Multi-million government investment in the future of UK science

- Major £179 million government investment will support the next generation of scientists, mathematicians and engineers from all backgrounds
- first-ever Stephen Hawking Fellows also announced, furthering the legacy of science's brightest star while enhancing our understanding of the universe
- comes alongside government funding to improve and boost uptake of science subjects at school

The next generation of world-leading scientists across the UK will benefit from a multi-million-pound government package of investment, the government announced today (Friday 6 March).

Marking the start of British Science Week, Business Secretary Alok Sharma and Education Secretary Gavin Williamson announced funding to support up to 11,000 students through 41 Doctoral Training Partnerships, as well as encourage more young people, particularly girls, to study STEM subjects at school and university, and pursue a STEM-related career.

The investment includes:

- £179 million for PhDs, formally known as Doctoral Training Partnerships, at over 40 UK universities in physical sciences, maths and engineering to develop the skills for ground-breaking research and high-tech industries like cyber security and chemical manufacturing. Part of the investment will go into pilots looking at how best to attract and support those from non-academic backgrounds to undertake this type of training.

- £8.9million to continue funding science education programmes including Science Learning Partnerships and Stimulating Physics Networks, which aim to improve science teaching and increase the take up of science at GCSE level and A level and ultimately encourage young people to pursue a STEM-related career.

Business Secretary Alok Sharma said:

> From Ada Lovelace to Stephen Hawking, our scientists and the discoveries they have made have pushed the boundaries, improving our healthcare and transforming the way we live, work and travel.
>
> Today's funding will support the talented people we have in this country to study these vital subjects, develop technologies for the

future and support the UK’s status as a science superpower.

Education Secretary Gavin Williamson said:

> Making sure that the next generation has the scientific skills to meet the world’s needs – from developing green technologies to curing illnesses – couldn’t be more important.
>
> That’s why we continue to invest in science programmes in our schools and ensure that anyone, regardless of their background, can participate.
>
> Girls now make up just over half of A level entries for the three core science subjects but there is more we can do so we will fund research to better understand how we can improve girls’ physics A level participation.

The government also announced the first Stephen Hawking Fellows, who will continue Professor Stephen Hawking’s legacy by furthering understanding of the Universe and tackling major scientific questions like the nature of dark matter and how planets are formed.

They will receive a portion of the £15 million funding already announced by the government, in partnership with the Hawking family, in 2018. The Fellowships will support ground-breaking research across physics, maths and computer sciences that challenges current assumptions, advances scientific knowledge and inspires the public through their discoveries.

Stephen Hawking’s children, Lucy, Robert and Tim Hawking, said:

> We are proud to be associated with this initiative, which builds on the legacy of our father by supporting research into these areas of science.
>
> One of his greatest achievements was opening up even the most complex scientific breakthroughs to the wider world and we hope that these Fellows are able to continue that important mission by inspiring people from all walks of life in the wonders of science.

UK Research and Innovation Chief Executive, Professor Sir Mark Walport, said:

> Professor Stephen Hawking pushed forward the boundaries of human knowledge, both through his research which transformed our understanding of the universe and his rare talent for communication.
>
> The Fellows announced today will continue his legacy, pushing the boundaries of knowledge and inspiring the public with the value and

> beauty of science.
>
> The EPSRC Doctoral Training Partnerships will play a key role in equipping a diverse range of researchers and innovators with the skills they need to generate impact across the UK.

Today's funding announcements follow the government investing up to £300 million to fund experimental and imaginative mathematical sciences research over the next 5 years. The new funding forms part of the government's commitment to significantly boost research and development funding reaching 2.4% of GDP by 2027 and levelling up every part of the UK.

Doctoral training partnerships in physical sciences, maths and engineering

Previous government investments in physical sciences, maths and engineering doctoral training have resulted in pioneering advances – they include developing new methods to predict the location of road collision hotspots (University of Newcastle) or hydrogel-based wound dressing that helps them to heal and control infections (University of Bath with Public Health England).

After completing PhDs, nearly 40% of engineering and physical sciences doctoral students go on to be employed in business or public services, with 39% of those working in academia and 22% using this knowledge and skill in training or working in other sectors.

EPSRC Executive Chair, Professor Dame Lynn Gladden, said:

> Doctoral training is a vital element of the UK's research and innovation system, providing thousands of people with the skills they need to succeed and deliver benefits for the UK.
>
> EPSRC's Doctoral Training Partnerships provide an opportunity for universities to support ideas from outstanding research students, to explore emerging research areas and to support universities' research priorities.

