THE QUARK

Brought to you by the Society of Physics Students

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What is the Quark?

The Quark is a monthly newsletter provided by the Public Relations Committee of the Society of Physics Students (SPS). Our goal is to help new students become more familiar with the Physics Department and give returning students more insight on aspects of the department they might not have been aware about.

If you have any questions about The Quark or SPS, you can email our Public Relations Officer (shanmuga.shivakumar@ttu.edu)

Crucial Capacitors

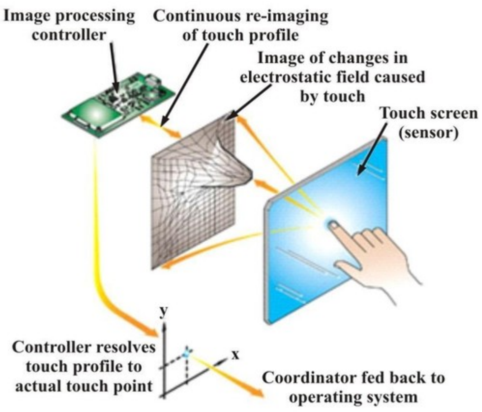
Written by Akash Maheshwari

The arrangement of two oppositely-charged conducting plates placed parallel to one another results in a well-known capacitor known as the parallel-plate capacitor. In order to better understand the varied capabilities of parallel-plate capacitors, one must first understand how capacitance relates quite simply to the area A of each plate and the separation distance d between the plates. We know that by Gauss's law the electric field between the plates is given by $E= \sigma/ \varepsilon_0$ and knowing that the charge density on each plate is given by $\sigma=Q/A$, we find that $E=Q/(\varepsilon_0 A)$. We can then find that the magnitude of the potential difference between the two plates can be given by $V=Ed= (Qd)/(\varepsilon_0 A)$. By using the definition of capacitance ($C=Q/V$) we find that capacitance $C=(\varepsilon_0 A)/d$.

By using this formula, one can clearly see that capacitance is directly proportional to the area of each plate and inversely proportional to the distance between the plates. In other words, if A is increased or d is decreased or both, then capacitance will increase. We will focus on how the distance between the plates of parallel-plate capacitors can affect the capacitance of a system and its many useful applications.

One application of parallel-plate capacitors can be found within modern computer keyboards. Each key is connected to the upper plate of a parallel-plate capacitor so that one the key is depressed, the distance between the plates decreases. By decreasing the distance between the plates, capacitance increases. The computer can detect this change in capacitance and register which key has been selected.

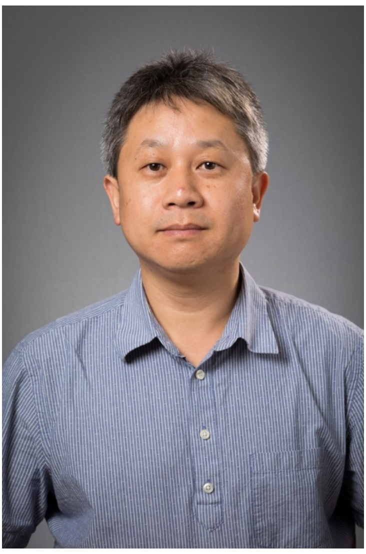
Perhaps the most pervasive application of parallel-plate capacitors is touchscreen technology. Capacitive touchscreens are found in a variety of electronics including smartphones, smartwatches, tablets and computers. In a general arrangement, the bottom part of a piece of glass is coated with a transparent conductor with a dielectric material placed in between. Since our skin is also a conductor, placing a finger on the screen brings an electric charge nearby which changes the electric field between the capacitors. If the electric field is distorted, a change in capacitance occurs in that location. By forming a grid and constantly measuring the capacitance at each point within that grid, the touchscreen is able to determine where it has been touched.



The basics of capacitive touchscreens

These are just two examples of how parallel-plate capacitors are utilized in useful applications that we use on a daily basis. As experimentation continues, novel uses of capacitors will lead to revolutionary technologies that can change the way we live our lives.

Professor of the Month: Dr. Myoung-Hwan Kim



Written by Shanmuga Preyan Shivakumar & Ivan Cornejo

Dr. Myoung-Hwan Kim is the new experimental physicist of the Texas Tech Physics Department. He is a graduate of Hanyang University in Seoul, South Korea where he received his bachelor's degree in Physics. He also received his Master's at the prestigious Pohang University of Science and Technology (POSTECH) in Pohang, South Korea. Then after a slight break from academia he received his P.H.D from the University of Buffalo in Buffalo, New York.

