Autumn 2009 Issue 28

space:uk

The BIG questions

Tim Peake: UK astronaut

Disasters and the British satellites built to help

What a Mars rover, polar bears and a bizarre photo shoot have in common

New space innovation centre in the UK

Plus: pull out poster and all the latest UK space news

BNSC
BRITISH NATIONAL SPACE CENTRE
www.bnsc.gov.uk

WELCOME

Space in the UK goes from strength to strength. The SEEDA/ Oxford Economics report published this summer stated that the UK space industry is worth £6.5 billion to the UK economy, and indirectly supports 68,000 jobs – great news. Add that to the fantastic space science, environmental studies and telecommunications capability we have in this country, and we have much to be proud of.

However, BNSC continues to examine how best to serve the UK space sector. We are consulting on the structure and funding of UK civil space activities to decide the best way to organise our efforts in future, whilst the Innovation Growth Team, which is sector-led, will publish recommendations on the next 20 years of space early next year. The opening of the new European Space Agency Centre at Harwell is also a really exciting development (see feature page 14).

These efforts will make sure that the 'hidden jewel' of space in the UK will sparkle even more brightly in future.

Dr David Williams
Director General, BNSC

Isn't our cover picture incredible? It's one of the latest images from Hubble and proves beyond all doubt the importance of the recent servicing mission. Over its lifetime of nearly 20 years, Hubble has done more than almost any other mission to reveal the wonder and excitement of space exploration. Who can look at those images and not be inspired?

Usually in *space:uk* we aim to answer questions about space but it turns out that there are some really big questions even rocket scientists don't know the answers to. We've posed some of those questions in the feature on pages 8-10 and all of the baffling questions we could think of on the pull out poster. I don't know about you but I'm planning to hang the poster on the *space:uk* office wall and sit contemplating the meaning of everything. Saves doing any work.

Speaking of questions, thank you for all the responses to our survey. I'm pleased to report that they were overwhelmingly positive but there are some useful things we can learn. We've already made some tweaks and look out for more changes in the next issue. In the meantime, please don't hesitate to send comments, at any time, to **bnscinfo@bnsc.gsi.gov.uk**

Richard Hollingham
Editor

BNSC is a partnership and consists of six Government Departments, two research councils, the Met Office and the Technology Strategy Board.

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Front cover image: Nicknamed the 'Butterfly Nebula', the wings are actually rolling cauldrons of gas tearing across space
Credit: ESA/NASA

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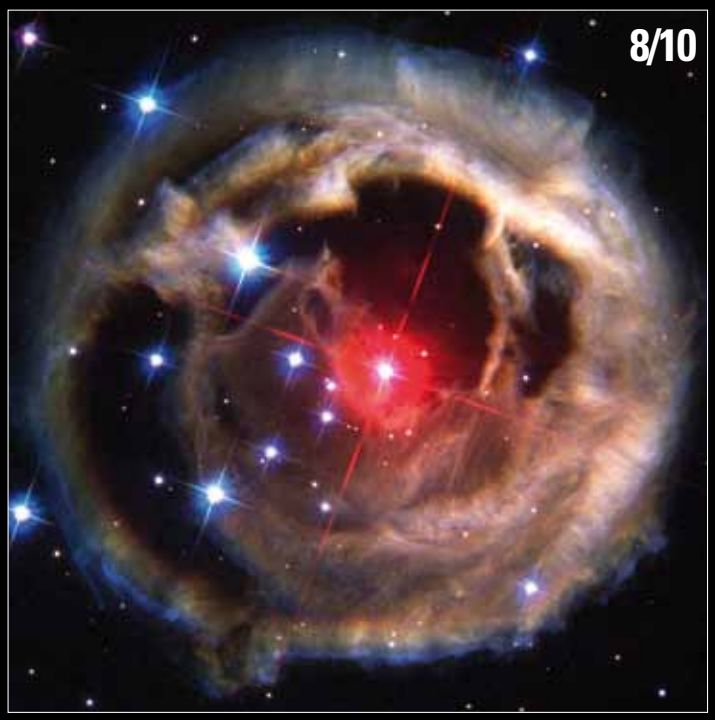


Credit: NASA, ESA and H.E. Bond (STScI)

Credit: UKAEA

Credit: Claire Cousins

SPACE:UK NEWS

NEWS IN BRIEF

Making an impact

UK engineers have designed a spacecraft to save the world from an asteroid collision. The team at Astrium call the invention a 'gravity tractor'. The spacecraft would first rendezvous with an object heading for Earth. Then the craft would use its gravitational attraction to slowly pull the rock off-course. The process would take several years but, as long as the object were far enough away, it would only take a slight change of course for it to miss our planet. Although there is no imminent threat to Earth, history suggests that it's only a matter of time before what's known as a 'Near Earth Object' poses a real danger.

Credit: Astrium

Artist image of the gravity tractor

Pinpoint accuracy

Scientists at the UK Space Geodesy Facility have successfully measured the exact position of a satellite orbiting the Moon. By aiming powerful pulses of laser light, they located NASA's Lunar Reconnaissance Orbiter to within 10 cm at a distance of 350,000 km. Knowing the exact position of a spacecraft orbiting the Moon enables scientists to make more accurate measurements of surface terrain and the gravitational field.

World Space Week

Events to celebrate space take place across the UK from 4-10 October. World Space Week is backed by the United Nations and is described as the 'largest annual public space event on Earth'. Events in the UK include lectures, displays and events for schools and families.

www.worldspaceweek.org

NEW ESA CENTRE

A new European Space Agency (ESA) research facility has been opened in the UK. Based on the Harwell Science and Innovation Campus in Oxfordshire, it will focus on climate change research and the development of new technologies for planetary exploration. The facility will also examine ways of using space technology and satellite data for everyday applications.

Speaking at the launch event on 22 July, the Director General of ESA Jean-Jacques Dordain said: "I hope that by connecting our competence and the expertise that exists today at Harwell, we shall innovate and contribute to the growth of the economy."

He said that this was exactly the right time to invest in space. "Space is not a luxury, I think with space you prepare the future. At a time of economic crisis this is exactly the right time to invest in the future," he said. "All the scientific progress we are making can help improve people's quality of life."

The new ESA facility at Harwell forms part of a wider vision for the future of the UK's 'space economy'. ESA Director of Science and Robotic Exploration, David Southwood, said the centre would tap into UK expertise. "There's something in the way the British do things which is a bit different from how things are done in the other big countries of Europe – that's what we want to capture," he said. "It's a challenge for the UK as well as for ESA."

See also feature on page 14

Credit: BIS

Lord Drayson (l) and Jean-Jacques Dordain (r) at the launch of the new ESA centre

UK SPACE: THE NEXT 40 YEARS

In the week of the 40th anniversary of the Moon landings, the Government announced a consultation on the UK's future in space. The consultation is seeking opinions on the funding and management of the UK civil space programme and whether BNSC provides the best structure to meet the challenges of the future.

"Space is so important to our future," said the Minister for Science and Innovation Lord Drayson. "The UK space industry has thrived under BNSC but the Apollo 11 anniversary demonstrates the need for ambition, purpose and a clear sense of commitment."

The UK space sector is second only to the United States in space science, contributes some £6.5 billion a year to the UK economy and supports 68,000 jobs. However, with the world increasingly dependent on advances in space technology, the consultation is asking whether a single agency might better co-ordinate the UK's space strategy.

