THE QUARK

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Lateral Acceleration: Getting a handle on vehicle handling

By Akash Maheshwari

Have you ever wondered how tight of a turn your car can make at a specific speed? Car manufacturers typically boast impressive acceleration, top speed and horsepower figures, but what about how a car handles? Lateral acceleration and cornering performance can be quantitatively measured by using skid pad testing.

If you have ever taken a tight turn a little too fast, you may have experienced a significant lateral acceleration and your car may have lost traction. Some drivers hope to experience a momentary loss of traction and create vehicles that enable them to do so. These drivers aim to drift: intentionally oversteer to lose traction but still have the ability to control the vehicle through a corner. However, many drivers who seek improved track performance hope to possess a car that corners well and can withstand a significant amount of force before traction is lost. Skid pad testing is a method used to determine the amount of lateral force a vehicle may withstand before losing traction.

Skid pad testing is performed by driving a vehicle around a measured circular track and slowly increasing the vehicle's speed. When the vehicle's tires begin to slip, the speed of the car is measured. Since the velocity of the vehicle and the radius of the track has been measured, lateral acceleration may be determined by squaring the velocity figure and dividing by the radius figure. The acceleration figure is typically calculated in

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About The Quark

The Quark is a monthly newsletter produced by the Public Relations Committee of the Texas Tech chapter of the Society of Physics Students (SPS). Our goal is to help new students become more familiar with the Physics Department and provide 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 Rob Chambers at Robert.Chambers@ttu.edu .

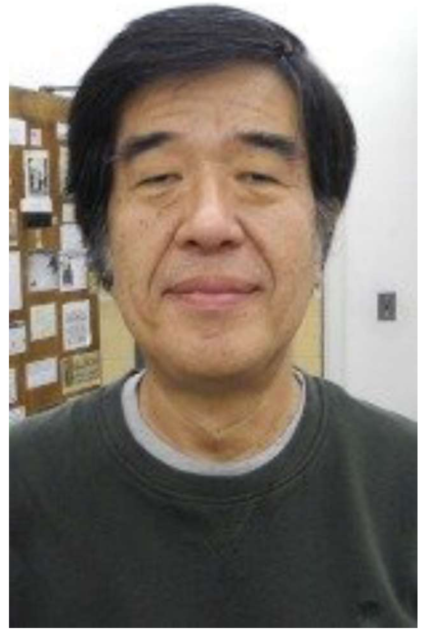
Gs. This centripetal acceleration can also be used to find the maximum amount of lateral force a vehicle can withstand before losing control.

Once a vehicle's skid pad performance is measured, comparisons of cornering abilities can be easily compared across various makes and models of vehicles. Expensive sport cars like Ferraris, Lamborghinis, Porsches and BMWs boast some of the highest lateral acceleration figures; many performance vehicles can withstand lateral accelerations of 1.1-1.2 Gs before traction is lost. Why is this so? One reason is because many of these high-performance vehicles employ All-Wheel Drive to provide more control to a vehicle. Rear-Wheel Drive vehicles are notorious for oversteering, where the back tires lose their traction very easily if an increased amount of power is sent to the back tires. AWD vehicles balance power with cornering ability and result in better track performance. Additionally, many of these manufacturers optimize their vehicles' weight distributions. For example, BMW is well-known for achieving a near perfect 50:50 weight distribution in many of its models. BMW claims that this distribution is ideal for better handling and cornering performance. Moreover, many of these vehicles are vehicles that have a mid-engine layout. This means that the engine is not located in a large hood in the front of the vehicle, but rather the engine is located between the front and rear axles. As a result, these vehicles are able to achieve even better weight distributions and centers of gravity that enable them to possess better handling. Moreover, certain profiles and types of tires can provide increased grip to certain vehicles.

As technology continues to advance, the lateral accelerations of high-performance vehicles experience a paralleled increase. More sophisticated internal computers, innovative tire designs and creative restructuring of vehicles' components will undoubtedly lead to more advanced and sophisticated machines that are much more capable than the cars on the road today.

Professor Spotlight: Dr. Shuichi Kunori

By Samuel Cano



Can you tell me about your upbringing and experience in school? And where your interest in physics came from?

I was born in 1951 in Sendai, Japan and actually stayed there for all of my education, from elementary school all the way to completing my Ph.D. My father was a chemist at the university and kept some chemicals and equipment in our house. I played with them during my early elementary school days.

Several of my cousins and my brother are medical doctors, and across from my house was my Uncle's medical clinic. Chemistry and the medical community were very familiar to me at a young age and I knew I didn't have an interest in them. As a child I was very interested in cars and would read books about engines and I learned to drive at a young age, maybe 14 or 15. My interests shifted to physics when Japanese particle physics theorist Shinichiro Tomonage won the Nobel Prize in Physics in 1965. I started reading books on Particle Physics and joined my high school's Physics Club.

Entering Tohoku University I had already decided Particle Physics was for me. At the time Elementary Particle Physics was the most attractive field and seemed like the most advanced. At the university there was a Bubble Chamber Laboratory, which is one of the detectors used in particle physics. Naturally I joined that research lab during my senior year and was able to learn to conduct data analysis using data from the bubble chamber for my undergraduate thesis. I graduated in 1976 and decided to stay at Tohoku University for graduate school. From there I continued onto more advanced projects at the Bubble Chamber Laboratory, completing my Ph.D. in 1981.

