# 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 and Editor in Chief, Colin Brown.
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# Students Gather to View Lunar Eclipse

*By Akhila Reddy*

Looking up at the night sky on Sunday night, viewers would have seen a strange sight: the full moon slowly disappearing underneath a dark shadow before magnificently reappearing with an orange red tinge.

This phenomenon, 2019's only lunar eclipse, was celebrated outside the library at Texas Tech.

Robert Morehead, director of the Preston Gott Observatory and instructor in the Department of Physics and Astronomy, organized the event, arranging for telescopes and publicizing the observing. "I'm a professional astronomer, and so this space in astronomy has always been my passion," Morehead said. "I just get really excited about his stuff, and I really like sharing it with other people too. That's the best part." Total lunar eclipses occur every couple of years or so, he said. This particular eclipse has been named the "Super Blood Wolf Moon," Morehead said before explaining the reasons why. The "Super" part of

the title refers to the moon being slightly closer to viewers than it is on average, appearing approximately 12 percent bigger, he said.

The "Wolf" part of the title derives from traditions naming the full moons of every month, such as the Harvest moon in September.

The "Blood" part of the title refers to the red color of the moon caused by the light from the sun being refracted around Earth by Earth's atmosphere and being projected onto the moon.

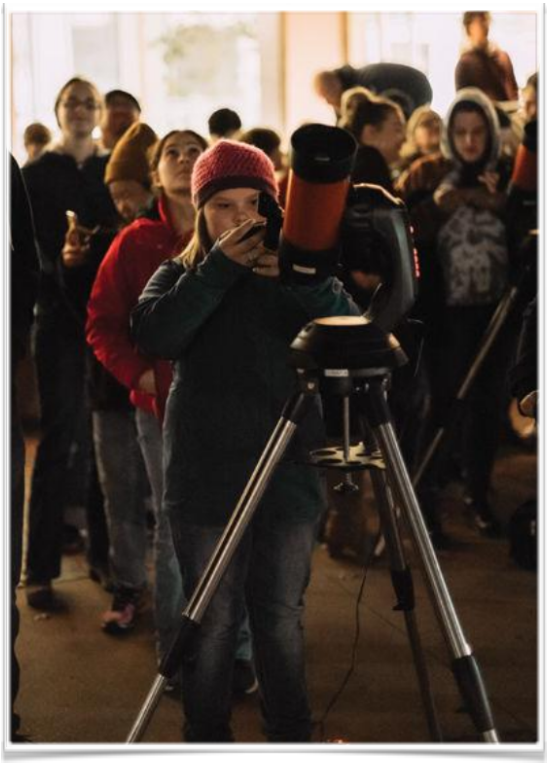
"So what you're seeing is basically the light from all the sunsets and all the sunrises on earth right now on the moon itself," Morehead said. "So if you were on the moon watching the eclipse from the moon you would be seeing a total solar eclipse, and you would see the earth blocking the sun within ring of red light around it."


Eve Woodward, a sophomore public relations major from Mansfield, attended the event with a friend. She said hosting events like the observing party are a way to raise awareness of astronomy.

"It encourages people to come out and actually do it because I wouldn't have done if it had just been the two of us going outside," Woodward said. "This made it fun."

Brittany Jones, a freshman mechanical engineering major from Wichita Falls, attended the event because of a long-running passion for astronomy. Having the event brings people together to appreciate nature and the earth, things people should do more, she said.

"I am a space nerd. Long term, I want to work for NASA. I try to take the opportunity to go to as many events as I can," Jones said. "I've been looking at solar eclipses and lunar eclipses all my life whenever there's a chance. This happens to be the blood moon, and it's beautiful, and I'm glad I'm out here with everyone."



The next lunar eclipse will occur in a couple of years, Morehead said. However, the next big solar eclipse will occur in April 2024 in Texas.

The solar eclipse will go right up the corridor between San Antonio, Houston and Dallas, through the metroplex, he said. People should make the effort to view eclipses, especially solar eclipses.

