The Quark

The Quark - December 2017

In This Issue...

The First Observation of an Interstellar Asteroid

The first instance of an interstellar asteroid being observed was recorded in Hawaii. The asteroid itself is said to be long and thin, shaped like a cigar.

An Interview with Dr. Lamp

Here we’re introducing a recurring segment in which we’ll interview some of our favorite professors in the physics department.

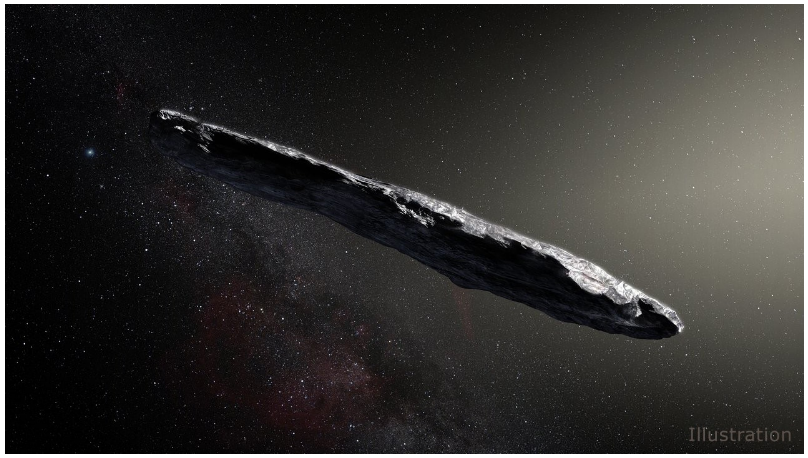
Dr. Lamp teaches PHYS 1408, does his research in Physics Education, and regularly does outreach events at local high schools and elementary schools. His office however, would make you think he’s a career botanist, and his physics demonstrations tend to include quite a bang.

The Coffin Problems

Some problems in physics and mathematics are interesting not only because of their difficulty, or importance to their field, but because of their history.

The Coffin Problems are a set of problems that were used to discriminate against certain applicants at Moscow State University. They were most prominently given to Jewish Students in order to prevent their admission.

‘Oumuamua: Our First Guest From Interstellar

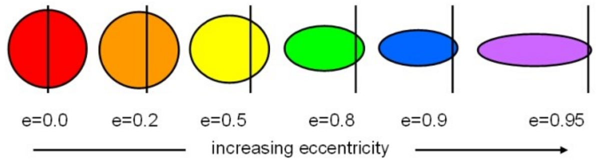


An artistic rendering of the asteroid

The first interstellar asteroid recently got its name ‘Oumaumua, meaning "a messenger from afar arriving first" in the Hawaiian language[10]. Though first thought to be a comet from outer space, observers from the European Southern Observatory (ESO) and elsewhere noticed that the mysterious object hardly showed the properties of a comet after its slingshot past the sun on Sept. 9[4]. Hence, they reclassified it as an interstellar asteroid. Being first of its kind, the International Astronomical Union (IAU), responsible for naming the newly found celestial bodies, created a whole new series designation 1I/2017 U1; it also received its temporary name A/2017 U1.[9]

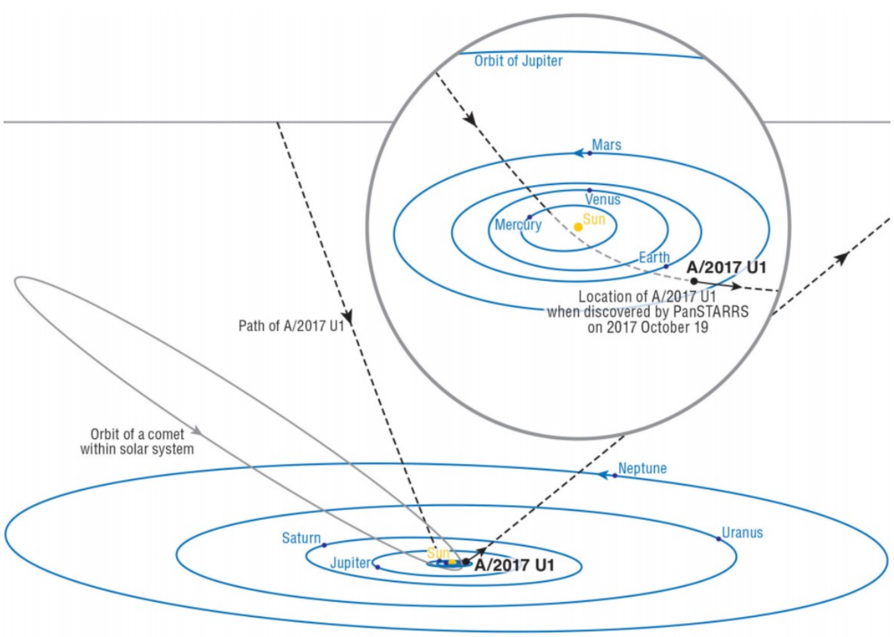
Robert Weryk, a postdoctoral researcher at the University of Hawaii’s Institute for Astronomy(IfA), was the first to identify the asteroid at the Panoramic Survey Telescope and Rapid Response System 1 (Pan-STARRS1) located in Haleakala, Hawaii.[7] The asteroid was first observed on October 19, traveling west at a rate of $6.2°$ per day[6] and spinning once on its axis every 7.3 hours. The Canada-France-Hawaii telescope confirmed the observation on October 22.[6]