What was your first move after getting your Ph.D.? And how did you eventually end up at TTU?

During my time as a graduate student, I worked with a visiting researcher from the University of Maryland, who worked in our lab for a year. After I finished my Ph.D., he invited me to the University of Maryland for a Postdoctoral position. It was a great opportunity so my wife and I made the decision to move to the United States. I continued my work there and spent some time at Fermi National Particle Accelerator Laboratory (Fermilab) outside of Chicago, IL handling a lot of the software development. I was with the University of Maryland for around 5 years before I began working on the up and coming Superconducting Super Collider (SSC) in Texas. During this time I worked at both at Fermilab and with the SSC and commuted between them when I had to. Sadly the SSC never became a reality, but I was able to begin working on the European Large Hadron Collider (LHC) and never looked back.

Afterwards I came to Texas Tech University as an Associate Professor, there I knew Dr. Nural Akchurin whom I had collaborated with before. At Texas Tech I continued research in High Energy Physics and taught as a professor. Today I am a Research Professor and a member of the High Energy Physics group in our department.

What research are you currently conducting?

During my career I have been most interested in learning about the missing pieces in the Standard Model of Particle Physics. I have been exploring proton-proton collisions, and studying the results for new physics. This includes a lot of interesting data analysis techniques, I currently work with two graduate students learning from collisions at the LHC. I am most active with CERN and the LHC. Another project I am involved in is in the early stages of Research and Development for a new detector. This is down the line, maybe a few years before the process of putting it together begins, but the work has already begun.

I am also interested in Muon Tomography, which is using muons from cosmic rays to image large objects. I am currently working with a group of undergraduates to develop a Portable Muon Telescope.

Do you have a favorite memory in physics, maybe from a project you worked on or an event you were a part of?

I had a lot of fun times in Japan and the US. One of them was when I was working on a high energy muon scattering experiment at Fermilab in the 1980s as a Postdoctoral Researcher. There were a few postdocs and about 10 or so students from US and European institutions that were working day and night next to the detector. Professors did not show up often, maybe every few months and at the time there was no Zoom so we were essentially working independently. We assembled and operated the detector and formed shifts to take data. We felt we were really working together for Physics, it felt like we were a family.

Do you have any hobbies or interests outside of Physics?

I have been an avid skier since my days as a student in Japan. As a graduate student, my professor used to joke that I spent too much time on the mountain. Since moving to the United States I have enjoyed skiing in Colorado and Canada, it is one of my favorite pastimes. I have also been a tennis player for just as long, I spent many days in Japan playing tennis in the sun.

Do you have any advice for physics students?

The only advice I can give is that you really need to separate yourself from the textbook sometimes. When you're given a problem in class or in a research environment, I think it is important to spend time thinking about it alone. There is a lot to gain from understanding a problem for yourself. When you do this, you'll find that later in life you become a much better critical thinker and can work research problems with much more confidence.

Student Spotlight: Alexandria Clark

By Robert Chambers

One night, when she was eleven years old, Alexandria Clark went stargazing for the first time. That single experience set her on a path of discovery, where she set out to learn all she could about space and everything in it. Growing up, she received an education that leaned far more into liberal arts than anything STEM related, which gave her a unique perspective on how to approach STEM concepts.. Now she is implementing this in her college career and applying it towards getting her degree in astrophysics, and eventually fulfilling her dream of becoming an astronaut. Alexandria chose to pursue her goals at Texas Tech because it has one of the only astrophysics programs in the state of Texas, complete with it's own observatory.

Alexandria is currently researching X-ray galaxies under Drs Ann Hornschmeier and Thomas Maccarone. Her most recent project is writing a proposal to get observation time to study these galaxies using the NuSTAR satellite telescope. In her own words, "the overall goal of this project is to select star-forming galaxies for a NuSTAR proposal to study galaxy spectral energy distributions and X-ray source populations. In order to accomplish this, I have to assess the current content of the NuSTAR archive for galaxies and compare it to other catalogs such as LEGUS and HECATE. Using that data I then calculator and plot the luminosity, fluxes, and exposure times based on star formation rates and stellar masses of the galaxies. Finally, I will aid in proposing a scientific question and motivation for the NuSTAR project proposal." Working on this project has given Alexandria valuable experience in writing scientific proposals, and she describes it as her favorite part of her college career so far.

Outside of her schoolwork and research, Alexandria enjoys drawing, playing and listening to music, playing lacrosse, and watching movies. She is also learning Russian as another part of her plan to become an astronaut. After all, besides the US, the Russians have the largest space program still running. Any aspiring or newly certified astronaut will very likely come into close contact with Russian Cosmonauts, so being able to communicate with them in their own language is a good idea.

Once she graduates from Texas Tech, Alexandria plans to go straight for a Ph.D. in Astrophysics, and afterwards she hopes to train as a NASA Astronaut. She sees being an astronaut as a noble career path, but she admits that she is also just enamoured with the sheer adventure and excitement of going to space. Her Ph.D. would give her a good chance at being accepted as one of then next generation of astronauts, but is by no means a guarantee. Luckily, there is no shortage of career opportunities for a doctor of astrophysics, and she would be able to continue researching space regardless of if she travels there or not. Her advice to new physics students is that "it's only going to get harder as you go, so make sure you know the basics and build a good foundation. Anything you're not sure of, you need to focus on." In addition, she cautions new students against taking too many physics classes in a semester and overloading themselves.

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