CavMag

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UNIVERSITY OF CAMBRIDGE | Cavendish Laboratory Department of Physics

150 YEARS OF THE CAVENDISH LABORATORY

Welcome
to CavMag 32

Harry Cliff

This year the Cavendish Laboratory is celebrating its 150th anniversary. To mark this extraordinary milestone, we're pleased to present a special edition of CavMag that looks back on a century and a half of scientific innovation that has transformed our understanding of nature and the way we live. In these pages you'll find articles from our staff charting the histories of some of the lab's research areas, from soft matter and the theory of condensed matter to radio astronomy and high energy physics. While it's impossible to cover all the Cavendish's astonishing achievements in a few short pages, we hope this issue will give you a hint of the breadth and depth of our work, which continues to lead the world, as it has since the days of James Clerk Maxwell.

For the cover, we've commissioned a special illustration by Stewart Harris that attempts to squeeze 150 years of science into a single image. You may be able to spot a few familiar faces, from famous figures of the past to a smattering of our current staff, chosen in an attempt to cover a range of different research areas. Of course, we couldn't come close to including all the Cavendish's important figures and we apologise in advance for any egregious omissions! If you think you can name all the faces on the cover, please write to us at **cavmag@phy.cam.ac.uk** for the chance to win a much sought-after Cavendish Laboratory mug and a printed poster of the cover artwork. The identity of each face will be revealed in the next issue.

Inside, you'll find details of our plans to celebrate our 150th year, including a special event for our alumni community to be held next January. You'll also be able to read about a rather exciting theatre project that will bring some of the Cavendish's history to life for the general public in the very place it all began, the lab in Free School Lane.

We're also pleased to present a number of letters from our readers sharing recollections of their time at the Cavendish Laboratory. Thank you to everyone who wrote in – we only regret that we were unable to publish everything we received. For the full collection, head to our social media channels where we continue to share alumni stories using the hashtag #150CavendishStories.

This will be the first of two 150th anniversary editions to fall through your letterbox. While this issue casts an eye back over the Cavendish's achievements to date, the May 2025 edition will look to the future of our research programme, as we complete the move into the cutting-edge Ray Dolby Centre.

As ever, we are keen to hear from you, so please do get in touch via email or using the contact details on the opposite page with any comments or suggestions. We hope you enjoy this 150th anniversary edition of CavMag.

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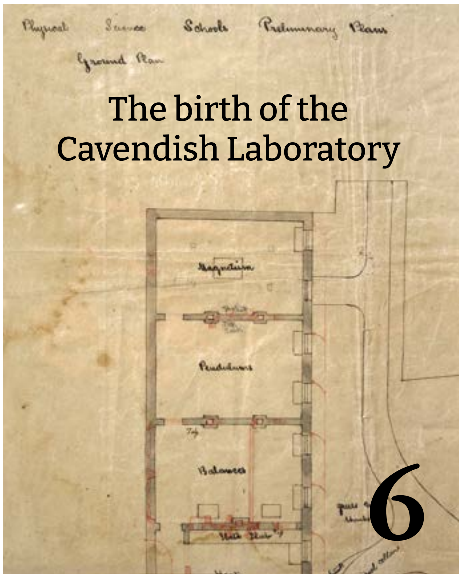