It has been theorized that it could have been traveling for millions or possibly billions of years before entering the solar system.[8] Though thought to have originated from outside our solar system, formation models imply that they are from planetesimals, building blocks of solid planets[1], ejected into interstellar space during orbital migration.[3][6] Through its light curve, a graph of light intensity of a celestial body, they identified that the interstellar asteroid is oblong and cigar-shaped.[6] ‘Oumuamua has a diameter of less than a quarter mile, and the ratio of length to width of 10:1, such a proportion has never been observed before (out of the 750,000 known asteroids from our system). The red pigmentation of the asteroid is a result of the materials it’s composed of.[6] Unlike the materials encountered in the asteroids originating from our solar system, the composition in ‘Oumuamua is different from what has been found and as a result was determined to be from a different solar system.



As it approached from about 20 degrees above the ecliptic, the plane where planets and most asteroids orbit the Sun, ‘Oumuamua did not encounter our planets during the slingshot. It has a hyperbolic trajectory and the largest eccentricity, deviation from a circular shape to an ellipsis[2], found in an asteroid yet ($e \approx 1.13$)[6]. This eccentricity further suggests that its trajectory was affected by a gravitational force distinct from that of the sun.

After finding that it’s not affected by the gravitational force of the planets, the astronomers predict that it would move out of the solar system soon. Passing the Mars’ orbit around November 1, it will cross Jupiter’s orbit in May 2018 and will later leave our solar system heading towards the constellation Pegasus.[8]



A diagram of the asteroid’s path[6]

Professor Spotlight: Dr. David Lamp

As a young boy growing up in the central part of Missouri, Dr. David Lamp was curious about how things worked. He was intrigued by the machinery in his family’s farm. One of the many things that fascinated him were the couplers on a train and how they stayed together. This was one of the first questions that put him on the path to physics.

In his early days he studied physics in the MIZZOU, The University of Missouri, and fell in love with the campus. So much, in fact, that after he spent 1 semester at the University of New York he transferred back to MIZZOU and received all of his degrees there. On one of his first research projects, he worked in Solid State Physics using the research reactor there to create uniformly doped semiconductors.

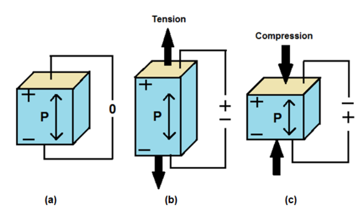
From Stress to Electricity

The piezoelectric effect is the ability of certain materials to generate an electric charge in response to mechanical stress.

The most famous application of this effect can be found in analog record players. The needle of the record player vibrates mechanically as it reads the record’s grooves, which, in turn, generate electric impulses, which then generate soundwaves.

Researches from Empa, the Swiss Federal Laboratories for Materials Science and Technology, created a rubbery, thin, and flexible material which exhibits the piezoelectric effect when stretched or compressed.

"This material could probably even be used to obtain energy from the human body. You could implant it near the heart to generate electricity from the heartbeat, for instance," said Dorina Opris, who is part of the team who developed this exciting new material.



Demostration of The Piezoelectic Effect

https://futurism.com/flexible-material-electricity-stress/

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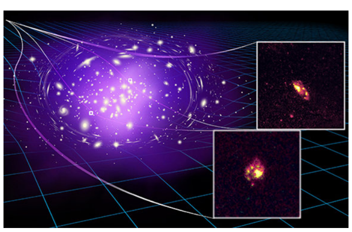
An Ancient Galaxy

Researches from The Australian National University (ANU) and Swinburne University of Technology discovered the most ancient spiral galaxy to date. Using a combination of gravitational lensing and the Near-infrared Integral Field Spectrograph (NIFS) on the Gemini North Telescope, the researchers were able to 11 billion years in the past to spot the galaxy A1689B11. A1689B11 is located in the Abell 1689 galaxy in the Virgo constellation. The galaxy is reported to have formed 2.6 billion years after the big bang.