"Having seen one myself now, all I can say is it's one of the most incredible things you can experience," Morehead said. "Especially a total solar eclipse, it is just an amazing experience. Day turns into night. The corona around the sun is dazzlingly beautiful. It's almost impossible to actually describe it."

To Jones, the appeal of eclipses derives in part from how rare they are, she said. If people have the opportunity to take part in these events, they should.

"They're so rare," Jones said. "Like, if you're not there at that specific time or place to see it right, there's not going to be a lot of chances for you to see that, so make sure that you do."

Educating the general public on the science behind these events is important, he said.

"It's important because astronomy is an important part of understanding our universe and by extension understanding our world and our place in it," he said.

Additionally, if the public has positive experiences with astronomy it can raise their interest and passion, he said. Getting the public interested in science can be difficult, but events like lunar eclipses are opportunities to do so.

## Student Awards

This semester we have seen many students in the department recognized for various awards and achievements. Here are a few:

- 01/2019 Graduate Student Hira Farooq - 2 Distinguished Student Awards at the 2019 March APS Meeting in Boston
- 01/2019 Undergraduate Students Sadman Ahmed Shanto, Colin Brown, and Ismael Alaniz - Silver Medal in University Physics Competion.
- 02/2019 Graduate Student Milind Pattanayak - 2019 Ken Hass Outstanding Student Paper Award
- 02/2019 Undergraduate Student Priyadarshini Rajkumar - international summer internship project at the UK Liverpool Telescope
- 02/2019 Ph.D. student Tyler Wang - Graduate Student Research Support Award

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# Professor Spotlight: Dr. Nural Akchurin

*By Ravyn Perez*

Dr. Nural Akchurin is the former Physics department head and the current Associate Dean for Research in the College of Arts and Sciences. He graduated from Vassar College with a degree in Physics and went on to receive his PhD at the University of Iowa.

Growing up, Dr. Akchurin's developed an interest in science fairs and building huge kites, as well as, of course, physics. He also managed to find another niche in music after a family member introduced him to piano. Music has remained a creative hobby of his to this day.

After graduating, he was excited to begin working with the SSC, the Superconductor Super Collider, a particle accelerator planned to be constructed in Texas that would've surpassed the Large Hadron Collider as the largest and most energetic supercollider. After its unfortunate cancellation, he began working at CERN, the European Organization for Nuclear Research.

After staring with CERN, he began working at Texas Tech in year 2000. During this time, he participated in the building of Compact Muon Solenoid (CMS) detectors at the Large Hadron Collider (LHC) which played a role in the discovery of the Higgs boson. This was his most prestigious experienced which was even more memorable to him due to it being announced on the 4th of July in 2012.

Currently, he is working with a team at Texas Tech to develop new types of calorimeters to improve measurements of energy of fundamental particles at high energies. This intrigued him because dark matter and dark energy can be produced in hadron colliders so he and his team at TTU search for it in CMS collisions. "My colleagues at TTU and I have developed a new type of calorimeter that takes advantage of the features of scintillation and Cherenkov photons to improve the energy measurements of hadrons." This dual-readout method is a whole new approach that paves the way to precision energy measurement of all fundamental particles. His team is in the construction phase of a large fraction of CMS's endcap calorimeter modules. His goal is to develop a new generation of detectors and the assembly of silicon sensors which are expected to be built at CERN by 2025.

