THE QUARK

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Upcoming Events

- Carol of Lights 011/30 in front of the Physics Building
- Final General Meeting of the Semester 12/03 in Room 234 at 6pm
- Dead Day Social and Secret Santa 12/06 location TBA time TBA

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, Sadman Ahmed Shanto, at sadman-ahmed.shanto@ttu.edu.

China's Plans for an Artificial Moon

By Nelson Mora & Colin Brown

Wu Chunfeng, head of the Tian Fu New Area Science Society in Chengdu, announced on October 10 that there will be an artificial moon launched into the orbit of earth sometime in 2020. The intention of this plan is to replace street lights with a dusk-like glow from a satellite in orbit. A satellite which they expect to be 8 times brighter than the moon. According to Wu, this artificial moon will be about 500km above earth, and save $174M in electricity from streetlights. Not much is known about this artificial moon at this stage, not even its size or cost.

The City of Chengdu is located in southwestern China. This is where the artificial moon may soon provide its light.

This artificial moon would provide light in the same manner as the original, by reflecting sunlight back to the earth from orbit. This orbit would likely need to be geostationary, that is, it would need to remain fixed in the sky over Chengdu. This detail has caused some skepticism about the distance of the satellite from earth.

> **"Their claim for 1 LEO sat at [300 miles] must be a typo or misinformed spokesperson, ... The article I read implied you could hover a satellite over a particular city, which of course is not possible."**
>
> *Ryan Russell, an associate professor of aerospace engineering at the University of Texas at Austin, in an interview with Astronomy.com.*

The Chinese are not the first to attempt this feat of engineering. An attempt was made by Russian Scientists in 1993 and 1999 to launch a similar device. Both times the device was deemed a failure. Another attempt was made last year in July 2017 with the Mayak satellite. This cubesat was developed by a group of young scientists with the support of Moscow State University of Mechanical Engineering. It too, was deemed a failure after it was unable to deploy its reflectors.

The history of these attempts is undoubtedly daunting for the scientists and engineers working to create Chengdu's new moon. It will still be a few years before we see if they were able to overcome the challenges that held the previous moons back. Though even if their moon is far too dim, they will still have made a star.

Sources:

[1] http://www.chinadaily.com.cn/a/201810/19/WS5bc922f3a310eff303283431.html

[2] http://en.people.cn/n3/2018/1016/c90000-9508748.html

[3] https://www.nbcnews.com/mach/science/city-china-wants-launch-artificial-moon-space-ncna923946

[4] http://www.astronomy.com/news/2018/10/why-chinas-artificial-moon-probably-wont-work

[5] https://www.nytimes.com/1993/01/12/science/russians-to-test-space-mirror-as-giant-night-light-for-earth.html

[6] http://www.cnn.com/TECH/space/9902/04/space.mirror.01/index.html

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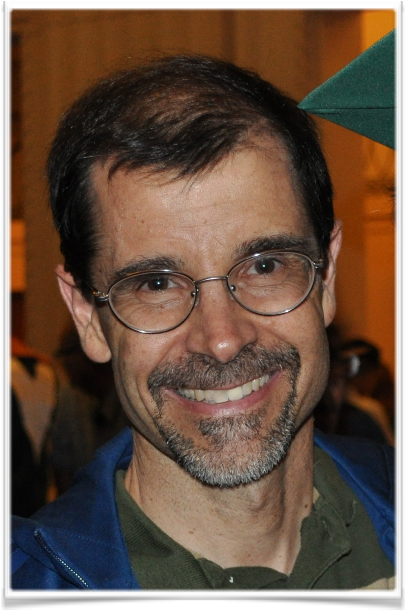

Professor Spotlight: Dr. Joseph Romano

By Ravyn Perez

Dr. Romano teaches a graduate-level class in classical mechanics as well as Physics 2. While he didn't expect to be a professor when he was first going to school, his uncle is a professor so in the back of his mind, he understood and was open to the possibility. He first received a Bachelors of Science and Electrical Engineering at Cornell University. He then switched to Physics for his Masters and then continued with a Ph.D. in General relativity. His interest in math and science in high school at first encouraged him to choose electrical engineering. Towards the end of his Bachelor's, he began showing more interest in the theoretical and mathematical aspects of his studies. He decided to take more physics and math courses as a junior and senior. After his Bachelor's, he then applied for his Master's at Syracuse University and was accepted. Solid State Physics was his original plan for graduate school due to its combination of Electrical Engineering and Physics topics. He enjoyed his professor who taught Mathematical methods so much, however, that he was inspired to also study general relativity. "Whatever he's doing that's what I would like to do." he said and made a spontaneous decision to switch. It wasn't easy though, as his lack of an undergraduate degree in Physics made it difficult to jump into the graduate Physics courses with his lack of traditional Physics Education.

