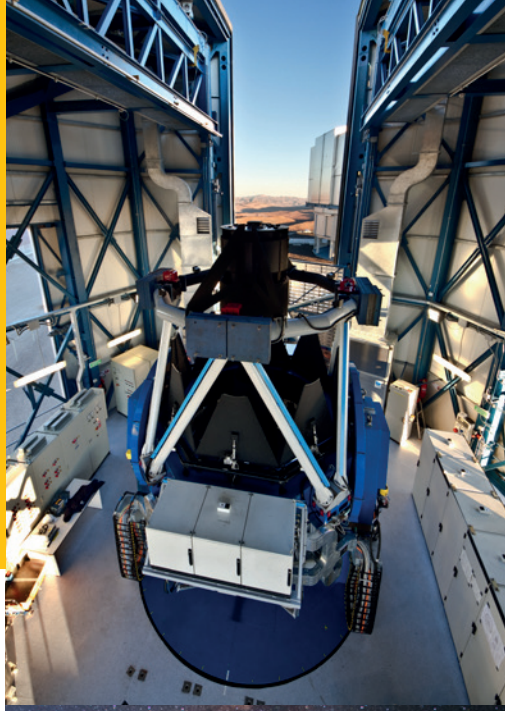
Science and Technology Facilities Council

Benefits of the UK–ESO Partnership



Access to world-class astronomy facilities

ESO membership provides the UK with many rewards

World-Class Research	World-Class Innovation	World-Class Innovation
2020 Nobel Prize for the UK for providing evidence of the black hole in the centre of the Milky Way	**258** UK organisations have benefitted from ESO membership	**10%** of PhDs and students within the ESO training programmes come from the UK

The UK has been a member of the European Southern Observatory (ESO) since 2002. Across three observing sites in Chile, ESO builds and operates some of the most technologically advanced terrestrial telescopes. Membership delivers a vast range of opportunities for UK scientists and industry to lead new discoveries in Astronomy.

Of ESO's 16 Member States, the UK is currently the second largest partner. Nearly half of all the research papers that come out of ESO data involve a UK author. Prior to the UK's membership, this figure was only 13%.

From an annual commitment of £22.7M, the UK receives back the monetary equivalent of ~£45.5M each year.

This summary of the report "Socio-economic impact evaluation study of the UK subscription to ESO", by independent consultants Technopolis, reveals the benefits of the UK's subscription to the European Southern Observatory (ESO).

UK access to ESO facilities has provided our user community with the opportunity to continue to advance science and understanding in the field of astronomy and astro-physics, while generating advanced technologies and solving real-world challenges.

> **"Over the past two decades, this global institution has helped UK scientists to deliver incredible research and advance our understanding of astronomy. But in doing this, its influence and reach goes beyond science to benefit our economy and society in the UK"**
>
> UKRI Chief Executive
> Professor Dame Ottoline Leyser

> **"Without ESO membership, a good fraction of [the UK's] academic astronomers would be unable to pursue their research"**
>
> UK Astronomy Researcher

World-Class Research

The sort of preferential access to ESO facilities and telescopes that UK astronomers enjoy provides them with unique opportunities to build on their world-leading research capabilities. This access has allowed UK scientists to make critical contributions to our understanding of the Universe that have directly led to many important discoveries.

Membership also places the UK in prime position for involvement in ESO instrument development, both providing a platform to influence scientific direction and building skills in the UK community to take advantage of the instruments when installed.

ESO is the most productive astronomical observatory in the world.

Nearly half of new ESO papers now involve a UK author, up from just 13% in the period before the UK joined and 15-20% of proposals for observation time come from UK PIs.

The UK has above average success rates and was awarded 29% of time in 2019/20 (while contributing 17% of fees).

UK scientists have used ESO to make critical contributions to advancing understanding of the Universe, enabling many important discoveries.