The £179 million funding in Doctoral Training Partnerships (DTPs) will be managed by the Engineering and Physical Sciences Research Council (EPSRC), part of UK Research and Innovation (UKRI)

EPSRC supports about 11,000 doctoral students through DTPs, Centres for Doctoral Training and Industrial Cooperative Awards in Science and Technology (CASE) studentships.

The 4 pilot projects include:

- defending the UK through novel cybersecurity and defence systems research: the University of Southampton will develop the skills of current and former defence and security staff, armed services personnel

and police through new research focusing on cybersecurity and control systems for autonomous systems like drones
- driving productivity for sustainable growth: Brunel University London will provide future engineers with the skills, knowledge and experience to drive forward research and innovation in sustainable technologies, supporting the UK to reach its net zero ambitions
- expanding skills in data-science and engineering: Queen Mary University of London has partnered with IBM, BT and the BBC to expand the number of scientists and engineers with data-science and engineering skills, by providing students with access to world-class researchers and facilities, while allowing them to apply their new found skills in an industry setting
- developing sustainable and efficient chemical manufacturing: the University of York will develop the skills of research scientists and employees working in the chemicals industry to help chemical businesses transform their current manufacturing practices, so they are more efficient and sustainable

Universities hosting DTPs in for students starting in the 2020 and 2021 academic years:

Aston University	Brunel University London
Cardiff University	Cranfield University
Durham University	Heriot-Watt University
Imperial College London	King’s College London
Lancaster University	Loughborough University
Newcastle University	Open University
Queen Mary University of London	Queen’s University of Belfast
Swansea University	The University of Manchester
UCL	University of Bath
University of Birmingham	University of Bristol
University of Cambridge	University of East Anglia
University of Edinburgh	University of Exeter
University of Glasgow	University of Huddersfield
University of Kent	University of Leeds
University of Leicester	University of Lincoln
University of Liverpool	University of Nottingham
University of Oxford	University of Plymouth
University of Sheffield	University of Southampton
University of St Andrews	University of Strathclyde
University of Surrey	University of Warwick
University of York	

Boosting science uptake at school

We have also seen a 31% in the number of STEM A levels entries taken by women in England between 2010 and 2019.

The government will continue to fund a number of programmes in science education for a further year, including:

- the network of 41 Science Learning Partnerships, run by STEM Learning, which aims to improve the quality of science teaching and increase the take up of GCSE science. The Department for Education has provided £17.7 million of funding from 2016 to 2020
- Project Enthuse, which provides bursaries for science teachers and technicians to attend high-quality professional development. The department and the Wellcome Trust have jointly funded this programme, with the Department for Education providing a total of £13.1 million from 2013 to 2020
- the Isaac Physics programme, run by the University of Cambridge, which offers support and activities in physics problem solving to teachers and students studying GCSE and A level physics. The Department for Education has provided £7.3 million grant funding from 2013 to 2020
- the Stimulating Physics Networks, run by the Institute of Physics, to improve the take up of A level physics, particularly by girls. The Department for Education has provided £8.6 million of funding for the SPN from 2016 to 2020. This includes funding for the Institute of Physics to deliver the Improving Gender Balance research trial, which aims to encourage greater uptake of physics among girls

The Stephen Hawking Fellowships and the Fellows

In collaboration with the Hawking family, the Stephen Hawking Fellowships were launched by the government in 2018, in recognition of Stephen Hawking's exceptional contributions to scientific knowledge and popularisation of science.

Each Stephen Hawking Fellowship provides up to 4 years' funding, dependent on the nature of the proposed research, for fellows with a strong passion for curiosity-driven science, who seek to challenge current assumptions and inspire the public through their work.

Fellows will carry out public engagement and scientific communication to help them inspire a wider audience to explore complex scientific ideas.

Dr Danai Antonopoulou – The University of Manchester

As small as cities and incredibly dense, neutron stars are formed from the collapse of giant stars. Due to these extreme conditions the neutral particles – neutrons – that form them behave as superfluids inside a hard crust that forms the star's exterior. Each neutron star is surrounded by a magnetosphere, like Earth's but a trillion times stronger.

Based at the Jodrell Bank Centre of Astrophysics, Dr Antonopoulou will advance our knowledge of neutron stars and their unusual physical properties, such as superfluidity and superconductivity and the nature of extremely dense matter.

A detailed public engagement programme aimed at school children and students,

and targeting underrepresented groups, will aim to inspire them about astrophysics and science in general.

Dr Martin Archer – Imperial College London

The interplay between the Earth's magnetic field and the wind of electrically-charged particles blown off the Sun forms a shield in space, protecting us against most of the harmful radiation from the Sun and more distant sources.

Sound waves bounce around the different regions of this shield, acting like different instruments in an orchestra that transfers energy into our atmosphere. Dr Archer's research will focus on the part of the shield that creates drum-like vibrations, and the results could ultimately be used to improve forecasting of space weather and predict potential risks to satellites.