As a graduate student, he did research in theories of classical and quantum gravity. He sought to describe gravity at small scales using the principles of quantum mechanics. After getting his PhD, he did post doctoral research assignments at several universities. His first 2 years at the University of Maryland and another 2 at the University of Utah. He continued his work on

The Math Club Putnam Seminar

On **Wednesday, November 28**, Dr. Cezar Lupu will be giving his talk "The Anatomy of a Putnam Problem" in **Math 238 at 6pm**.

These Putnam Problems are called as such because they're taken from The William Lowell Putnam Mathematical Competition, the preeminent undergraduate mathematics competition in the United States and Canada.

In his talk he'll be specifically covering question B2 from the 2007 competition, pictured below.

Suppose that $f:[0,1] \to \mathbb{R}$ has a continuous derivative and that $\int_0^1 f(x)dx = 0$. Prove that for every $\alpha \in (0,1)$,

$$\left|\int_0^\alpha f(x)dx\right| \le \frac{1}{8}\max_{0\le x\le 1}|f'(x)|.$$

This talk also serves as a preview for his Putnam Seminar class he will be offering in the spring: Math 4000-001.

quantum gravity at both. He then moved into the field of data analysis at the University of Wisconsin-Milwaukee. Followed by a year at California Technical University as a visiting researcher. Since then, his primary focus is data analysis for LIGO, a project focused on gravitational wave detectors. His work at the University of Wisconsin had the most impact on him. It was there that he learned the basics of data analysis of gravitational waves which he continues to do for LIGO.

LIGO has recently detected gravitational waves from the collision of 2 black holes. These were rather strong signals which could be detected with relative confidence. In the future however, he is interested in different methods of data analysis. Ones that could detect stochastic gravitational waves, random signals that are too weak or numerous to detect individually. Binary black hole systems can be too distant or not massive enough to confidently detected by a single detector. The data from multiple detectors, however, can be combined to create a signal that can be seen. In the end, he's just happy to have work detecting waves and sees himself continuing to do so for years.

The Quantum Theory of Biology

By: William Kariampuzha

Quantum mechanics is a nondeterministic description of nature. Rather than exact values, we have certain probabilities of knowing something about the universe. It gets its name from the discrete packets of energy called quanta.

Classically, the electron is a particle that has one position at any given time. However in 1937, Davisson and G.P. Thompson[8] (J.J. Thompson's son) demonstrated that electrons have wavelike characteristics. This supported the de Broglie hypothesis that all forms of matter have wavelike properties. It also revealed that the larger the mass of the wave-particle, the less prominent its wavelike features become. The more wave-like an object is, the less we can determine about the momentum and the position together. This is known as Heisenberg's Uncertainty Principle. The uncertainty principle also applies to the simultaneous measurement of energy and time. This wave-particle duality is what gives rise to the uncertainty. Resulting in a non-deterministic world where we may not know everything about a system at any given time.

Biology research often deals with uncertainties similar to those of quantum mechanics. We know that DNA codes for RNA, which codes for a polypeptide, which in conjunction with other polypeptides, folds intricately into a complete protein. However, this Biochemistry is not perfect, and thus not completely deterministic. Given a single chromosome of DNA neither we -nor the cell- know exactly how the DNA is going to be replicated. It's possible that integrating Schrodinger's Equation can give us a 99% probability[9] of finding an electron in an atomic suborbital. Similarly in Biochemistry we have a 99.9999999% probability (1 error per billion nucleotides[10]) of finding that each complementary base pair in the daughter strand lines up correctly with its parent strand.