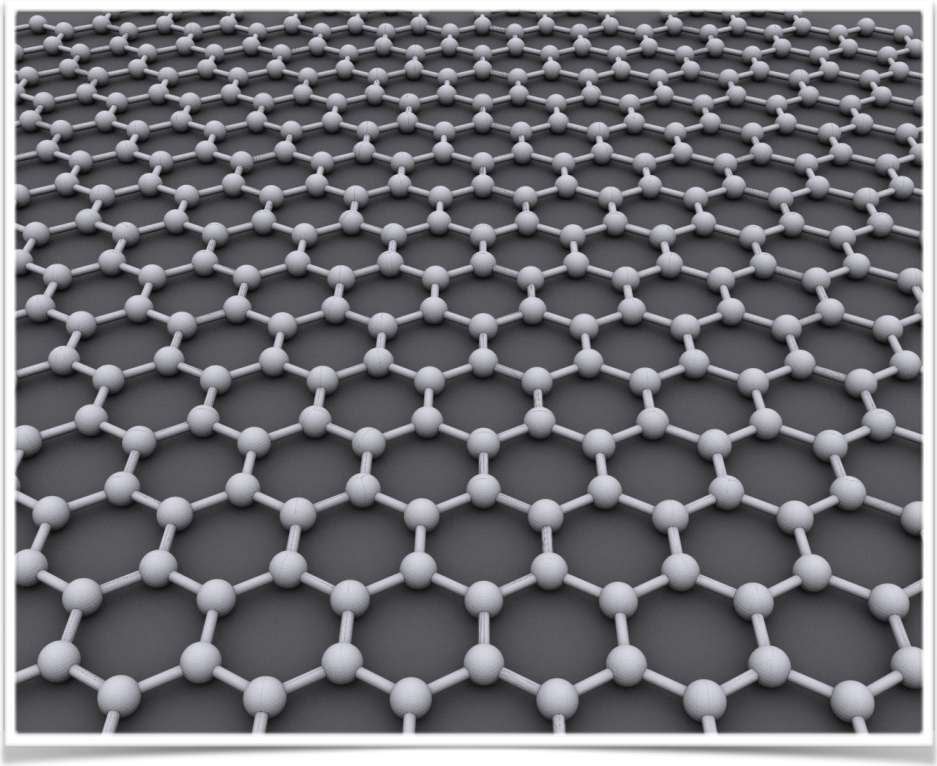
# Discovery of a Graphene Superconductor

*By: William Kariampuzha*

Chemistry and Physics are both concerned with properties of matter and follow the same physical laws, only distinguished by their methods and scope. This overlap is very strong in the study of elements and their forms.

One particular set of protons and neutrons may have the title of being the most useful element on Earth. Carbon is an integral part to all Earth based life and can come in many allotropes. An allotrope is a macroscopic form in which an element can take in nature. Some allotropes of carbon include peat, bitumen, anthracite (otherwise known as coal), graphite, diamonds, and of course, graphene. Of the allotropes, graphene is unique in the fact that it is two dimensional. It is a hexagonal lattice that is a single atom thick. To form the lattice, each carbon atom bonds to three others in the same plane. This makes graphene one of the only true two-dimensional solids discovered by man.

Graphene is of research interest today due to its incredible conductive properties. It has no gap between conduction and valence bands, making it a semimetal. This lack of a band gap means that it conducts electricity. While most semi-metals conduct electricity worse than regular metals, pure graphene has a lower resistivity than silver i.e. the most conductive metal. In addition, due to the fact that graphene has the highest surface area of any carbon allotrope, it is currently being tested in



The Chemical Structure of Graphene

supercapacitors to be an improvement upon activated carbon

These qualities arise from the the electronic properties of carbon and the unique structure of graphene. Carbon has four valence electrons, which can lend themselves to, at most, 4 bonds with other elements of carbon. Diamond famously has all four valence electrons covalently bonded to each in an extremely rigid tetrahedral form, which is why it is one of the hardest known materials. In graphite and graphene, only 3 sp2 hybridized covalent bonds are formed at each carbon, which leaves one delocalized electron in a $\pi$ orbital that is found above and below the plane of the graphene sheet. This last untethered electron allows free movement of electricity through the material rapidly.

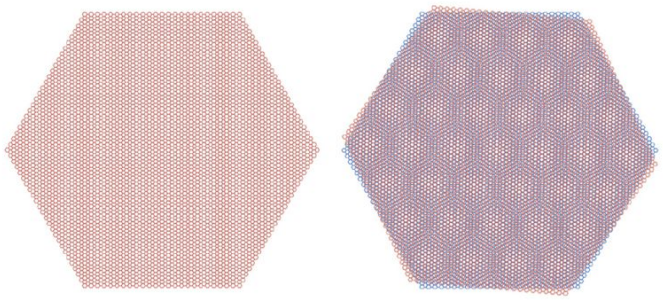
Graphene is also a substructure in many of carbon's other allotropes. When rolled up, graphene takes the form of a carbon nanotube - an ultralight, stronger-than-steel material. When balled up, graphene becomes a buckminsterfullerene. When stacked in layers held together by Van der Waals forces, graphene takes the form of graphite.

