Job title: PhD student studying the Earth's magnetic environment

Name: Andrew Walsh, Mullard Space Science Laboratory, UCL

Area of research: Satellites, Probes, Planetary

Details:

For my PhD studies I use the European Space Agency's Cluster and Double Star spacecraft to investigate how the solar wind and the magnetic field of the Sun interact with the Earth's magnetosphere – the area of space around to the Earth containing its magnetic field. This interaction is responsible for one of the most spectacular sights you can see in the night sky: the Northern and Southern Lights (The Aurora Borealis and Aurora Australis). One process I'm investigating helps cause the Aurora and is called a substorm. Substorms happen roughly every 6 hours and each one generates about the same amount of power as 100 Hoover Dams (~$2x10^{11}$W). We've known about substorms for over 30 years but still haven't discovered exactly how and why they happen.

Outcomes:

The space around the Earth is becoming increasingly crowded with satellites that are vulnerable to radiation and particles from the Sun. By understanding how these particles interact with the magnetosphere we can predict when the satellites might be damaged and can protect them by switching off delicate electronic components. Knowledge of the space close to the different planets will also be vital when we start sending astronauts to Mars and beyond. The same physics that governs how magnetic fields and particles interact is also important when designing fusion reactors; so we can use near-Earth space as a huge laboratory to help solve some problems in this area of science as well.

Weblinks:

Mullard Space Science Laboratory: http://www.mssl.ucl.ac.uk
Cluster: http://sci.esa.int/cluster
Double Star: http://sci.esa.int/doublestar
Space Weather: http://www.spaceweathercenter.org
Magnetosphere exploration: http://www.phy6.org/Education/Intro.html

How I got here:

After GCSEs I stayed at school to do A-Levels in Maths, Physics, Computing and Geography. I then took a gap year and worked in an environmental chemistry lab, testing soil and water samples for pesticides before going on to study for a 4-Year MPhys degree in Physics with Astrophysics at the University of Leicester I'm now starting the second year of my PhD at MSSL.

Job title: PhD student studying the Sun's eruptions

Researcher: Gemma Attrill, Mullard Space Science Laboratory, UCL

Area of research: Solar Physics

Details:

I study the atmosphere of the Sun using telescopes that 'see' in Extreme Ultra-Violet (EUV) light. The Sun's atmosphere is a very violent and stormy place. Without using special telescopes, we can see it's atmosphere only during a solar eclipse. Using the EUV telescopes, we observe huge eruptions of hot gas (many times the mass of Mount Everest!) that get blasted out into space and can be directed towards the Earth. The Sun is dominated by magnetic fields and by looking at the magnetic fields of these eruptions, we can understand how likely they are to interact with the Earth's protective magnetic shield. These events are called coronal mass ejections and can cause the Northern (& Southern) Lights as well as cause problems for satellites and radio communication. 50 years ago, this wasn't a problem, but our modern dependence on satellites means that today, we really need to understand and ideally, learn to forecast this Space Weather.

Outcomes:

Physicists are trying to understand how and why these huge magnetic explosive storms happen. Understanding the detailed physics of the mechanism responsible for such eruptions is a huge challenge. Since we are trying to understand how and why these storms occur, it makes sense to analyse the signatures of the start of these eruptions. By understanding the physical nature of these signatures, we hope to advance understanding of the eruption mechanism itself.

Weblinks:

MSSL research group: http://www.mssl.ucl.ac.uk/www_solar
NASA's "Living with a star" outreach programme: http://lws.gsfc.nasa.gov/
Solar eclipses: http://sunearth.gsfc.nasa.gov/eclipse/solar.html

How I got here:

I studied History, Physics & Maths for my A-levels then completed my 4-year Masters degree (MPhys) in "Physics with Planetary & Space Physics" at the University of Wales, Aberystwyth. The final 6 months of my degree was spent living in the High Arctic at UNIS (University Centre in Svalbard), studying the beautiful Northern Lights. During the summer holidays, I worked as a summer student at the Mullard Space Science Laboratory, learning about research and the Sun. This experience helped me to decide to pursue my PhD studies here. So far during my PhD I have lived and worked in Kyoto, Japan for and have attended & presented my work at several national & international conferences including Germany, Italy, Mallorca and Japan.