The birth of stars from colliding galaxies

A UK-led team of scientists employed the Multi Unit Spectroscopic Explorer (MUSE) and X-Shooter instruments on the ESO VLT to observe the ejected material from the **collision of two galaxies** creating conditions for new stars to form

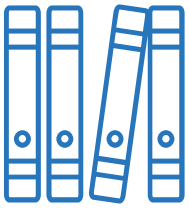
UK scientist

Assembly of galaxies

A team of astronomers led by the University of Cambridge's Cavendish Laboratory and the Kavli Institute for Cosmology, used the ESO ALMA telescope to search for clouds of interstellar gases that formed the **first known galaxies**

UK scientist

Notable scientific advancements



Over **17,000** publications, with more than **1,000** added each year.
(10% of the global astronomy and astrophysics output).

An archive of **1.5m** images and **1,640TB** of data, available for further exploration.

UK scientists are major users of the ESO Archives: over the past **24** years, more than **29,000** scientific papers with a UK author have cited one of the Archive's **16,497** articles.

Between **2012** and **2020** there were **911** unique UK users of the ESO Archive (11.2% of all ESO users globally during this period).

Between **2014** and **2019**, there was an average of **2,155** UK papers per year citing ESO publications.

Over a sixth of UK papers citing ESO research are among the **10%** most cited globally.

The UK's combination of high output and high (and improving) citation profiles in the astronomy and astrophysics subfield since joining ESO is a very strong achievement.

World-Class Innovation

Technologies developed using ESO

UK scientists and engineers have been heavily involved in the development of ESO instruments, leading to a wide range of novel technologies, including:

Active and Adaptive optics – paving the way for future application in optical and quantum communication

Next generation lasers – with compact footprints, low maintenance cost, long service lives and excellent beam quality

Time Reference Systems – applied in the field of navigation (GPS, interplanetary spacecraft navigation) and global geodynamics, which demand high precision

Information on contracts

UK companies have been issued a range of contracts including those for:

- Filters
- Optical imaging detectors
- Cryogenics
- Large optics
- Software
- Civil Engineering
- Insurance

£117m in ESO contracts has been secured by the UK between **2002** and **2020**

At least **258** different UK organisations had successful bids to ESO over the **16** years **(2004-2019)**

For the period **2004-2019** there were **1,114** individual contracts awarded with UK involvement

In some years, the UK has secured nearly **1/4** of the total value of contracts awarded

Contract brief case study

Observatory Sciences Ltd is a small UK company that provides software control systems for large scientific research facilities. After contributing to the development of the VISTA telescope in 2002 and building relationships within ESO, the company secured three consultancy contracts to support the design of the ELT's software systems. In 2017, the company also won a contract to provide software maintenance services for the VLT and VLTI, valued at up to €1m.

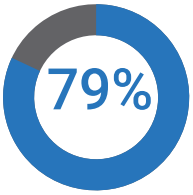
Software consultant

Wider societal benefits

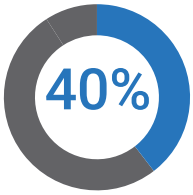
UK teams use their experience developing new techniques and technologies on ESO projects to deliver wider societal benefits including:

- Disease diagnostics and therapy (e.g. cancer treatment)
- Microscopy and satellite communication

UK suppliers also realise wider benefits, beyond the direct value of their ESO contract. A survey of UK suppliers revealed:



had seen an increase in their reputation or brand value as a result of working with ESO through past contracts.



had already seen an increase in sales income elsewhere (i.e., beyond any additional ESO contracts).