Dr. Kim has had an interesting experience with the subject of physics. Having been interested in being a physicist ever since the 6th grade, he had always thought he would be a theoretical physicist. During his undergrad years at Hanyang University, Dr. Kim said that "[he] didn't study much but was interested in making a club." He then gathered a few of his friends and founded a student organization that applied the physics they learned in class in practical ways and improved the public's interest in physics by hosting events like physics circuses. However, because of this his grades were not to his liking, but a boom for physics and other sciences happened during this time and a research opportunity opened for him. The first undergraduate research program happened at POSTECH and since it was new Dr. Kim was able to get into the program. This moment was as Dr. Kim said "a turning point for [his] career," here Dr. Kim would begin working on building superconductors. Although he believed he was not very good at experimental others disagreed and with this he decided that instead of theory he want to be an experimental physicist for condensed matter.

Dr. Kim continued to research at POSTECH for his Master's. He then went on a hiatus from academia and joined the South Korean army afterwards he was at a loss about what to do. A former officer of his worked for the Korea Basic Science Institute (KBSI) offered Dr. Kim a job at KBSI. He worked there for a while as a cryogenic and magnetic engineer, however this for him was very boring. He then decided that he would return to working on his PhD which he would do at the University of Buffalo, where he started doing research on the Infrared Hall Effect in various common materials. After graduating from the University of Buffalo, Dr. Kim did two Postdocs one at the University of Maryland and one at Columbia University. During this time, he did research with graphene photodetectors for the first time in the U.S. and Meta surface to control light in waveguide. After a quick faculty position at the University of Texas at the Rio Grande Valley, he decided to come to Texas Tech.

Dr. Kim is still setting up most of his labs since he only arrived at Tech relatively recently. The research topics that are his main focus are Tailoring evanescent light on a surface, Quantum computing using rare-earth Ion cubit, and Infrared Hall on quantum materials. Dr. Kim describes his research as "[him trying] to control light using materials for all [his] projects." If these projects sound intimidating to get into don't worry the way he starts students off research is by giving them their own projects with certain guidelines. He gives students these projects to teach them how to be independent, he will still help guide you but mostly he will let you do the research and ask questions yourself. However, if you feel like you could get stuck that is perfectly fine Dr. Kim has a very friendly nature and is always willing to help students out.

Dr. Kim is currently enjoying being apart of the Texas Tech Physics Department as well as being in Lubbock in general. He greatly appreciates the dry weather after living in the humidity of Brownsville for so long. He also enjoys being a part of a university that values research and collaboration. The final thing he is grateful for is that Tech actively encourages undergraduate research. He gave us a piece of advice for undergraduates to remember when looking for research, "Just visit and talk about your interests with what research you want and what is available."

Time Flies

Written by Akash Maheshwari

Time is a theoretical abstraction that has altered the way in which humans view the world. One interesting way in which time passes differently is when the distance between an observer and a massive body is changed. Known as gravitational time dilation, time actually passes faster at a position further from a large object compared to a position closer to the object. For instance, imagine that a very precise clock was placed on Mount Everest and another very precise clock was placed at sea level. The clock on Mount Everest would be at a distance farther away from the mass of the Earth thereby

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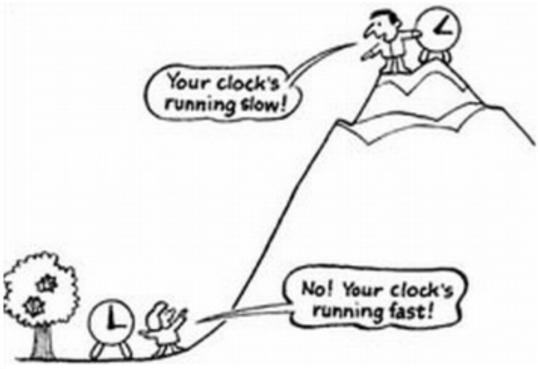
The idea of the relativity of time was first suggested by Einstein in his theory of general relativity in the early 20th century. Einstein correctly predicted that, as a result of special relativity in accelerated frames of reference, time would change at varying distances from a massive body. Einstein correctly predicted that, as a result of special relativity in accelerated frames of reference, time would change at varying distances from a massive body. A massive object warps the space-time continuum so that time passes more slowly closer to the object. one foot taller than another individual born at the same time will be 90 billionths of a second older over 80 years as a result of their height difference.