"We now have to look ahead to the next 40 years," said the Minister. "So we can provide the best support to our world-leading space sector. So it can continue to flourish and when economic growth takes hold, make an even bigger impact on the UK economy and our lives."

The consultation is open until 14 October 2009. To take part visit the BNSC website.

Credit: NASA

FIRST LIGHT FOR NEW OBSERVATORIES

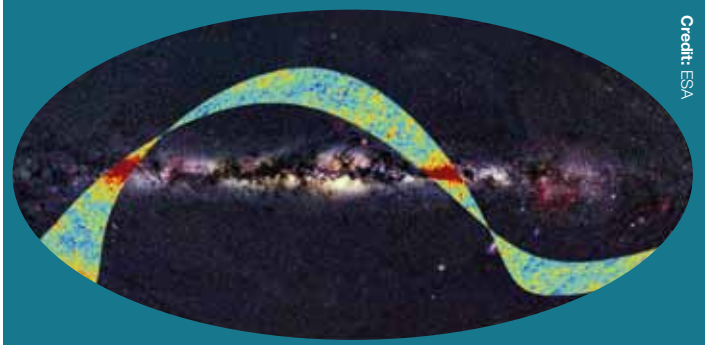
The first images and data obtained by ESA's Herschel Space Observatory demonstrate that the satellite is in excellent condition following its launch in May. They also provide scientists with a tantalising glimpse of the science to come. Herschel is the largest space telescope ever built and will detect stars being formed in our own and other galaxies.

Credit: ESA

Herschel's first test image shows the 'Whirlpool Galaxy' some 35 million light years from Earth

Herschel was launched on the same Ariane rocket as Planck – a satellite designed to investigate the formation of the Universe. Following a successful period of testing, **Planck** has begun its observations. The first images from Planck suggest it is working well. The satellite is measuring variations in the temperature of the Cosmic Microwave Background radiation, ancient light left over from the Big Bang.

Planck is so sensitive that it can detect what an ESA spokesman described as "the equivalent of measuring from Earth the body heat of a rabbit sitting on the Moon." (Presumably the rabbit would be in a spacesuit - Editor).



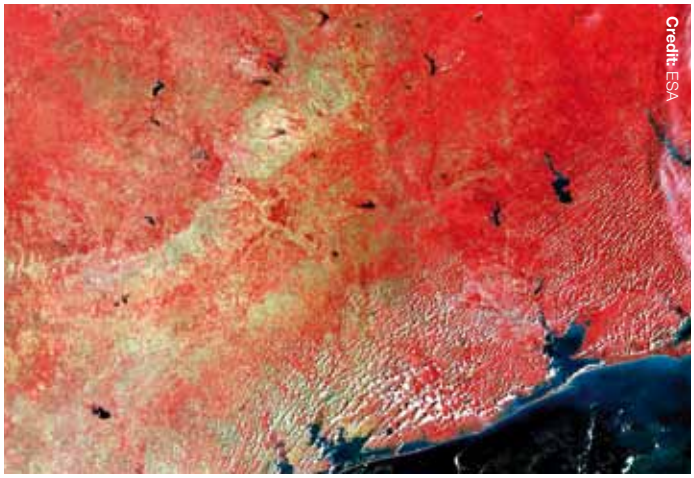
Credit: ESA

This superimposed strip across part of the Milky Way shows the area of the sky mapped by Planck during its 'First Light' survey

See also feature from page 8 and our pull out poster

SPACE:UK NEWS

NEW CRISIS SATELLITES



The first image from UK-DMC2, showing the US states of Texas and Oklahoma. The artificial red colour in the image indicates green vegetation

Two new British-built 'disaster monitoring' satellites have been successfully launched from the Baikonur Cosmodrome in Kazakhstan. The satellites, UK-DMC2 and the Spanish-owned Deimos-1, will form part of the Disaster Monitoring Constellation (DMC), designed to provide detailed images of the Earth in times of crisis. The new spacecraft were built by Surrey Satellite Technology Limited (SSTL) and will increase the number of satellites in the constellation to six.

When disaster strikes, the DMC is used to provide images and detailed maps to assist rescue workers. Since the launch of the first satellite in 2002, it has responded to earthquakes, floods, fires and the aftermath of typhoons and hurricanes.

The two satellites were launched on a Dnepr rocket – a launch vehicle developed from the SS-18 intercontinental ballistic missile. They are an advance on the first generation of DMC satellites and carry improved cameras, enhanced memory and faster communications.

The company that provides images from the DMC, DMC International Imaging Limited, has also won a €3.9 million contract with ESA to monitor sub-Saharan Africa. The satellites will gather information on land-use, drought and the destruction of tropical rain forest. This will be used to help governments protect the environment and improve food security for some of the world's poorest people.

For more about the DMC – see the Learning Zone from page 16

GOCE FLIES FREE

After a successful launch, the European GOCE satellite has reached its final orbit and begun its measurements of the Earth's gravitational field. GOCE (Gravity field and steady state Ocean Circulation Explorer) is orbiting just 254 km above the Earth's surface, at the very edge of the atmosphere.

The satellite was launched in March and early tests suggest it is performing well.

To measure gravity, the sleek-looking spacecraft has to eliminate other accelerations caused by air-drag and even photons from the Sun. To overcome these challenges, GOCE uses an electric propulsion system built in the UK by QinetiQ (see page 6: Mission to Mercury).

The data GOCE gathers will be used to help our understanding of ocean circulation and climate. Helen Snaith from the National Oceanography Centre in Southampton will be working on the results. But she has to be patient.

"From a science point of view we will have to wait about a year before we can get enough data to work with," she said. "However, the prospects are looking incredibly good and that's very exciting!"

To read a feature on GOCE and listen to a podcast visit the BNSC website.

Artist's impression of GOCE

LOST MOON MISSION STILL WORTHWHILE

A close-up of the Moon's surface taken by Chandrayaan-1

India's first unmanned mission to the Moon, which lost contact with the ground, will still produce useful science according to the Chief Engineer for the UK-built instrument on board. Chris Howe from the Rutherford Appleton Laboratory oversaw the construction of the C1XS X-ray spectrometer on the Chandrayaan-1 spacecraft. He told *space:uk* that although he was sad about the loss of the mission, the science team still has lots of material to work on. "C1XS was a splendid instrument and it really has performed spectacularly well."

C1XS was designed to examine the chemical elements on the Moon's surface – particularly aluminium, magnesium and silicon – and relied on solar flares for its measurements. When sunlight shines on the Moon, the surface absorbs X-rays and then emits new X-rays. Each element produces a distinctive pattern of rays and by detecting these from an orbiting spacecraft, C1XS could build up a detailed map of the Moon's surface composition.

"It looks like we have thirty separate passes that we should be able to get some information from," said Chris. "We're predicting that we will get at least four or five decent scientific papers out of the mission."

The reason for Chandrayaan-1's loss is due to a failure of the onboard control systems. Communications were lost on 29 August and the Indian Space Research Organisation terminated the mission the following day.

Chris Howe is hoping for another mission. "We're still missing data from quite a lot of the Moon," he admitted. "We have a flight spare for the C1XS instrument which could be flown if we had a spacecraft to put it on."

NEWS IN BRIEF

New expert group

A new industry-led 'expert group' has been set up by the Government to examine the future challenges and opportunities for the UK space industry. The Space Innovation Growth Team for Space will be chaired by the head of technology company Logica, Andy Green, and will report to the Science Minister Lord Drayson.

The group is charged with creating a 20-year strategy for British leadership in space and will seek views from the entire space industry as well as other industries that rely on space technology.