The 2018 University Physics Competition

The Society of Physics Students Public Relations Committee once again organized students to participate in this year's University Physics Competition. The problems released to competitors were an analysis of the acceleration of a light sail to relativistic speeds using a laser array, and an examination of the chemistry of decomposition in order to determine optimal methods of composting. 9 students participated in teams of 3, each with their own faculty sponsor.

- Team A: Peter Wibert, Alexandria Clark, Nelson Mora
  - Sponsor: Dr. Lamp
- Team B: Colin Brown, Ismael Alaniz, Sadman Ahmed Shanto
  - Sponsor: Dr. Sanati
- Team C: William Kariampuzha, Derek Esomonu, Mathew Torres
  - Sponsor: Dr. Wigmans

To learn more, visit http://www.uphysicsc.com/

In 1905, Albert Einstein explained the need for a minimum activation energy in the photoelectric effect. He did so by equating this minimum quantity of energy to a discrete packet known as a quantum. Accounting for the total energy in a system requires summing these quanta of energy. With their size determined by Planck's constant. Analagous to this is how biologists account for information in a system. By summing up triplets of nucleotides in a particular order. Just as there is no in-between energy between 2 and 3 quanta of energy, a biologist cannot take the sum of the 3 parts of nucleotides, they are discrete. In 1961 Francis Crick, Sydney Benner, et al.[11] performed a similar experiment to Einstein. They demonstrated that the minimum quantity of information that can be stored and translated into an amino acid is a discrete packet of 3 nucleotides known as a codon. Any amount less than this will not code for any useful information.

As energy and mass increase in a physical system, new & exciting properties emerge. Quantum mechanics has several bridges into a human sized world. These bridges are now contributing to development of lasers, scanning tunneling microscopes, and superconductors. Similar emergent properties arise in our own bodies. The human genome is made up of about 3 billion nucleotides arranged in the double helices of DNA and supercoiled complexes of protein. With 3 billion base pairs and a rate of one nucleotide error per billion, we have at least 3 nucleotide errors in DNA in every cell. These errors, as well as those in supercoiling (a field known as epigenetics) and the genetic diversity caused by meiosis, can create drastic changes in DNA over time. This uncertain nature of DNA replication leads to unexpected change. If this change is summed over generations, we have the phenomenon of evolution. These emergent phenomena in physics and biology are very different, but fundamentally they are caused by the uncertain and quantified nature of both quantum mechanics and DNA replication.

Sources:

[8] https://en.wikipedia.org/wiki/George_Paget_Thomson

[9] Dr. Dominick Casadonte, Texas Tech University

[10] Freeman et al., Pearson Biological Science, Sixth Edition

[11] https://en.wikipedia.org/wiki/Crick,_Brenner_et_al._experiment

Student Spotlight: William Milestone

By Carlos Perez

William "Will" Milestone is from the small, cold town of Milton, Wisconsin. During his younger years at Heritage High in Frisco, Will had this awesome teacher, Mrs. Cooper. Her lectures were always fun and her demonstrations never failed to engage. It was because of her that Will decided to pursue his degree in Physics. He's currently working towards his B.S. in Applied Physics with a minor in Mathematics. His applied concentration is in Electrical Engineering. During his time at Texas Tech Will has accomplished no small number of things. During his sophomore year he was Historian for the Society of Physics Students and he continues to be deeply involved today.

Recently, Will, along with Public Relations Committee Officer Shanto, created the Undergraduate Colloquium. The Undergraduate Colloquium was created with the aim of engaging undergrads with the world of active learning. The program is a series of seminars, discussions, presentations, and workshops led by undergrads for undergrads. These will cover content that is not sufficiently covered in available undergrad courses. Will was also hired as an Engineering Technician at Marker Ink, an engineering consultant firm. Like all Physics students, Will has a set of fields that greatly interest him: quantum computing and nanotechnology. The fact that this is a new and exciting field is something which just attracts him even more. Will is "ready to graduate," and will do so in this upcoming spring semester after taking his last set of classes. He plans to attend grad school in hopes of continuing his education in these fields. William encourages his fellow undergraduates to explore different fields of physics to find out what truly interests them, and then study it hard. Aside from being a great physicist, Will enjoys solving Rubik's Cubes, reading textbooks, and watching birds.

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[1] http://www.chinadaily.com.cn/a/201810/19/WS5bc922f3a310eff303283431.html

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