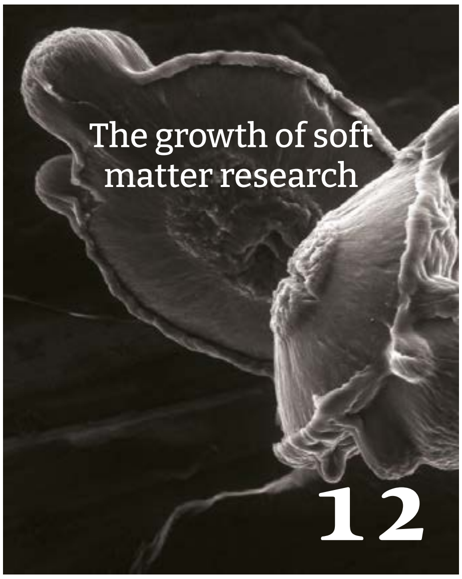

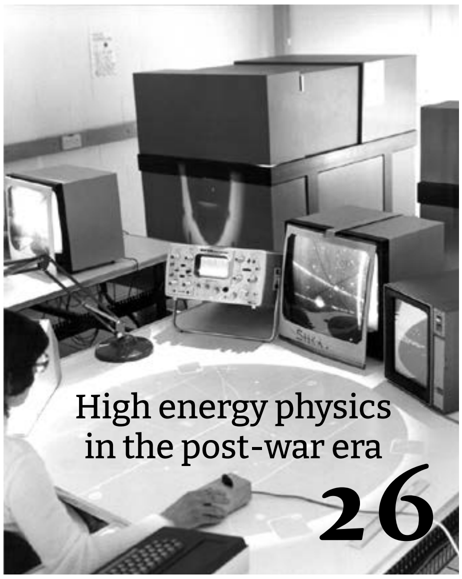

Write to us:

Do you like this redesigned issue? Would you like to read more articles about our staff, or find out what other alumni are doing? We are always delighted to hear from our readers, please contact us by email, postal mail or on social media. Letters may be published in future issues. Please mark your email or letter: ‘for publication’.

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Celebrating 150 years of Cavendish Laboratory

Join us to celebrate our 150th anniversary!

We are excited to announce plans to commemorate our 150th anniversary this year. Under the theme *"Celebrating our heritage, showcasing our present, and shaping the future,"* we have a fantastic line-up of events designed to bring our community together — honouring our rich past, showcasing our current innovations, and looking ahead to an exciting future in physics.

Three major events will be held leading up to June 2025:

- **Friday 24 January 2025: Cavendish Alumni Reunion**
  We are delighted to welcome you back to 'Cavendish 2'. This special reunion will offer a chance to reconnect with fellow alumni and reflect on the legacy of Cavendish research that you helped shape. It will also be a poignant opportunity to say 'goodbye' to the old buildings that have housed generations of physicists over the past 50 years. Look out for your e-invitation coming very soon.

- **May 2025: Public Opening of the Ray Dolby Centre**
  An official ceremony will be held to mark the opening of the Ray Dolby Centre, our state-of-the-art research facility. This event will acknowledge the generosity of the Dolby family and highlight the crucial role that philanthropy plays in advancing scientific research on a large scale.

- **June 2025: Two-day Cavendish Science Festival**
  To wrap up our celebrations, we're hosting an unmissable two-day festival packed with student talks, science discussions, live experiments, and even art performances. This festival will be a vibrant celebration of our shared achievements and a look ahead at the groundbreaking research that will define our future.

Beyond these events, we have a variety of other activities planned and plenty more ways for you to engage, including:

- From November 2024 to May 2025, a special **Cavendish Exhibition at Cambridge's Whipple Museum of the History of Science** will showcase and celebrate the history and discoveries of the Department.

- **In March 2025, the prestigious Scott Lectures** will relaunch with a series of lectures open to all by Mikhail Lukin, head of the Quantum Optics Laboratory at Harvard University (from 3rd to 7th March)

- In March 2025, we'll launch a new **demonstration-packed historical talk** and a **Cambridge Physics Audio Tour** for the Cambridge Festival.

- Plus, we're sharing your stories as part of the #150CavendishStories campaign on social media, celebrating the diverse contributions of our alumni community.

This is a unique moment in our department's history, and we'd love for you to be part of it. Whether you can attend one event or all, we hope you'll join us in celebrating the incredible legacy and bright future of the Cavendish Laboratory.

Stay tuned for more details and updates throughout this year-long celebration, on our website and via email.

Remember to update your details at **alumni.cam.ac.uk/update-your-details** to not miss a thing!

The Old Cavendish Experience

Harry Cliff and Val Gibson

Step inside the lab that changed the world

As the Cavendish Laboratory celebrates it's 150th anniversary we're pleased to announce an exciting project to bring the extraordinary history of the lab to life for the general public. Beginning in 2026, the *Old Cavendish Experience* will invite audiences to step inside the Old Cavendish Laboratory on Free School Lane and journey back in time to an era when world-changing discoveries were made within its walls.

