancy and Archimedes' principle are also fundamental in understanding why sea levels rise. Temperatures have been continually increasing as greenhouses gases, such as carbon dioxide, are emitted in enormous quantities from anthropogenic sources. As global temperatures rise, ice begins to melt. Glaciers that tend to move slowly begin to move at a much faster rate as water decreases friction between the underside of the glacier and the rock surface it moves upon. Ice sheets that were previously found on land make their way to the water. Massive blocks of ice and frozen sediment fall into the ocean. Since large objects that were previously not found in the ocean are now present in the ocean, they displace a volume of water equal to the volume of the submerged object (or the portion of the object that is submerged). This has a result of increasing the volume of water and objects in the ocean which then has the effect of raising sea levels. So the melting of land ice, glaciers and ice sheets as a result of global climate change has the consequence of raising sea levels since objects from land displace a great volume of ocean water.

Student Spotlight: Madeline Lockhart

By William Kariampuzha

Our resident Barry Goldwater scholar is always on the grind. Madeline just finished delivering a talk at the Undergraduate Colloquium to all STEM students about interviewing in STEM fields, and the inner workings of the physics professional world. A native of Los Alamos, New Mexico, this summer she is returning to her former physics lab there to partake in the Dr. G. Robert Keepin Nonproliferation Science Summer Program, an intensive eight week program chock full of seminars and a research internship. If that was not enough, Madeline just got a fall semester internship in the US State

STEM & Leaf Corps

The STEM & Leaf Corps is a rapidly growing service organization at Texas Tech University that offers tutoring and supplemental instruction to middle and high school students in the Lubbock area. Their physics outreach has included general tutoring at Lubbock and Estacado High Schools, AP Physics 1 Reviews for students at Lubbock High, and project based enrichment over principles of physics at OL Slaton and Hutchinson Middle Schools. They have over 70 tutors and have made an impact on around 1000 students this past year. If you have time once a week, enjoy giving back to the community, and want volunteer hours, contact physics major Jake.Noltensmeyer@ttu.edu for more information.

Department Bureau of Arms Control, Verification, and Compliance, where she will be immersed in policy writing that limits the proliferation of nuclear weapons. While there, she will also be completing most of her political science minor, and will be supported by the Texas Tech Congressional Internship Program.

While you may not always see her on campus, Madeline stays connected to Texas Tech. A physics major with a political science minor, she has been active in many organizations such as the Math Club, Women in Physics, and the Society of Physics Students for much of her time at Tech.

She even organized one of the SPS semester trips to Los Alamos National Laboratory, where they saw the particle accelerator as Los Alamos Neutron Science Center (LANSCE) and got a tour of the labs in which she had worked. Some of her other favorite trips with SPS included trips to NASA Johnson Space Center, the Very Large Array in New Mexico, and Sandia National Laboratories in Albuquerque. Due to her unabashed love for travel, she told me her favorite memories in the Society of Physics students were the trips and the outreach events.

In the Texas Tech Physics department, she jumped into research her freshman year with the chair of the physics department, Dr. Nural Akchurin. Since then she has garnered numerous publications and awards primarily from her work in the national laboratory. In addition to extensive research her freshman and sophomore years, she has learned from our resident professors through classes, her favorites including Applied Mathematics and Nuclear and Particle Physics. She also represented Texas Tech while attending numerous conferences run by the American Nuclear Society, Institute of Nuclear Materials Management, and the American Physical Society Conference for Undergraduate Women in Physics to present her undergraduate

research. The aspect of the physics department that she appreciates most is that many undergraduates are involved in research.

Three years ago, Madeline Lockhart chose Texas Tech University for the academic opportunity in the Physics Department, the outstanding Honors College, close-yet-far proximity to home, and the National Merit Scholarship, a full-ride scholarship that pays for her entire cost of tuition, room and board, books, and any other associated fees. Since then she has taken advantage of all the opportunities here, including President's Select, applying to the Barry Goldwater Scholarship her sophomore year against naysayers and winning it, and most recently being inducted into the Mortar Board Honor Society for Outstanding Seniors.

Her main interests outside of the academic world are intramural softball; tutoring through Student Disability Services; volunteering, in which she won Outstanding Volunteer at Bean Elementary; and traveling, which she has done and will do extensively through conferences and study abroad programs in South Europe, Florida, Washington DC, and California.

The next step on her quest to Strive for Honor requires her to utilize her Bachelors in Physics, minors in Mathematics and Political Science, and her Certification in Policy and Technical Fundamentals of International Nuclear Safeguards in order to complete a Master of Philosophy in Nuclear Energy at Cambridge University. There she will focus on all the political, social, and physical aspects of nuclear energy to allow her to specialize in nuclear non-proliferation and hopefully make a lasting international political impact. In the meantime, if you do catch her on campus and want to learn a little calculus while at it, just know that while she is busy, she is always willing to teach others cool mathematical concepts. Madeline is so passionate about math that she tattooed her left ankle with an integral while she was a math major.

References:

[1] https://eventhorizontelescope.org/

[2] https://twitter.com/blackgem_array?lang=en

[3] https://www.buzzle.com/img/articleImages/608922-3685-13.jpg

Acknowledgements

The Public Relations Committee of the Society of Physics Students would like to thank the following people for contributing to the success of this month's edition of the *Quark*:

- Dr. Simone Scaringi
- Madeline Lockhart

Writers

- Colin Brown
- Shanmuga Shivakumar
- William Kariampuzha
- Akash Maheshwari

Editors

- **Editor in Chief:**
  - Colin Brown
- William Kariampuzha

[4] https://www.depts.ttu.edu/phas/People/Faculty/bio_scaringi/bio_scaringi.php

[5] https://www.depts.ttu.edu/artsandsciences/newsletter/studentFeaMadelineLockhartMay18.php

[8] https://oceanservice.noaa.gov/facts/sealevel.html

[9] https://www.cut-the-knot.org/pythagoras/bath.shtml

[10] https://www.scientificamerican.com/article/fact-or-fiction-archimede/

[11] Dr. Dylan Schwilk, Texas Tech University

[12] Dr. Michael San Francisco, Texas Tech University

[13] Douglas C. Giancoli, Physics for Scientist and Engineers, Fourth Edition