More recently, physicists, with the aid of extremely sensitive atomic clocks, have found that even a difference in height of one foot can produce a noticeable change in the passage of time. This means that an individual This means that an individual one foot taller than another individual born at the same time will be 90 billionths of a second older over 80 years as a result of their height difference.



This astounding discovery comes as a result of novel developments in precision clocks. The researchers who reached this result used a clock based on the vibrations of a single aluminum ion contained by two electric fields. This so-called quantum logic clock is more than twice as precise as the previous mercury clock; it will not lose or gain a single second even after 3.7 billion years. Because accuracy is key in performing gathering measurements on time, these clocks have been instrumental in providing compelling evidence for gravitational time dilation.

Time is a fascinating construct that can continue to be explored. Some of the most advanced principles of physics involve the complex idea of time, and the understanding of this principle is necessary to further the knowledge of our intricate world. With the current trend of incredible advancements in technology, knowledge of the previously unknown will become available and further progress will continue to be made in science. Physics is such an interesting area of study because, like time itself, it is constantly progressing.

Student Spotlight: Victoria Blackmon

Written by Shanmuga Preyan Shivakumar

Victoria Blackmon has always been interested in the unknown and contributing to our understanding of the universe. Her passion for understanding the laws of nature and learning about different cultures is what drove her to major in Astrophysics and minor in French. As the current president of Women in Physics (WiP) and an undergraduate researcher under Dr. Maccarone, Victoria is a student that strives for honor in her own way by helping ensure women have proper representation in STEM fields while also setting an example for students interested in astronomy and physics.

During her time here at Texas Tech, Victoria has received several scholarships, including the Gott Gold Tooth Award and Sidney Sundell Scholarship in Astrophysics, both of which were presented to her at the Annual Physics Departmental Banquet for exemplary merit in several astronomy courses and being committed to her research. She is currently researching stellar mass black holes (black holes that are relatively close to the size of our sun), collecting data, and drawing conclusions between the peak optical luminosities and orbital periods of these black holes. This data will then be compared to the data found using the Large Synoptic Survey Telescope (LSST) once it is finished being built in 2020.

As an active student among the physics department and at Tech, Victoria is involved in a couple of student organizations/societies. She was involved in the Society of Physics Students (SPS), being a part of both Public Relations and Fundraising Committees for a time before taking up the position of secretary for WiP when it first started back in 2018. She remained dedicated to WiP and it's goal to improve the recruitment and retention of women in STEM fields ever since. She has high hopes for the young organization and believes it is important to join because "WiP can teach students important skills in a comfortable way."

After being involved with the organization, she became more comfortable talking to crowds, interviewers, and professors. She also greatly appreciates the experience of being a leader because it has helped her become more organized and responsible as a person. Aside from being involved in WiP and SPS, Victoria is a part of the French Honor Society, in which she was inducted in Spring 2017.

Victoria's hobbies include fencing, baking, relaxing at home, and trying out different fashion styles that suit her aesthetic. Although she hasn't fenced in awhile due to prioritizing her studies, she hopes to pick it back up once she graduates. Victoria also loves to learn about French culture, which is why she thoroughly enjoys the classes she has taken for her French Minor.

After she graduates, Victoria hopes to get into grad school to study either astronomy or astrophysics. She has a huge interest in high-energy astrophysics, black holes, and pulsars. Victoria's piece of advice to new students is to talk to your professors, attend office hours, and ask questions as much as possible so that you can understand the material better. Finally, she recommends students to "take time out of your day to do things you enjoy to help reduce stress and anxiety."

Women in Physics

Women in Physics is a student org that seeks to improve the recruitment and retention of women in physics by providing opportunities for academic and professional development.

We have hosted a number of workshops ranging from hard skills (such as Arduino builds and Soldering) to soft skills (such as resume building and preparing for interviews.)

Membership is open to all students (regardless of gender) currently enrolled students at Texas Tech University with an interest in STEM.

If you have any questions or want to join WiP, please contact our Secretary (shanmuga.shivakumar@ttu.edu) or visit us at ttuwip.com.

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* Rob Chambers

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His efforts as the previous Editor-in-Chief and PR Officer is the reason The Quark was able to be released as consistently as it was. The Quark would not have been what it is now without his hard work.

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