Through theatrical performances staged in the former lab's Maxwell Lecture Theatre and adjoining rooms, visitors will be immersed in the history of the lab, discovering how breakthroughs including the splitting of the atom and the unravelling of DNA were made, and encountering the scientists and technicians who made them. Original laboratory spaces will be restored to their former states and populated with rich sets that recreate the lab environments of the 19th and 20th centuries.

Founded on the expertise of Cambridge's physicists and historians of science, and realised through the creative skills of artists and theatre professionals, the project will target a wide range of audiences including tour groups, schools, students, visitors to Cambridge and members of the local community. The first performances are slated for a summer run in 2026, which if successful, will be continued and expanded in subsequent years. In addition to the live performances, a digital project will share the stories of the Old Cavendish beyond the boundaries of Cambridge.

Since the Cavendish relocated to West Cambridge in 1974, there has been little to see at the old lab apart from a plaque or two. You will often find a tour group sheltering under the archway as their guide briefly recounts some of the old lab's history, before they shuffle off to one of Cambridge's other sights. The Old Cavendish Experience now offers a unique opportunity to invite people inside this historic site and to showcase one of Cambridge's greatest contributions to science and the wider world.

The project has just received approval from the University to move to development and fundraising, and we have an ambitious target to reach if we are to make this vision a reality. If you would like to follow the project as it develops, or perhaps even offer support, please contact the team at **info@oldcavendishlab.co.uk.** We'd be delighted to hear from you as we embark on this journey.

The entrance to the Cavendish Laboratory on Free School Lane.

The birth of the Cavendish Laboratory

Malcolm Longair

By the mid 19th century, the University of Cambridge had fallen behind in the physical sciences, leading to a long campaign to establish a laboratory for experimental physics. Malcolm Longair explores how the Cavendish Laboratory came to be.

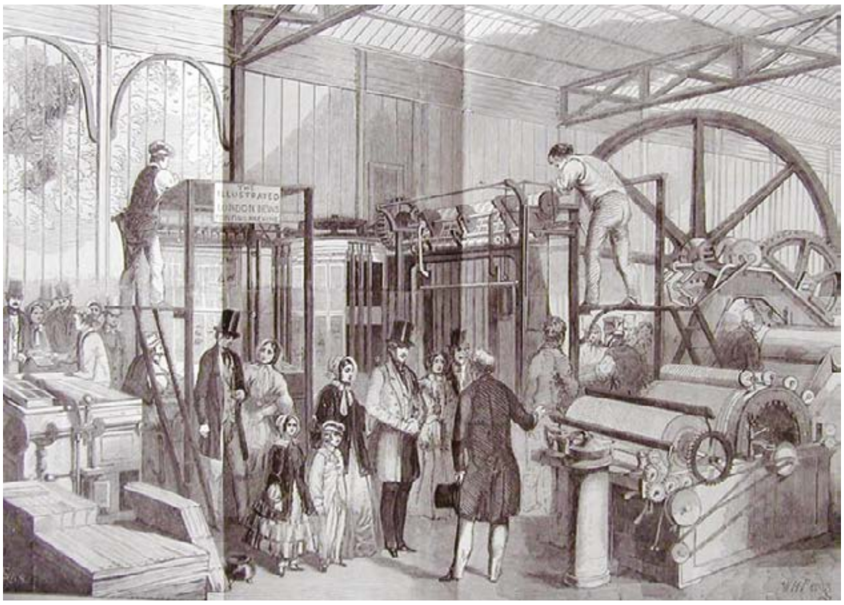
The opening of the Cavendish Laboratory in 1874 was the result of a long campaign to make experimental physics an integral part of research and teaching at Cambridge University. From the beginning of the 19th century, the emerging sciences of electricity, magnetism, heat and thermodynamics were added to the edifice of Newtonian physics and found practical application in the burgeoning industrial revolution.

Experimental physics in Britain was largely carried out in private laboratories or workshops but was not part of university curricula. In Cambridge, natural philosophy was at a rather low ebb. As Edmund Whittaker wrote:

> 'The century which elapsed between the death of Newton (1727) and the scientific activity of [George] Green (1841) was the darkest in the history of [Cambridge] University. ... In the entire period the only natural philosopher of distinction was John Michell ... but his researches seem to have attracted little or no attention among his collegiate contemporaries and successors, who silently acquiesced when his discoveries were attributed to others'

In 1841, Albert, the Prince Consort, took on the role of promoting industry and science in Britain. His most spectacular achievement was undoubtedly the Great Exhibition of 1851, intended to demonstrate that the country was an industrial leader on the global stage.