"Britain is a global leader in space," said Lord Drayson. "This initiative will help to keep us there."

Ice mission countdown

An ESA mission which will monitor the thickness of polar ice has come a step closer to launch. The infrastructure designed to control and support the CryoSat-2 satellite – known as the ground segment - has been completed. The satellite itself will now undergo a series of reviews before it is shipped to the launch site in Russia for launch early next year. CryoSat-2 has been built in just three and a half years after the original CryoSat was lost in a launch failure. The UK leads the science team for the mission, designed to improve our understanding of the Earth's changing climate.

CryoSat-2 undergoing testing in Germany

SPACE:UK NEWS

MISSION TO MERCURY

UK motors will take a spacecraft to one of the most inhospitable places in the Solar System. QinetiQ has been awarded a £23 million contract to supply a propulsion system for the BepiColombo mission to Mercury. The mission is a joint venture between Japan and ESA and much of the spacecraft is being built in the UK.

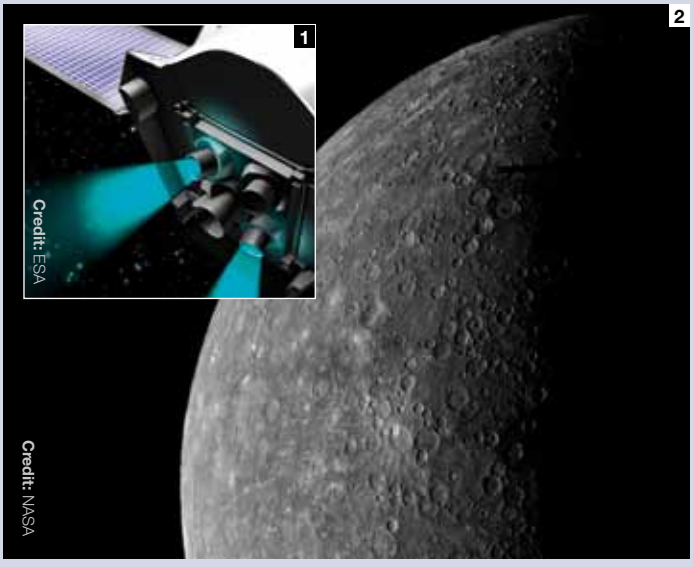
The propulsion system for BepiColombo is based on technology already flying on ESA's GOCE satellite. Electricity generated by solar panels will be used to produce charged particles from xenon gas. A beam of these charged particles, or ions, is then expelled from the spacecraft to propel it forward.

Mercury's harsh environment makes this a particularly challenging mission. The spacecraft will have to endure intense sunlight, fearsome radiation and temperatures up to 470°C.

"The goal of the mission is very important," said ESA's Director of Science and Robotic Exploration David Southwood. "Mercury has regularly confounded planetary scientists with its exceptional properties and that makes it a grand scientific challenge."

Astrium in the UK is responsible for the entire structure of the spacecraft, which is due for launch in 2014.

More details can be found on the missions pages of the BNSC website.



1. Artist image of BepiColombo's engines
2. Mercury is a tough place to visit

SALT AND SOIL SATELLITE

A European satellite built to measure the moisture of the soil and the saltiness (salinity) of the seas, is being prepared for launch. ESA's Soil Moisture and Ocean Salinity (SMOS) mission is due to be launched from Plesetsk Cosmodrome in northern Russia at the beginning of November.

Measurements from SMOS will help our understanding of the global water cycle and the circulation of water in the oceans. Soil moisture plays an important role in the water cycle and data from SMOS will be used to improve the accuracy of weather forecasts.

The salinity of the sea affects the density of seawater – an important factor in driving the currents in our oceans. These currents move vast quantities of heat around the globe and have a tremendous effect on our climate. Without the warm water from the Gulf Stream providing heat to the atmosphere, for example, the UK would be several degrees colder in winter.

SMOS will be launched alongside Proba-2, an ESA satellite designed to test new spacecraft technologies. Equipment on board Proba-2 includes a new type of solar panel and instruments to investigate the Earth's magnetic environment.

For a podcast featuring SMOS visit: http://planetearth.nerc.ac.uk or download the Planet Earth Online podcast from i-Tunes

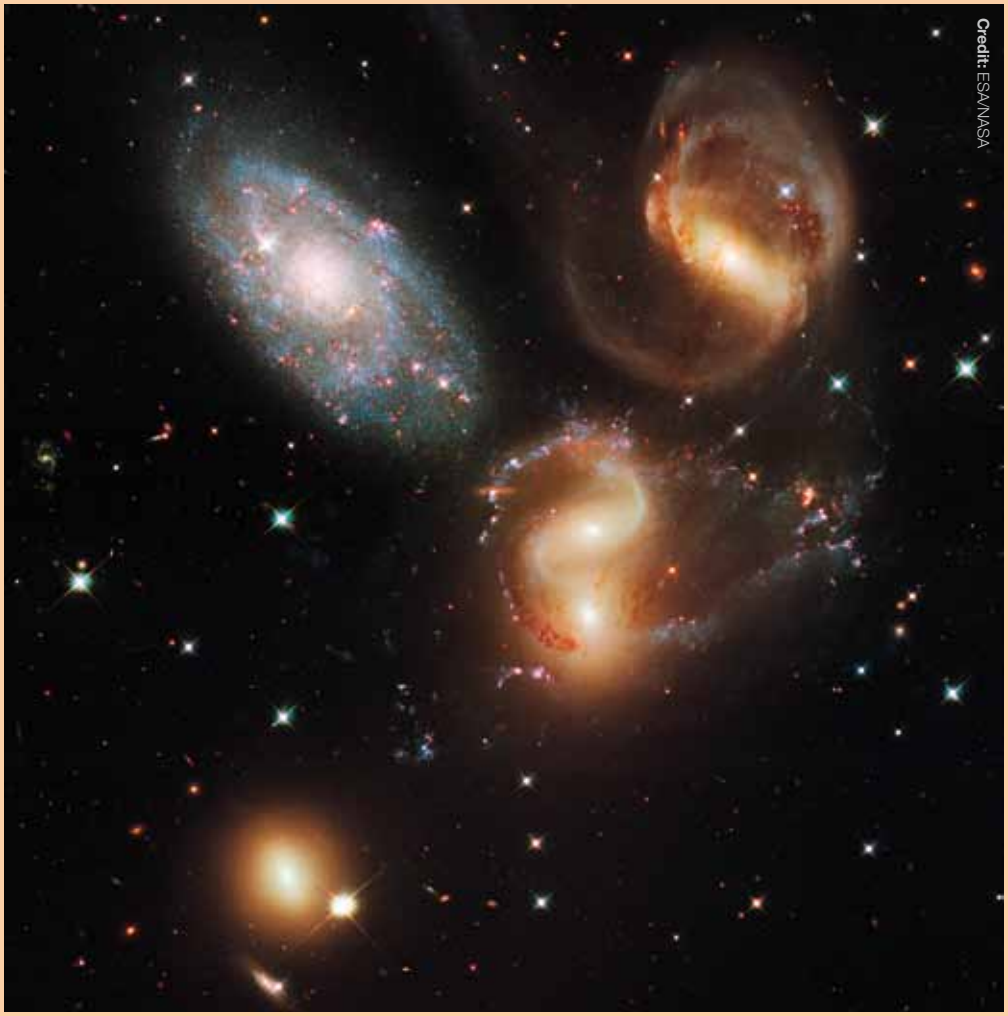
Salt formations in the Dead Sea

HUBBLE'S NEW VISION

It's difficult to describe the pictures from the rejuvenated Hubble Space Telescope without using the words 'breathtaking' or 'stunning'. The latest images suggest the final servicing mission to the international observatory in May was a complete success. The new suite of instruments fitted to Hubble allows it to study the Universe in far more detail than ever before.