World-Class Skills

UK workforce skills and capabilities are enhanced by being part of ESO

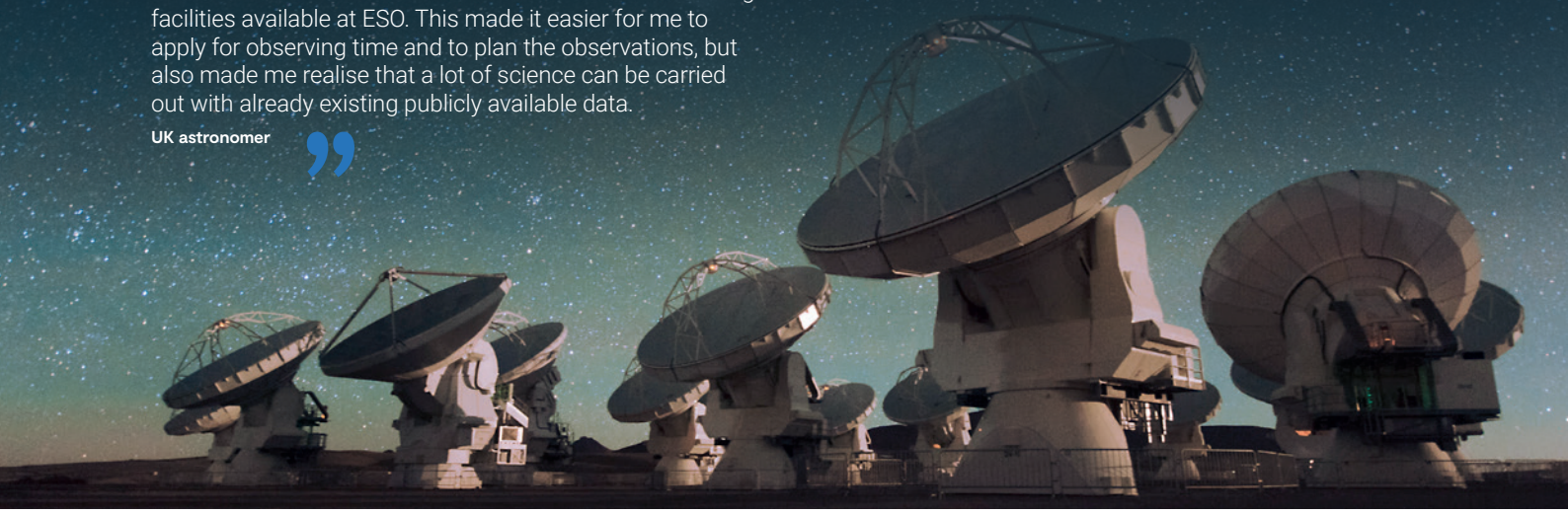
UK suppliers and users benefit from a wide range of training and skills development opportunities through direct or indirect interactions with ESO.

In addition, trainees and students benefit from the relationship through, for example, ESO programmes responsible for the training of over **80** UK ESO Fellows and students since the UK joined. This equates to ~14% of the total in recent years.

Most UK users reported that ESO had had a significant or critical impact on their ability to work in an international environment and on their experimental skills, as well as their team working, project management, communication, computing and problem-solving skills.

> I have acquired a deep understanding and knowledge of the Science Data Archive and of the instruments and observing facilities available at ESO. This made it easier for me to apply for observing time and to plan the observations, but also made me realise that a lot of science can be carried out with already existing publicly available data.
>
> **UK astronomer**

> The ESO Fellowship program lets the Fellow develop their own research in the context of the best observational facilities in the world. Europe has no other scheme like it (UKRI Fellowships are aimed at a more advanced career phase). It has been the basis of my scientific career.
>
> **UK astronomer**



The UK public's appreciation of astronomy and the number of students studying STEM subjects in the UK is boosted by ESO membership.

Alongside STFC's Communications and Public Engagement teams ESO, its' Member States, users and the media disseminate and reach out to the UK public.

8,219

UK-based followers of ESO on Facebook (May 2020).

605,000

UK-based views of ESO material on YouTube (2007-2020).

300,000

unique UK users of its main website in just a four-year period (2016-2019).

> An image we created in part from ESO Public Survey data was picked up in a news story that was the Most Viewed and Most Shared item on the BBC News website. It elicited many comments extolling the virtues of science and highlighting the UK's role in cutting-edge research.
>
> **UK astronomer**

Interesting Fact - 10% of the registered users of the ESO Science Archive are amateur astronomers

Science and Technology Facilities Council

technopolis group

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