A recent discovery in the usage of graphene is in regenerative material science. Additionally, in March 2018, Cao et al. published "Unconventional superconductivity in magic-angle graphene superlattices." In this paper, they had found that a bilayer of graphene twisted relative to each other at 1.1° allowed for the phenomenon of superconductivity! This impressive finding may allow us to revolutionize the energy industry and open up the opportunity to attain energies previously unattainable in high energy particle physics.

On October 22, 2004, Andre Geim and his colleague, Kostya Novoselov, first isolated graphene at the University of Manchester for which they were awarded the Nobel Prize in Physics in 2010. For the past 15 years, graphene has continued to amaze when we utilize its unique properties and by it's incorporation into other solutions and materials. However, its widespread usage is currently limited by the difficulty in producing it en masse. One can only hope for another Bessemer revolution to take us into the future. In the meanwhile, you can do a Nobel Prize winning procedure right where you are. Gather a graphite pencil and Scotch tape, place the tape on the graphite tip, and rip off. Voila, on that tape there is graphene, extremely impure, but still there. And yes Dr. Geim's assistant, Da Jiang, actually did this procedure - albeit in slightly more controlled settings- to isolate graphene.

# Student Spotlight: Andrew Howell

*By David Palmore & Colin Brown*



The Image Shows on the left a graphene structure that is then rotated to form the superconducting material shown on the right [3]

Andrew Howell is a Sophomore student in the TTU Physics Programs and is the current Treasurer for the TTU Society of Physics Students.

His interest in physics was sparked during his time at Trinity High School in Euless, Texas thanks to his high school physics teacher Mr. Murphy. Andrew recalls that Mr. Murphy had graduated with a concentration in astrophysics and that this helped him teach his students and inspire their interest in physics. Andrew is himself also pursuing his degree with a concentration in astrophysics. During high school he also participated in the Cross Country and Robotics teams.

Before becoming the SPS Treasurer, Andrew worked on the Fundraising committee for a year and a half. Now as treasurer he does the vital job of ensure that SPS is capable to procuring the funds it needs. He does so by starting fundraisers and managing SPS spending on events such as the semester trip.

Andrew is currently doing research under Dr. Scaringi in Astrophysics. This research involves analyzing unique light curves of certain stars using Fourier Analysis in the hope of identifying catastrophic variable stars.

After college Andrew intends to pursue a graduate degree. One of the schools he hopes to get into is University of Nebraska- Lincoln. He wants to pursue a doctorate and find work at a national research lab. His subjects of interest for research are white dwarfs and black holes.

In his free time, Andrew enjoys playing video games, hanging out with friends, occasionally programming as a hobby, and playing Dungeons and Dragons.

When asked for what options he'd recommend to other undergraduate struggling in physics, Andrew said:

*"Talking to people, whether it is Professors, classmates, or other SPS members. Talking things out and bouncing ideas off of each other helps you better understand the concepts."*

# References:

[1] https://www.tandfonline.com/doi/abs/10.1080/00107517308213730?journalCode=tcph20

[2] https://www.nature.com/articles/nature26160

## 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. Nural Akchurin
- Sadman Ahmed Shanto
- Andrew Howell
- David Palmore

## Writers

- Colin Brown
- Ravyn Perez
- William Kariampuzha
- Akhila Reddy

## Editors

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

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[4] https://www.graphene-info.com/graphene-supercapacitors

[5] http://patft.uspto.gov/netacgi/nph-Parser?Sect2=PTO1&Sect2=HITOFF&p=1&u=%2Fnetahtml%2FPTO%2Fsearch-bool.html&r=1&f=G&l=50&d=PALL&RefSrch=yes&Query=PN%2F7071258

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