A pillar of gas and dust in the constellation Carina masks the birth of a new star

Hubble also captured this sharp new full-disc image of Jupiter

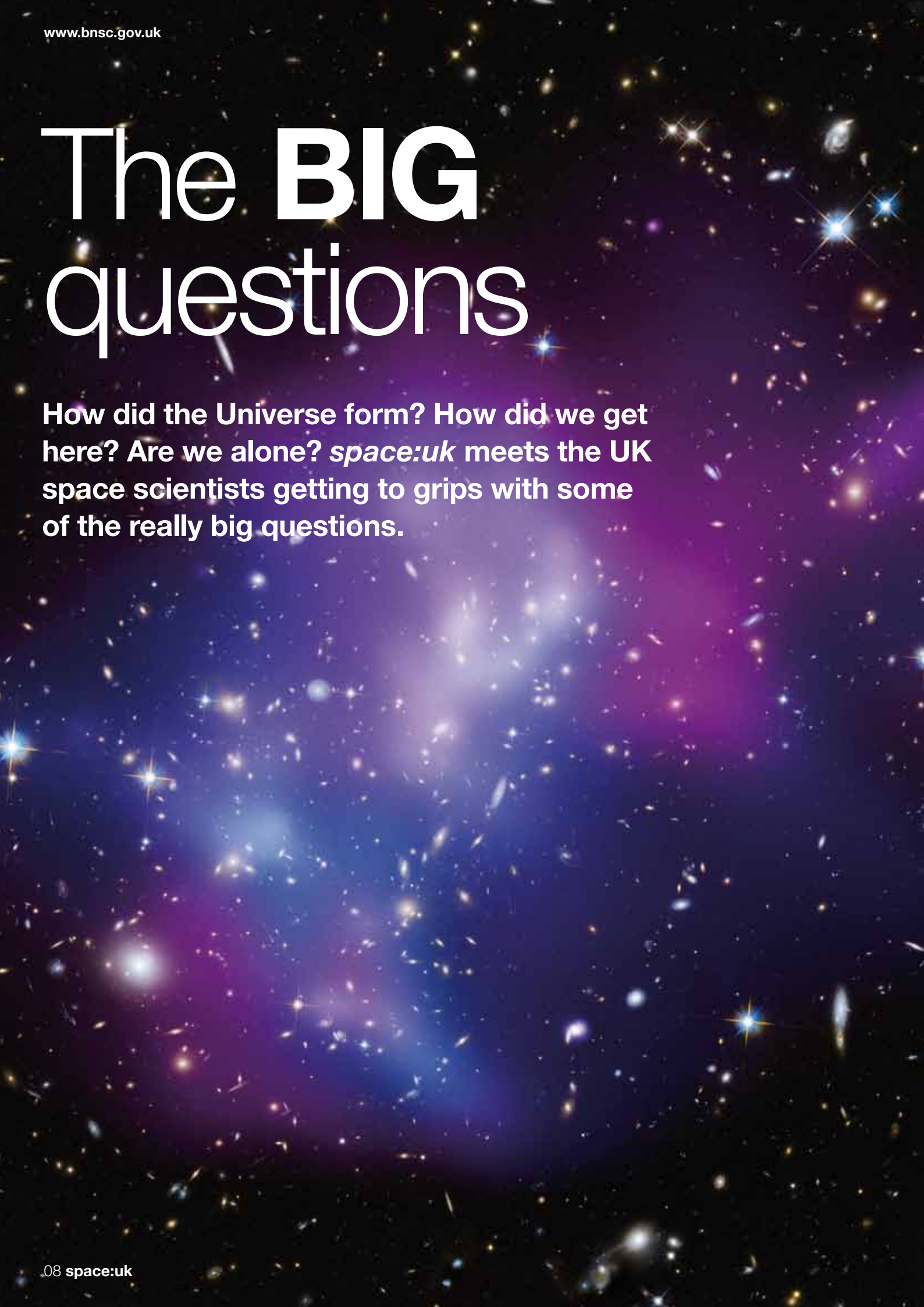


Hubble can study the Universe in far more detail than ever before

A group of five galaxies known as Stephen's Quintet

The **BIG** questions

How did the Universe form? How did we get here? Are we alone? *space:uk* meets the UK space scientists getting to grips with some of the really big questions.



"Together, Planck and Herschel will explore the Universe throughout almost its entire history"

Professor Matt Griffin

Imagine you could step into a blue telephone box, travel back in time and witness the creation of the Universe. OK, maybe not the exact moment of creation (even Doctor Who can't do that) but billions of years ago, shortly after the Big Bang.

Now imagine how it would feel to follow the birth of the cosmos, the formation of galaxies and the evolution of our Universe. Finally, in true Time Lord fashion, imagine searching for life on other planets. This is not science fiction. It is the equally mind-blowing world of astronomy and space science.

Unlike the Doctor however, scientists have no access to a Tardis. Instead, state-of-the-art space telescopes, orbiting above the Earth's atmosphere, travel through time for us. These telescopes can capture remnants from the Big Bang and light from stars that exploded millions of years ago. They are also helping scientists answer some of mankind's biggest questions.

"One of the main themes of modern astronomy is the attempt to understand how the Universe developed from earliest times and evolved into what we see and live in today," explains Professor Matt Griffin from Cardiff University.

Matt heads the international, UK-led consortium that built SPIRE (Spectral and Photometric Imaging Receiver). This sophisticated camera and spectrometer is onboard the largest space telescope ever built: the Herschel Space Observatory.

Herschel, with its 3.5 metre primary mirror, can see the Universe in the far infrared part of the spectrum – well beyond red in the rainbow of colours that make up visible light.

Although infrared radiation cannot be seen with the naked eye, light at this wavelength can penetrate through dust clouds. Herschel's instruments can investigate regions where stars and galaxies formed, by detecting the faint glow of dust particles heated up by young and developing stars.

Herschel, one of two new space telescopes on the block, was launched in May on the same Ariane 5 rocket as the Planck Surveyor. Both European Space Agency (ESA) missions involve the expertise of scientists and industry across the UK - from Cardiff University and the Rutherford Appleton Laboratory in Oxfordshire, where SPIRE was assembled and tested, to the UK Astronomy Technology Centre in Edinburgh.

