KES Physics Newsletter

Autumn term 2016

Matthew Latter

Studied Physics, Maths, Music tech, Further maths (AS)

Reading Acoustical engineering at Southampton University

At KES 2008 - 2015

I am currently in my second year of studying for a MEng (that's masters of engineering to the layman) in Acoustical Engineering. My degree is akin to Mechanical Engineering in many ways, for example, five out of six of my first year's modules were shared with the Mechanical, Aerospace and Nautical Engineers, with four of them also being shared with the Civil Engineers. My first year modules were: Mathematics for Engineering and the Environment; Electrical and Electronics Systems; Mechanics, Structures and Materials; Thermo-Fluids; Design and Computing; Acoustics 1. The latter of which is exclusive to my degree. My first year was extremely fun and I made a lot of good friends and memories with both the people on my course and the people I lived with. My second year is thus far also going swimmingly. At present I am studying: Mathematics for Engineering and the Environment part II; Electronics, Drives and Control; Engineering Management and Law; Systems Design and Computing; Audio and Signal Processing. As you can probably guess, most of my second year modules are continuations of the first year modules, except Audio and Signal Processing. Audio and Signal Processing was a completely new concept to me at the beginning of this semester and I am absolutely astounded by how much knowledge I have gained in the subject (in all of my modules, for that matter). I am now able to confidently produce spectrograms and energy spectral density plots in Python code and carry out real-time digital signal processing on my own voice (which is really cool). I'm really looking forward to semester two this year as I will be swapping Maths, Electronics and Signal Processing for Fluid Mechanics, Vibration and Acoustics 2. Also, in the New Year I will be tasked with making a functioning loudspeaker for my Systems Design and Computing module. Just think how awesome it'll be when I'm at one of my (many many) house parties and I can just whip out my speaker and say "Yep, I made that bad mammajamma myself.

My first term at Oxford has flown by! Topics I have been studying in lectures and tutorials this term include classical mechanics, relativity, electronics, linear algebra, calculus and optics. I have also been undertaking practical work in the teaching laboratories. We did some interesting experiments, including one in which we proved the wave-particle duality of the electron. I have also been doing a bit of computer programming in MATLAB as part of the practical physics course. This involved creating an animation to model the nuclear decay of a radioactive substance with multiple decay products, using random matrices.

Robert Clemenson

Studied Physics, Chemistry, Maths, Further maths

Reading Physics at Oxford University

At KES 2008 - 2015

The highlight of my term occurred in sixth week, when Professor Stephen Hawking decided to pop into college for lunch (See picture…). He was kind enough to stay for pictures with a group of physics students.

In my limited free time during term, I have been reading around the topics of relativity and group theory. Towards the start of term, I went to an astronomy event at St Catherine's college, where I viewed the Andromeda galaxy through one of the telescopes.

With the abundance of free time I have enjoyed since the end of term, I have been re-reading Edwin A Abbot's 'Flatland: A romance of many dimensions'. I would highly recommend it to anybody interested in both Victorian literature and geometry. Like Tim, I too have been taking part in MOOC's, one run by Edinburgh University on 'AstroTech: The Science and Technology behind Astronomical Discovery', and another run by a Russian University on 'General relativity'.

Vector spaces are one of the most interesting topics I have studied this term. Vector spaces are mathematical structures (that are heavily related to the classical vectors you may have encountered) which satisfy a certain set of axioms. If a set is identified as a vector space, you can get lots of useful theorems and properties out for free. This is very useful in areas such as quantum mechanics where the state of a system can be represented as some 'vector' of a vector space.

I'm nearing the end of the first semester of my second-year studying aerospace engineering at the University of Bristol and it has been a most enjoyable semester. So far, I've studied; Aerodynamics, Aerospace Vehicle Design and Integration (AVDASI), Engineering Mathematics, Professional Studies, Space Systems and Structures. I will not go into too much detail but I will make a special mention for both AVDASI and Space Systems. In AVDASI the entire unit is a large group project (about 30 people) where we have been tasked with the design, manufacture and test a fully functional UAV (Unmanned Aerial Vehicle) wing. It is a challenging process but is certainly fun to work on and makes you feel like you are being an engineer (which is always good). I'll also mention Space Systems as our lecturer said once we pass the unit we can consider ourselves "Rocket scientists" which, in my opinion, is the best reason for studying aerospace. In my free time, I recently completed a MOOC (Massive Open Online Course) on "How to survive on Mars" with Monash University (AUS). We looked at what future colonists will need to survive on Mars, specifically discussing how they will get their water, energy, oxygen and nutrients. I'm also currently progressing through another MOOC called "Moons" with the Open University. In this course, we've looked at moons across the solar system and, it turns out, they are not all just lumps of icy rock and are, in fact, very intriguing objects indeed. If you have few spare hours a week I strongly recommend that you try a MOOC as, for me, they are really interesting and enjoyable to study. One final thing I've been attempting in my free time is learning Russian. I've triggered my inner 6-year-old and would one day like to become an astronaut. To be an astronaut however, amongst many other requirements, you need to be able to understand Russian. I'm not stupid and I do realize that the chances of me ever getting the chance to go to space are close to zero (in a nation of 66 million people, only one of us has been there) but I thought I may as well try and improve my credentials as best I can. As you can probably tell, I like space (a lot). In future letters, I will try to go into more how studying physics has helped me at University but until then до свидания.