He will also produce virtual reality experiences and a 'magnetospheric drum kit' to be used by artists, filmmakers and musicians in creating works for performance, as well as by communities within the public that don't normally seek out or are underrepresented in science.

Dr Francesca Chadha-Day – King's College London

85% of the matter in the universe is made up of dark matter, but the only way we know it is there is by observing its gravitational pull on stars, galaxies and other visible matter. As such, the search for dark matter is one of the greatest outstanding questions in physics.

Dr Chadha-Day will explore the theory that axion-like particles – a theoretical form of ultralight particle – could form dark matter, using telescope observations of neutron stars and galaxy clusters to search for axion-like particles.

She will also communicate her research and the wonders of physics to the public through stand-up comedy, while also engaging schools through talks and workshops.

Dr Andrei Constantin – University of Oxford

String theory is one of the leading candidates for a 'theory of everything', addressing outstanding questions such as how gravity and quantum mechanics work together on the smallest scale. It proposes that all fundamental particles including electrons, quarks and the Higgs boson are tiny strings or membranes that vibrate in space.

Dr Constantin will conduct forefront research in Mathematics, aided by machine learning, in order to elucidate the precise map between strings and elementary particles and ensure that the theory can be tested against data, such as that from the Large Hadron Collider.

The research programme is linked with an important range of outreach activities including talks to local schools and the public as well as popular

science publications, which will bring the fruits of the work to wider society.

Dr Ömer Gürdoğan – University of Southampton

Quantum Field Theory is at the heart of particle physics and describes the behaviour of particles that make up the universe. However, our understanding of the essential aspects of Quantum Field Theory is very limited.

Dr Gürdoğan will focus on scattering amplitudes, which are the quantum probabilities of the interactions of fundamental particles, and work towards an improved picture of Quantum Field Theory to help answer questions about how nature works at microscopic scales.

He will also conduct outreach activities including art exhibitions, interactive demonstrations in science centres, and virtual reality demonstrations for use in schools.

Dr Scott Melville – University of Cambridge

The very early universe was so hot and dense that particles experienced energies far greater than any we could recreate here on Earth. Measuring signals from this early time can teach us important lessons about physics in extreme conditions and help us to understand what is responsible for the rapid expansion of the early universe.

Understanding these extremely high energy processes will shed light on the fundamental structure of matter, such as what it is made of and how it is held together, and how it interacts with gravity.

Dr Melville aims to guide upcoming experiments to measure signals from the early universe, which could improve our understanding of the world around us. He will also develop public engagement activities, such as public talks.

Dr Francesco Muia – University of Cambridge

The recent detection of gravitational waves has opened a new era in astronomy and astrophysics, opening a new window of observation for phenomena in which gravity, instead of light, is the messenger and can be used to explore new fundamental physics.

Dr Muia will explore the catastrophic processes that produced gravitational waves during the first second of the universe’s history. The observation of such gravitational waves would lead to a substantial advancement in our understanding of the early universe.

In addition to the scientific impact of his work, he will aim to inspire the next generation of research leaders, carrying out lectures and public engagement activities on the history of the universe to schools in the UK.

Dr Rebecca Nealon – University of Warwick

Protoplanetary discs are formed by the gravitational collapse of gas and dust

and serve as the birthplace of planets. Recent observations have shown that not all of these discs are aligned like the planets in our solar system. Instead, some are misaligned and show complicated structures.

Dr Nealon’s research will focus on the formation of these misaligned discs and could generate new knowledge about how planets interact with their host disc as well as the diversity of planets outside of our own solar system.

She will use numerical simulations along with observations of protoplanetary discs, generated through state-of-the-art telescope facilities, to engage the public as well as delivering public talks and contributing to outreach activities.

Dr Stefan Schacht – The University of Manchester

The Big Bang is believed to have created equal amounts of matter and antimatter, but almost everything we know – from the smallest object on Earth to the biggest star – is made up of matter. The quest for the missing antimatter is one of physics’ greatest outstanding questions.

Dr Schacht aims to build on last year’s observation of the unique phenomenon of matter-antimatter asymmetry in a form of particle called the D0 meson, to take us one step closer to answering our big questions about the fundamental laws of nature.

He plans to engage the wider public by establishing a programme for particle physics at the Bluedot festival, an annual music, science and art festival at the Jodrell Bank Observatory in Manchester.

Dr Schacht aims to build on last year’s observation of the unique phenomenon of matter-antimatter asymmetry in a form of particle called the D0 meson, to take us one step closer to answering our big questions about the fundamental laws of nature.