Each space telescope is helping us understand our Universe in a different way. Planck is examining the Cosmic Microwave Background – radiation left over from the Big Bang. It will survey the entire sky and map

Main image: A composite image of a galaxy cluster – a group of galaxies bound together by gravity
Credit: NASA, ESA, CXC, C. Ma, H. Ebeling, and E. Barrett (University of Hawaii/IfA), et al., and STScI

1. Red supergiant star V838 Monocerotis
Credit: NASA, ESA and H.E. Bond (STScI)

2. A fairing is lowered onto Herschel in preparation for launch
Credit: ESA

3. An Ariane 5 rocket carries the Herschel Space Observatory and the Planck Surveyor into orbit
Credit: ESA

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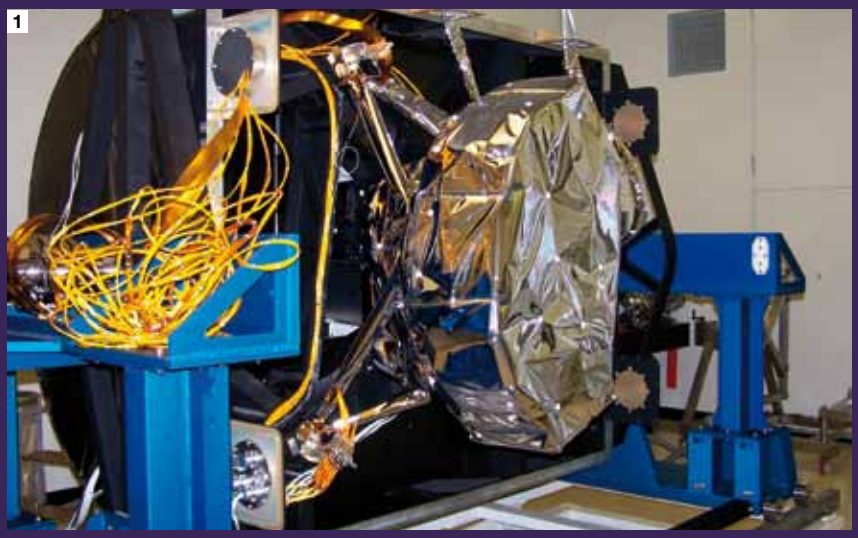


“We have good theories about the creation of planets in discs but haven’t really seen that in action, and with JWST we will be able to see that process.”

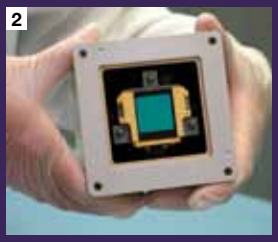
Professor Gillian Wright

The BIG questions
continued

electromagnetic ripples from the moment of creation. The faint signals will be focused onto two instruments, both of which have had major contributions from the UK.

These instruments can operate at extremely cold temperatures – only a tenth of a degree above Absolute Zero (-273°C) – and will help build up a detailed picture of the early Universe.

“Together, Planck and Herschel will explore the Universe throughout almost its entire history,” says Matt. “From just moments after the Big Bang, through the formation and evolution of galaxies, to the birth of stars and planets in our own galaxy today. This will give us a much better understanding of how our Universe came to be.”



1. Testing of the UK-built MIRI
Credit: NASA

2. The MIRI detector uses similar technology to digital cameras
Credit: NASA

The most famous and successful space telescope currently in operation is Hubble. Launched in 1990, it has provided stunning astronomical images ever since and has transformed how we view our Universe. Hubble helped determine that our Universe is 13-14 billion years old and played a key role in discovering dark energy – a force that causes our expanding Universe to accelerate.

Hubble also made the first ever detection of an organic molecule (in the form of methane) on a planet orbiting another star. Although the planet is believed to be too hot for life, the discovery is an important step towards searching for life beyond the human race.

Hubble’s fifth and final servicing mission in May opens the way for the next generation of space telescopes. One, the James Webb Space Telescope (JWST), is its natural successor. Scheduled for launch in 2014, the JWST will be six times larger than Hubble and even larger than Herschel. The telescope will be protected by a sunshield the size of a tennis court and its 6.5 metre diameter mirror will provide greater sensitivity than ever before.

“Hershel will find suitable stars with planetary systems that are just starting to form,” says Professor Gillian Wright from the UK Astronomy Technology Centre. “JWST will be able to go back and look at those individual stars and search for evidence of planets and maybe take images of the planets.”

Gillian is the European Principal Investigator of the telescope’s Mid Infrared Instrument (MIRI). “UK industry is building quite a bit of JWST,” she says. An international collaboration between ESA, NASA and the Canadian Space Agency, JWST will be sited in deep space, 1.5 million km away from Earth, and will also help answer big questions.

“We have good theories about the creation of planets in discs but haven’t really seen that in action,” adds Gillian, “and with JWST we will be able to see that process.”

“The other key aim is to study how planets form around stars by looking at star-planet systems other than our own,” she says. “Then we can understand how an Earth-sized planet might form and the conditions for life in the Universe.” JWST will also be able to look back at a time when the Universe was less than a billion years old and study how galaxies evolved.

As the International Year of Astronomy continues, and the Large Hadron Collider prepares to restart in November, it’s never been a better time in history for us to answer fundamental questions about the nature of our Universe.

Now all we need are the answers.

Credit: Alex Rumford

The interview
Tim Peake – UK astronaut

Test pilot, climber and caver, the first Briton to be selected into the European Astronaut Corps would certainly seem to have the 'Right Stuff' to make it into space. Major Tim Peake starts his training with the European Space Agency (ESA) this autumn but still has a long way to go before he blasts into orbit. *space:uk* will be following Tim's progress and caught up with him to talk about his ambitions.

continues >

1

The interview
continued

"I could be part of a team that can have a positive impact on society"

2

3

Q Why did you apply to become an astronaut?

A It really was a unique opportunity in my life where I could be part of a team that can have a positive impact on society. I do think that we face some enormous challenges this century and the space arena is going to be instrumental in overcoming many of those challenges.

Q The selection process lasted a year, what's it been like?

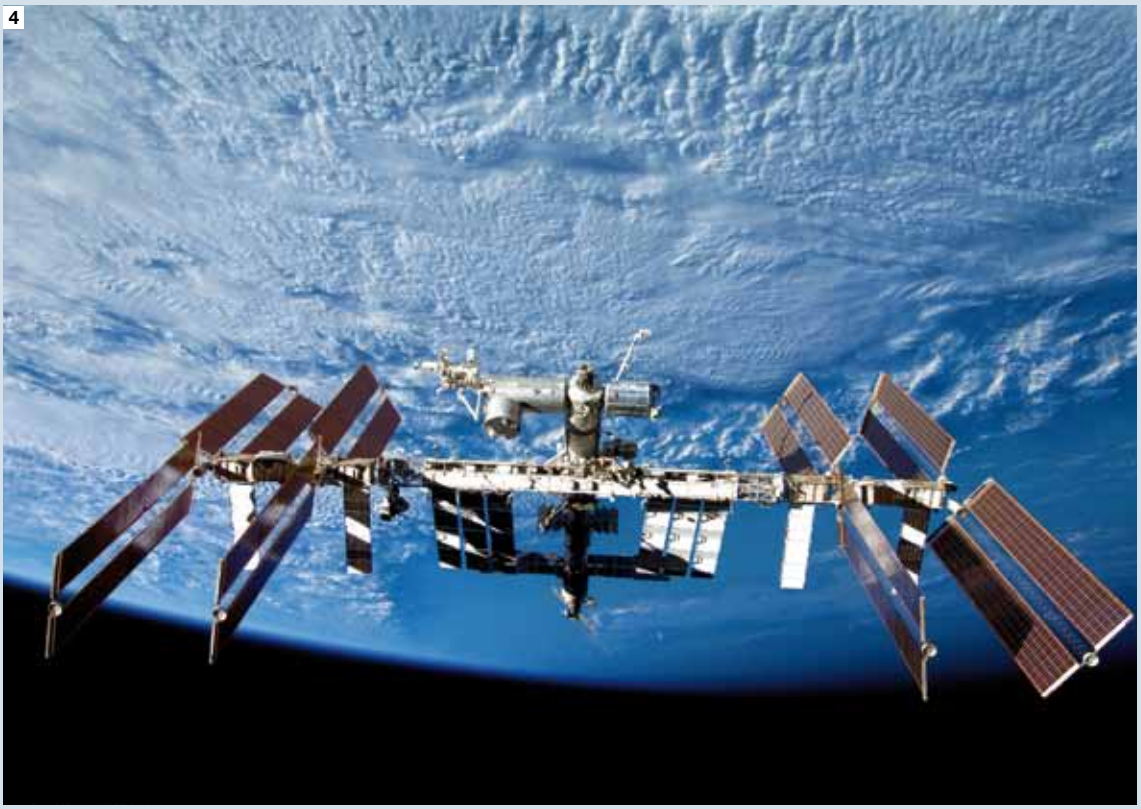
A It's been a fairly tough year. The online application form was a fairly tough one that really screened people down [from 8,000] to about a thousand who went forward for the first day in Hamburg. And that day was a high-stress day: computer-based testing, not many breaks between – designed to put you under pressure. A few tests involving maths, physics, engineering but actually the most difficult ones were the concentration, memory retention, perception and spatial awareness – those types of tests.