Job title: PhD student working on instrument design

Researcher: Glyn Collinson, Mullard Space Science Laboratory, UCL

Area of research: Probes / Planetary / Solar

Details:

I'm learning how to build the interesting bits of spaceships; the scientific instruments that help us explore the Solar System. Right now, I'm working on an instrument that is going to fly closer to the Sun than ever before, hitching a ride aboard ESA's *Solar Orbiter* Mission. You'd be surprised how little we know about the Sun, even though we have been studying it for a long time. it's the biggest and brightest object for hundreds of millions of miles and it's vital for life on Earth. MSSL is very rare in that we actually build space hardware ourselves on site. Just recently, we've built hardware that's flown to Mars, Saturn and Venus

Outcomes:

Our "seat" aboard the flight to the Sun is by no means assured! When a space agency (NASA/ESA) decides to launch a new mission, it writes a very long document that describes the new spaceship and what all of its scientific instruments will do. Then anyone, anyone at all, can write to them and apply to build it. The results of my research will be used to try and persuade ESA that we are the best people to get to build this particular instrument. I'm also helping scientists to use an instrument that's orbiting around Venus.

Weblinks:

http://solar-center.stanford.edu/activities/ (A great page about the sun)

How I got here:

I've got 4 A-levels (including only a "C" at maths) and a degree in Physics from the University of Bristol. When I'm not building spaceships, I'm either playing guitar, travelling or at the bottom of an ocean somewhere.

Job title: Spacecraft operations

Researcher: Dr Hina Khan, Mullard Space Science Laboratory, UCL

Area of research: Planetary/Terrestrial Space Science

Details:

I work on the European Space Agency flagship mission Cluster, which is a set of 4 spacecraft flying in formation around the Earth. The spacecraft make observations in area of space close to the Earth, known as the Earth's magnetosphere. The spacecraft were initially launched in 1996 but were lost due to the failure of the launching rocket. The mission was rebuilt and successfully launched in 2000. Cluster is the only 4 spacecraft mission in orbit around the Earth and has provided a wealth of science to understand the interaction between the Sun and the Earth. The mission is set to continue operation until Dec 2009. My job deals with ensuring that the data coming from the satellite is of good quality and can be used accurately for scientific studies. I make sure that the data are correct and are calibrated correctly so that scientists can make sense of what is happening in the Sun-Earth environment.

Outcomes:

By studying the data taken by space missions such as Cluster, we are able to understand the manner in which the Sun and the Earth connect with one another. The material coming off the Sun can be harmful to both life on Earth and in the surrounding space close to the Earth where satellites and astronauts might be working. By studying the data from Cluster, we are able to understand the level of the Sun's effect on the Earth's Environment and take precautions as necessary to ensure that people and equipment are safe. An example would be power surges caused by solar storms, where material from the Sun directly impacts the Earth causing magnetic disturbances at the Earth.

Weblinks:

The ESA Cluster home page http://sci.esa.int/cluster

How I got here:

I studied Physics and Astronomy at university and then continued to do a PhD in Space Science at the University of Leicester; one of the most prestigious Space Science research groups in the world. From there, I gained a 2yr fellowship to work at the NASA Goddard Space Flight Center and then a 1yr fellowship to work at the European Space Agency in Holland. I currently work at UCL have the opportunity to work at some of the most prestigious and scientifically advanced places in the world.

Job title: Post-doctoral researcher in solar physics

Researcher: Dr. Lucie Green, Mullard Space Science Laboratory, UCL

Area of research: Solar physics using satellites

Details:

I study the most energetic explosions in the Solar System. They take place on the Sun and few people realise that our local star is such a dynamic object. The explosions blast charged particles into space at incredible speeds. These fast moving particles can be hazardous to astronauts in space if they hit the human body and can damage satellites. The explosions can also heat up regions of the Sun's atmosphere to hundreds of millions of degrees making it shine brightly in X-rays. This high-energy radiation also has damaging effects at the Earth and can cause blackouts in radio communication.

Outcomes:

The explosions are called solar flares and coronal mass ejections and I use satellite images of the Sun for a clear view above the Earth's atmosphere. Actually, some of the light given off by the Sun (e.g. X-rays) can only be seen from space. I hope to understand why flares and coronal mass ejections happen so that in the future we can predict when they will occur.

Weblinks:

SOHO satellite website:	http://sohowww.nascom.nasa.gov
MSSL website:	http://www.mssl.ucl.ac.uk/www_solar/PUS/PO/

How I got here:

I left school with A' levels in Art, Physics, Chemistry and Maths. Initially I studied art at college but I soon wanted a different challenge so I went on to do a degree in Physics with Astrophysics at university. After my degree I continued on at university to study the Sun. Being a space scientist has meant that I have worked for NASA and travelled all over the world.