Timothy South

Studied Physics, Government and Politics, Maths, Further maths (AS)

Reading Aerospace engineering at Bristol University

At KES 2008 - 2015

As a researcher at the University of Cambridge, I am interested in studying the physics of environmental processes, particularly those involving fluid mechanics. Currently I am working on a project investigating how sand dunes form and evolve. Such structures are created in response to the flow of a fluid (air or water) over an erodible surface and can be found in deserts, coastal beaches, deep rivers and coastal bays.

Paul Jarvis

Studied Physics, Chemistry, Maths, Biology

Read BA and MSci natural sciences at Cambridge University

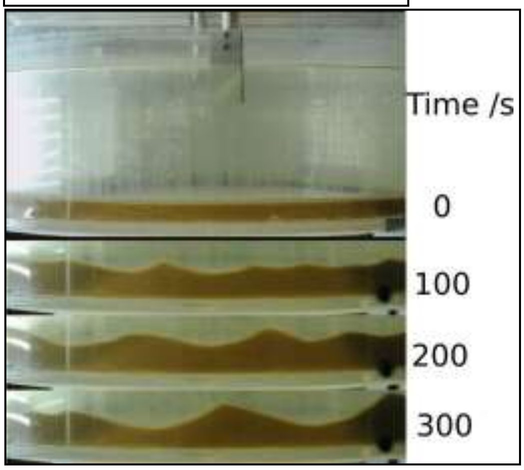
Ph.D. in Geology from Bristol University

Currently a post-doctoral research assistant at Cambridge University

At KES 2001 - 2008

In the last few months, we have started conducting experiments in our lab where we create underwater sand dunes (see figure). At the start of the experiment, we drive a steady flow of water of a flat bed of sand. The flow erodes and transports the sand, leading to the formation of ripples. Initially, these are small and irregular but they quickly grow into larger dunes with near-uniform wavelengths and amplitudes. We are trying to determine how changing the grain size of the sand, the flow velocity and the fluid density determines the wavelength and growth rate of the dunes that form. Other research groups have developed theoretical models predicting these relationships, but as yet, no one has provided convincing experimental evidence to support the equations.

Although our experiments are performed in water, the physics of dune formation on land is sufficiently similar for us to apply our results to desert settings. One of the many challenges facing communities across the world is desertification – the degradation of fertile land into desert. A famous example is the expansion of the Sahara desert southwards. By understanding how sand dunes form and develop, we can make predictions about how desert landscapes will change in the future. With continuing climate change likely to mean future desertification is an inevitability, such information is extremely useful for policy makers such as governments, who need to work to ensure affected communities are provided with the resources they need to live and develop.



Alex Broad

Studied Physics, Maths, Psychology, Further maths (AS)

Reading Physics at Swansea University

At KES 2012 - 2014

I'm currently nearing the end of the first semester of my third year studying physics at Swansea University. So far, my course has included modules on quantum mechanics, relativity, condensed matter, astrophysics and electromagnetism, to name a few things. Perhaps the most interesting thing I've studied this semester is general relativity which, in principle, is a geometric explanation for why gravity exists. This module contains a lot of mathematics, and a lot of the module involves solving geodesic equations, which describe how light and objects travel through the universe we live in. This may not sound interesting in itself, but from solving these you find a lot of interesting results. For example, it turns out that time actually slows down near very large objects (for example, the Earth or Sun). The amount that time slows is small near the Earth, but it does have a significant effect that global positioning systems (GPS) have to take into account. Another interesting result of general relativity is that light does not actually travel in straight lines, but instead curves around large objects (again, like the Earth or Sun). These effects on time and light travel, may not greatly affect us here on Earth, but elsewhere in the universe, there are certain places where these effects are huge. I am talking, of course, about black holes. Near black holes, time slows down and even comes to a stop altogether! And the curvature of light is so large that light can orbit around a black hole. Anyway, moving on from general relativity, I have also spent a lot of time doing experimental work using lasers. Being in my third year, I am able to do a lot more interesting practical work and, over the last few weeks, I have spent a lot of time working on spatial filtering techniques, which use lasers. Spatial filtering involves reducing or amplifying features of an image by blocking out certain regions of light in what is called the 'Fourier plane'. This has lots of interesting applications, such as holography and medical imaging. So that, and a few other things, is what I've spent most of my first semester doing. Next semester, I start my project dissertation on string gas thermodynamics, and will be able to tell you all about things like cosmology, particle physics and quantum optics.