Q Tests included a week-long medical – what do they do in that?

A [laughs] I think it's more of a case of what don't they do would be a shorter list – ranging from MRI scans, CT scans, X-rays, bone density X-rays, full dental, medical and also eyesight and hearing tests.

Q A lot has been made over the years when it comes to astronaut selection about this idea of the 'Right Stuff'. You would seem to tick those Right Stuff boxes…

A I'm not sure about that but I certainly think that there are a number of things that they're looking for and that expertise might



1. Europe's new astronauts and their new boss (from left to right): Luca Parmitano, Tim Peake, Thomas Pesquet, Simonetta Di Pippo (ESA Director of Human Spaceflight), Andreas Mogensen, Samantha Cristoforetti, Alexander Gerst
Credit: ESA

2. Michael Foale (British-born astronaut) during a space walk
Credit: NASA

3. ESA astronaut in mockup of the International Space Station (ISS) at the Gagarin Training Center, near Moscow
Credit: ESA-S.Corvaja

4. Tim's first mission is likely to be to the International Space Station
Credit: ESA/NASA

5. Could the next person on the Moon be a UK astronaut?
Credit: NASA

come in the form of a test pilot or it might come in the form of an astrophysicist. And along with your area of particular expertise you then have to obviously have the right character, the right psychological profile.

Q So what role will you have as an astronaut when you make it into space?

A Really the role of an astronaut I think is just to conduct any mission specific training that you've been assigned to do from a whole variety of different areas. Be that life sciences, physical sciences, medical research etc. As well as the day to day activities of managing the systems on board the space station, life support systems and communicating with the ground stations.

Q What about beyond that – have you got the chance to maybe go to the Moon, or even Mars?

A I think there is the chance, yes. There's a global intent to conduct a lunar exploration mission with the view to going to beyond the Moon and onto Mars. And it's certainly possible a European astronaut could be involved in one of those early missions back to the Moon.

Q And what would that be like?

A [laughs] That's difficult to describe. Clearly that would be the absolute pinnacle, it really would.

Q A lot is made of astronauts representing the European Union, the European Space Agency and now with you being a UK astronaut, the UK. Is that an important role of an astronaut?

A Yes I think it is. Obviously the European Space Agency represents the 18 member states and it's very important for Europe to be seen as a major player in the space arena. But also very important for Britain to have an astronaut that is involved in manned spaceflight. It's obviously a very high profile position but it's hopefully one that will inspire a younger generation to become more involved in science, engineering and technology and to see that there are some fantastic and fascinating careers available to them in that arena.

Q And what is your ambition then?

A I would love to have a space mission, any flight into space – be that on the International Space Station or otherwise – and in the meantime if I can do whatever I can to help promote space, to inspire a younger generation, then that would be extremely rewarding and fulfilling for me as a career.

Q And you can call yourself an astronaut – how cool is that?

A [laughs] I haven't yet done that, I'm sure when I get used to the term it might be but it feels quite bizarre at the moment.

You can hear the full interview with Tim on the BNSC website: www.bnsc.gov.uk

Innovation:UK

There was a surge of national pride in May when the European Space Agency (ESA) selected a British astronaut. Now there is another reason to celebrate: ESA has opened its first UK research centre.

"Every day we use space technology without realising it"
Lord Drayson

"Britain is undergoing a space renaissance," declared Space Minister Lord Drayson at the opening of the new ESA centre in July. The success of the UK space industry is often overlooked but it contributes £6.5 billion to the economy and supports 68,000 jobs.

"Every day we use space technology without realising it," says Lord Drayson. "Improved weather forecasts, global telecommunications and vital medical technologies have all flowed from UK investment in space technology."

UK expertise can be found across the Solar System. UK-built instruments are in orbit around the Earth, Mars and Venus and help space telescopes peer into the distant edges of our Universe. UK space research even ensured that the first man-made object to touch Saturn's largest moon, Titan, was 'made in the UK'.

ESA's permanent presence on British soil, at the Harwell Science and Innovation Campus in Oxfordshire, is being seen as a huge vote of confidence for the industry. The campus is already home to a number of leading science and technology based organisations including the Diamond synchrotron, the UK Atomic Energy Authority and the Health Protection Agency.

ESA Harwell project manager, Martin Ditter, is co-ordinating the new centre and describes the venture as an opportunity for different ways of working. "There's already a lot of activity and expertise in Harwell," he admits. "There is a knowledge and know-how in and around the site that we want to tap into".

"Our presence," adds Martin, "will make people aware of the existing technology and promote spin-off technology."

This innovation approach was pioneered by ESA in 2002 with the StarTiger project developed at the Rutherford Appleton Laboratory - also on the Harwell campus. A spin-off company took advantage of the fact that a camera designed for space could also see through clothing. This resulted in the camera being developed for airport security.

Earth Observation and climate change will be one of the major priorities of this new centre. Information from space, such as satellite monitoring, helps scientists predict what impact climate change will have on our planet.

"Space is absolutely vital for tackling climate change and handling natural disasters at home and abroad," agrees Lord Drayson.

Martin is confident that by the end of the year, staff will be in place to form the Climate Change Expert Unit. This will help improve how information from satellites is incorporated into computer simulations of the Earth's climate to make predictions for the future.

In the meantime, researchers are looking further afield. "Our first project will most likely be in the area of robotics and will start before the end of the year," says Martin.

The project currently at the top of the list is the development of the Sample Fetching Rover to return rocks and soil from Mars. This robot will collect samples on the Martian surface and take them to an ascent module. The module will then return them to Earth. The robot will incorporate artificial intelligence to make some of its own decisions.

Future collaborations between ESA, UK industry and academia will work on a project-by-project basis. Lord Drayson says the new facility "will strengthen our outstandingly successful space programme and take UK space into a new age."

"Britain is undergoing a space renaissance"
Lord Drayson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Main image: Harwell Centre
Credit: UKAEA

1. Mars Express image of the Ma'adim Vallis, one of the largest canyons on Mars. The new ESA centre will be developing new robotic technologies to return a sample of Martian soil to the Earth
Credit: ESA

2. The UK-built Mars rover undergoing tests
Credit: ESA

Disaster!

Fire, flood, famine – in the wake of disasters, information from satellites helps rescue workers save lives.

Main image. UK-DMC2 image showing forest fires in Los Padres National Forest, California in August
Credit: SSTL

1. A Rangoon suburb flattened by the cyclone

2. Burmese aid workers head into delta regions

3. Cyclone Nargis
Credit: NASA

Ever seen the TV show Thunderbirds? Above the Earth, the Thunderbird 5 satellite monitors disasters and coordinates rescue efforts. Okay, so there's no secret island where a family of uniformed heroes saves the day (as far as we know) but there is a satellite. Or rather there are six satellites – all built to respond to disasters.