"This galaxy is forming stars 20 times faster than galaxies today - as fast as other young galaxies of similar masses in the early universe. However, unlike other galaxies of the same epoch, A1689B11 has a very cool and thin disc, rotating calmly with surprisingly little turbulence. This type of spiral galaxy has never been seen before at this early epoch of the universe," said Dr. Tiantian Yuan, leader of the research team.



Images Produced by A1689B11 in the sky

https://m.phys.org/news/2017-11-ancient-spiral-galaxy.html

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Dr. Lamp in front the many plants that decorate his office, holding a broken ceiling tile that was the result of one of his many physics demonstrations.

When asked to provide a story from his days at MIZZOU, he told the story of how he met Jack Kilby, the man who invented the transistor.

Entering the office one day at MIZZOU, someone's outstretched legs were blocking his path. Not thinking anything of it, he walked by, kicking the man's legs slightly as he passed. He was pulled aside soon after by one of his colleagues, and told that the person he had kicked was Jack Kilby, the man who invented the transistor, who had been visiting their workplace.

Now, as a long time professor at TTU, he dedicates a large amount of his time to community outreach. Last November, Dr. Lamp was involved in a project for Friendship Legacy to try to get more kids interested in physics. One of his demonstrations in a Lubbock elementary school involved liquid nitrogen, a coke bottle, ping pong balls, and a bucket of water. In other words, the demonstration was a small ping pong bomb. As the nitrogen in the coke bottle became a gas, it created enough pressure to rupture the glass bottle. The resulting explosion had enough force behind it to break the table the bucket was placed on, and send ping pong balls high enough into the air to break several ceiling tiles, one of which he's holding in the picture above. Luckily no one was injured. Instead of being in trouble, the principal of the school thanked him and asked him to come again another time because, after all, it was a demonstration that the kids will never forget.

Dr. Lamp has been involved with Texas Tech University for over 30 years. He currently teaches Physics 1408 and would eventually like to teach modern physics in the future. His research now consists of teacher education and outreach programs to get more people interested in physics. One of his hobbies is growing Tomatoes.

The Coffin Problems

> *"For many people, the historical background of the following puzzle will be of more interest than the puzzle itself"*[12]

If you follow this link you'll find a set of math problems and their solutions referred to as "Jewish Problems." What these problems seem to have in common is that the solutions are elementary[13], but finding those solutions is extremely difficult. A mathematician might find problems like this interesting and worth collecting in a set. However according to Tanya Khovanova the reason for the existence of this set of problems is far more bleak.

> *"The Mathematics Department of Moscow State University . . . was at that time actively trying to keep Jewish students (and other 'undesireables') from enrolling in the department" –Tanya Khovanova*[13]

Jewish students were targeted by being provided these problems for their oral entrance exams. Failure to answer these problems was used as justification for rejecting the students admission. The simple solutions provided an effective defense against any claims of discrimination. As it was difficult to show that the problems were any harder than others, given their elementary solutions.

This use earned the set it's other name, "Coffin Problems" a direct translation from russian. Tanya Khovanova suggests that a more accurate translation may be "Killer Problems."[14] The problems could easily be used to kill any chances of admission for whomever they were given to.

> *"Now, after thirty years, these problems seem easier. Mostly, this is because the ideas of how to solve these problems have spread and are now a part of the standard set of ideas"*[13]

While their history is grim, that doesn't mean they don't retain their mathematical value. The methods of solving these problems are easily available online, and the techniques needed to solve many of them are explored in depth in a manner simple enough for students of Calculus I.[14] With the efforts made to improve our understanding of these problems, it's possible that they may not pose nearly as significant a barrier as they had in the past.

Whether you're someone interested in mathematics, or someone who wants to understand past discrimination, attempting to solve one of these problems is intriguing. Included on the right side of this page is Problem 21 of those given in the link at the start of the article. Solutions to all of the problems are given in this link. A more detailed explanation of the problem given can be found here.

Coffin Problems:

Problem 21[13]

The graph of a monotonically increasing function is cut off with two horizontal lines. Find a point on the graph between intersections such that the sum of the two areas bounded by the lines, the graph and the vertical line through this point is minimum. See Figure 1.

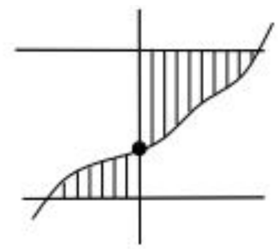

Figure 1 - Problem 21: Given the graph, find the point that minimizes the depicted area.

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