These spacecraft are known as the Disaster Monitoring Constellation (DMC) and are designed to provide detailed images of any part of the world in times of need. This data is used to produce maps and other information to assist relief efforts and, ultimately, save lives.

In recent years the DMC has provided images for dozens of situations including during the recent forest fires in Greece, the cyclone that devastated Burma in 2008, the flooding of northern and south-west England in 2007 and earthquakes in Iran, Kashmir and Columbia.

Satellite data is also used to monitor the long-term effects of disasters, which can last months or even years. It can help to identify risk areas – warning relief agencies of potential future disasters.

Disaster Monitoring Constellation

The DMC satellites are built in the UK by Surrey Satellite Technology Limited. They are owned by the UK, Algeria, Nigeria, China and Spain. Each satellite is around the size (and shape) of a washing machine and can capture images from a large area. The latest satellites - UK DMC2 and the Spanish Deimos-1 - have improved cameras, enhanced memory and faster communications. They all fly in a constellation so that, between them, they can see any point on the Earth at least once a day.

Links:

International Charter: www.internationalcharter.uk.com

Surrey Satellite Technology Limited: www.sstl.co.uk

Disaster charter

The DMC operates within an agreement called the International Charter: Space and Major Disasters. When disaster strikes, the United Nations or government agencies can activate this charter to pull together information from a whole range of satellites.

Images taken from space can show the extent of flooding or the damage caused by wildfires. They can reveal which areas have been destroyed and highlight where rescue efforts are most needed. The UK team that supplies DMC images (DMC International Imaging) incorporates information from the satellites into maps or diagrams. These might show villages and towns, roads and bridges – helping emergency teams on the ground.

In order to save lives, speed is vital. Once the Charter is activated, there are teams around the world 24 hours a day ready to make sure satellite images reach the people who need them.

Fortunately, the DMC satellites only have to spend a small amount of time responding to disasters. UK-DMC, for example, is also helping to map the Amazon to monitor rainforest loss for the Brazilian government.

They may not have the glamour and mystery of those International Rescue boys – but when the world needs help, the DMC is ready. And there are no strings attached.

Images taken from space can show the extent of flooding or the damage caused by wildfires.

Case Study…

In May 2008 a huge tropical cyclone hit Burma killing more than 140,000 people. Assessing the damage on the ground was difficult because the Burmese authorities restricted access to rescue teams. However, satellite images were able to reveal the full extent of the devastation. The images were compared with others taken before the disaster and superimposed onto maps to help relief agencies deal with its size and scale.

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Ask the expert

Richard Garriott

A year ago, British-born computer games entrepreneur and adventurer Richard Garriott flew as a space tourist on board the International Space Station. He didn't spend his time in orbit staring out of the window but undertook a whole series of scientific experiments and demonstrations. Many of the ideas were based on questions submitted through a BNSC competition for UK primary schools. You can see the videos for the experiments on the BNSC website but here are some of them, with answers from Richard.

Do your heart and pulse rate change in space?

Jack Taylor, Naphill and Walters Ash

I had my pulse checked very carefully when I was on the ground and I wore a medical harness when I was in space. Fundamentally my pulse rate remained the same. However, during exciting events like the launch my pulse rate increased – but I think that was out of excitement!

Can you drink water while standing on your head?

Henry Franks, Ryhall Primary School

In space, what you call the ceiling and what you call the floor; what you call standing on your head and what you call standing on the floor, all depend on your point of view. So I could stand on my feet drinking water from a plastic bag or turn upside-down and it was just as easy. In space there is no 'up' and there is no 'down'.

Can you create a zero gravity magic carpet?

Daniel Hayes and James Newsom, Ilkley Primary School

When I unfolded a towel in the space station, you could see straightaway that it would make a mighty fine magic carpet because up in space, everything floats. I was easily able to take a towel and fly around as if it were my own personal magic carpet. So, up in space towels make perfectly good magic carpets.

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1. When this happens, your heartbeat is almost certain to rise
Credit: NASA

2. Richard (right) poses with flight engineer Greg Chamitoff on the International Space Station
Credit: NASA

3. Richard floats into his new home from the Soyuz capsule
Credit: NASA

For more on Richard, go to www.richardinspace.com

Many thanks to Heather MacRae for her help in compiling these answers.

How do magnets work in space?

Elakiya Annadurai, Bannockburn Primary School

I released a small bar magnet and allowed it to float freely inside the space station. Once it had stopped spinning, one end was pointed towards the Earth. The reason it did that was because the Earth's magnetic field spreads out from the poles of the Earth into space. So if we were to fly over the South Magnetic Pole, the south end of the magnet would point straight to the ground. When I did the experiment, we were flying over Australia so the magnet was pointing at an angle. If we were flying in the northern hemisphere, over England for example, the north end of the magnet would be pointing down.

Are fizzy drinks different in space?

Nishant Mehta, Barham Primary School

Well there aren't any carbonated drinks in space but I used a small tablet that simulated the same thing. I added it to my water supply – in a clear plastic bag – and I found that all the bubbles it created stayed in one place rather than floated to the top. The reason is that there is no top. The gas just stays as a bunch of bubbles that remains suspended in the liquid. If you took a can of pop into space, it would do the exact same thing.


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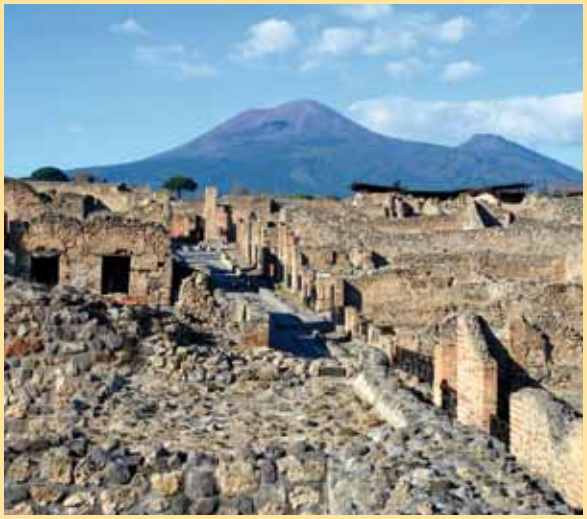
Teaching resources

By Helen Barraclough from Space Connections

Be Prepared!

With the DMC satellites we can now respond to natural disasters quickly, providing emergency rescue services with the information they need to save lives and limit destruction. But often there are also physical signs that can warn us before a major disaster occurs. So, even though we may not be able to prevent a disaster, we can evacuate the area and maybe reduce the number of casualties.



Mt Vesuvius behind the ruins of Pompeii

One of the first recorded natural disasters happened nearly two thousand years ago at Pompeii in 79AD. The volcano Mount Vesuvius erupted, burying the buildings and occupants under 60 feet of ash and pumice. The people of the city saw the warning signs of smoke coming from the mountain and felt the earth tremors but did not realise their importance. They thought that the earth was shaking due to the giants, who had been buried by the gods, stirring under the ground! Volcanic gases, such as sulphur dioxide, may also have been produced. This can kill small animals in water and on land and make the water taste unpleasant.

Can you design a poster or make a presentation for the people in Pompeii to warn them of the danger signs of a volcanic eruption? Include what to look out for and what to do if they notice them.

Curriculum links

History, geography, ICT

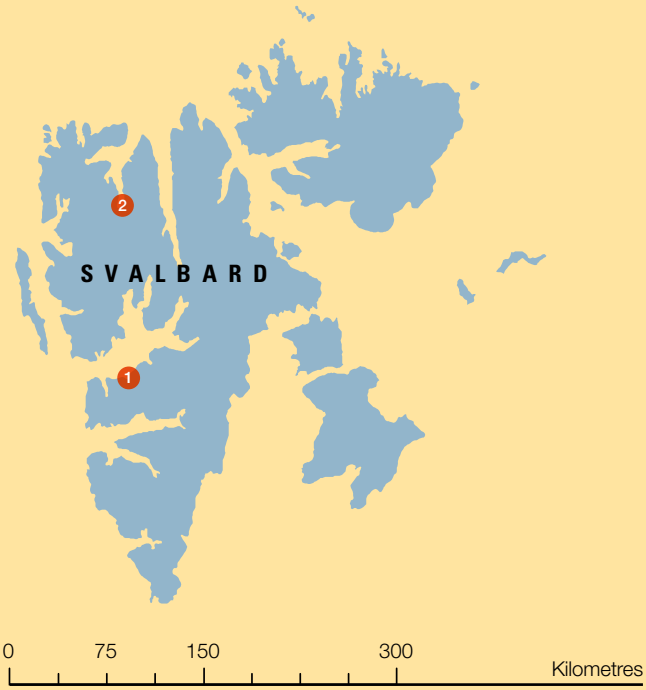
learning :zone

What I did on my summer holiday


Credit: Claire Cousins

Claire Cousins from University College London has spent the summer in the Arctic as a member of the Arctic Mars Analog Svalbard Expedition (AMASE). The aim is to develop experiments and test instruments for a future mission to Mars. Claire is a member of the PanCam instrument team; PanCam is the camera being designed for the ExoMars mission.

We asked Claire to keep a diary and here are some extracts…



CAREER FILE [SPECIAL]


Credit: Kjell Ove Storvik

06/08 1 LONGYEARBYEN

Arriving into Svalbard we are greeted by brown jagged peaks jutting up from an expanse of pristine glaciers and white clouds. The plane descends and the cloud gives way to the town of Longyearbyen. This will be our base for the first few days before boarding ship. I am collected by my PanCam team colleagues, and after grabbing some food, it's straight into the field for some initial equipment testing.

07/08

Safety is a big issue in Svalbard, and as such our first day here entails rifle shooting and polar bear psychology. After getting familiar with handling and loading the gun, we don our headphones, take our positions, and FIRE! We eventually fire our way through 16 shots, and it quickly becomes apparent some people have got it, and some haven't. I haven't got it.

11/08 2 BOCKFJORDEN

PanCam has its first proper day in the field, and it feels good to be outside walking on solid ground again after being cooped up in the ship for more than 20 hours. We obtain our first data set beneath sunny skies, and finish the day satisfied and hungry! So far so good…

13/08

We had a long day today. PanCam was deployed to Troll Springs, a huge set of carbonate terraces with an active spring at the top. To get here we had to be flown by helicopter. The pilots were great, and gave us a good ride with lots of swooping towards glaciers and hovering by cliff faces. However, despite the fun start to the day, our time at Troll Springs itself was slow, cold and seemed to last forever. Because of the weather, the helicopter pilots had problems collecting people, and we weren't picked up until late into the evening.

14/08

Today was a day a number of us were not looking forward to: initiation day. All the so-called 'newbies' were charged with the task of performing a breakdance, after which they would become true AMASErs. A bunch of us banded together to do a group dance, and after some brief direction by Paulo (a member of the rover team who also had professional dancing experience) we'd figured out our winning moves. So evening came and we donned our survival suits hip-hop style, accessorised with tin-foil bling and performed the worst dance hip-hop has ever seen. The night ended with a science demonstration up on deck, whereby the rover's arm was deployed to feed (sorry, deliver…) a bacon sandwich to a hungry engineer.

Credit: Claire Cousins

15/08

We deployed all the ExoMars instruments on AMASE today to assess the habitability of a site that could be compared to Mars. After a hard slog up the volcano to get to our target outcrop, the ExoMars instrument teams collected their data. Trying to work was hard, the steep ground under our feet consisted of loose scree, and it was a constant battle trying to stop things (including ourselves) slipping down the side of the volcano.

16/08

We spent our last day in Bockfjord at the nearby Jotun Springs. These warm springs have deposited shallow carbonate terraces, over which bright green, pink, and orange slimy biomats had grown. In an environment as harsh as Svalbard, these warm springs act as a little oasis in an otherwise inhospitable polar desert. We spent the day imaging the whole spring, in particular we were interested in seeing what photosynthetic pigments could be detected by PanCam.

20/08

After several days confined to the ship for a mission simulation, it was good to get back into the field. We were deployed to a small gully and I thought we'd been to some pretty amazing places already, but this was truly out of this world. The gully was lined with bright purple, pink, red, and yellow rocks, on top of which were iron-rich concretions that are similar to the 'blueberries' found on Mars.

23/08

After sailing through rough seas and bad weather, we are finally back in Longyearbyen, and on land, much to my relief. Having avoided sea-sickness for the entire trip, the last two days proved too much. We loaded everything off the ship, only to watch a new team of scientists load their stuff on – soon the ship would be off again on yet another adventure. The evening was spent readjusting to the real world and saying farewell to all the people who had made it such a fantastic trip.

Credit: Claire Cousins

Credit: Kjell Ove Storvik

The 'Men In Black' meal and photo shoot is a longstanding AMASE tradition

You can read the full diary on the BNSC website where you can also find out more about ExoMars

guide

SPACE TRAVELLER'S GUIDE

THE MILKY WAY

There are tens of billions of galaxies in the known Universe but the Milky Way is unique: it is the only galaxy that contains our Solar System.

A galaxy (from the Greek word *galactos* for milk) is a massive collection of stars, planets, asteroids and clouds of gas and dust. Galaxies exist in a variety of shapes and sizes and have names such as Tadpole, Cigar and Whirlpool.

The Milky Way galaxy is a giant pinwheel, or spiral, stretching across 100,000 light years. Most of its 300 billion or so stars are concentrated in spiral arms. On a clear night you can see one of these with the naked eye. It appears as a faint band of light passing through Orion and other constellations. Romans called this creamy haze the Via Galactica (milky road) and, since the spiral arm is part of our galaxy, this gave the Milky Way its name.

NASA's Spitzer Space Telescope has identified two major spiral arms for the Milky Way, emanating from a central bar. Our Solar System lies between these two arms, towards the outskirts of the galaxy.

Viewed from the side, the Milky Way is a disc with a central bump. At the heart of this bump is a supermassive black hole, Sagittarius A. Everything in the galaxy revolves around this centre but it takes our Sun 250 million years to make one revolution. The Milky Way formed around 14 billion years ago but as the Sun is four billion years old, it has only travelled around the galaxy 16 times.

Astronomer Edwin Hubble proved that other galaxies existed beyond our own and that the furthest galaxies were moving faster away from us. These discoveries, and the sheer scale involved, caused people to question our role in an ever-changing Universe.

Background image:
Artist's impression of the Milky Way based on astronomical information about our galaxy
Credit: NASA/JPL-CALTECH

1. The crowded heart of the Milky Way seen by the Chandra Space Observatory
Credit: NASA

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