Well before this time, however, Albert had been convinced of the need for the reform of Cambridge University. He became Chancellor of Cambridge University and proposed a number of reforms in 1848. The general consensus was that the University had fallen behind in the fields of the physical sciences. The proposals were generally welcomed but faced opposition from more conservative elements, which can be gauged from the response of William Whewell, Master of Trinity College:



Queen Victoria and Prince Albert visit the machinery department of the Great Exhibition of 1851.
(Courtesy of the Special Collections Department, Library, University of Glasgow)

> '... mathematical knowledge is entitled to *paramount* consideration, because it is conversant with indisputable truths ... that such departments of science as Chemistry are not proper subject of academic instruction ...'

But the Prince had allies. The prime minister Lord John Russell appointed a Royal Commission in 1848 to investigate 'the State, Discipline, Studies and Revenues of the University of Cambridge'. The Commission's report confirmed the Prince's recommendations, remarking that

> 'the operation of social causes little within [the University's] control left out of her true position, and become imperfectly adapted to the present wants of the country, so as to stand in need of external help to bring about some useful reforms.'

William Cavendish (1808-1891), 7th Duke of Devonshire, Chancellor of Cambridge University (1861-1891). Oil painting after George Frederic Watts by Katherine Maude Humphrey.

Despite Whewell and the conservatives' opposition, the Commission stuck to its guns, recommending that there should be a 'complete and thoroughly equipped laboratory for chemistry …' Were the recommendations accepted, there did not appear to be any reason 'why Cambridge should not become as great a School of physical and experimental as it is already of mathematical and classical instruction.' An immediate result was the establishment of the Natural Sciences Tripos in 1851, including chemistry, mineralogy, geology, comparative anatomy, physiology and botany, but physics was not included. It was only treated as a distinct discipline in 1861.

The importance of physics for industry was brought home by the involvement of William Thomson, the future Lord Kelvin, in laying the first successful transatlantic cable. The first attempt by the Atlantic Telegraph Company, costing £350,000, had proved to be a disaster – the cable deteriorated rapidly and was unusable in a matter of weeks. Thomson had already made a study of such cables using electromagnetic theory, but his results were rejected by the empirical electricians. A further £1 million was raised and, following Thomson's recommendations, a cable was successfully laid in 1866. Thomson was knighted in the same year, an unusual distinction for a university professor. The University of Glasgow provided him with a suite of six experimental laboratories in their new buildings.

The untimely death of the Prince Consort in 1861 threatened to delay the Royal Commission's reforms. He was succeeded as Chancellor by William Cavendish, who became the seventh Duke of Devonshire in 1858. Cavendish, a distant relative of the famous natural philosopher Henry Cavendish, was a first-rate scientist. He excelled in the Mathematical Tripos and was the first Smith's Prizeman in 1829. He was also a major investor in the steel industry, applying scientific methods to improve industrial steelmaking. The discovery of rich deposits of high-grade haematite ore on his estates in north Lancashire resulted in a vast expansion of steelmaking capacity. By his death in 1891, he had amassed a fortune of £1,790,870.

Britain was seriously lagging behind continental Europe in training in the physical sciences and engineering. Experimental physics was still not part of the Natural Sciences Tripos and so a further syndicate was appointed in 1868 to address the issue. It recommended setting up a professorship of experimental physics, as well as the construction of a specially designed laboratory. The professor would be supported by a demonstrator to give personal instruction to the students and a museum and lecture room attendant to service the laboratories, the instruments and apparatus. The cost of the building was estimated to be £5,000 and the instruments £1,300, while the annual cost of employing the professor, the demonstrator and the lecture attendant was £660.

The colleges, however, were not prepared to make the funds available. The deadlock was broken when Cavendish wrote to the Vice-Chancellor on the 10th October 1870,

> 'I am desirous to assist the University in carrying out this recommendation into effect, and shall accordingly be prepared to provide the funds required for the building and apparatus, so soon as the University shall have in other respects completed its arrangements for teaching Experimental Physics, and shall have approved the plan of the building.'

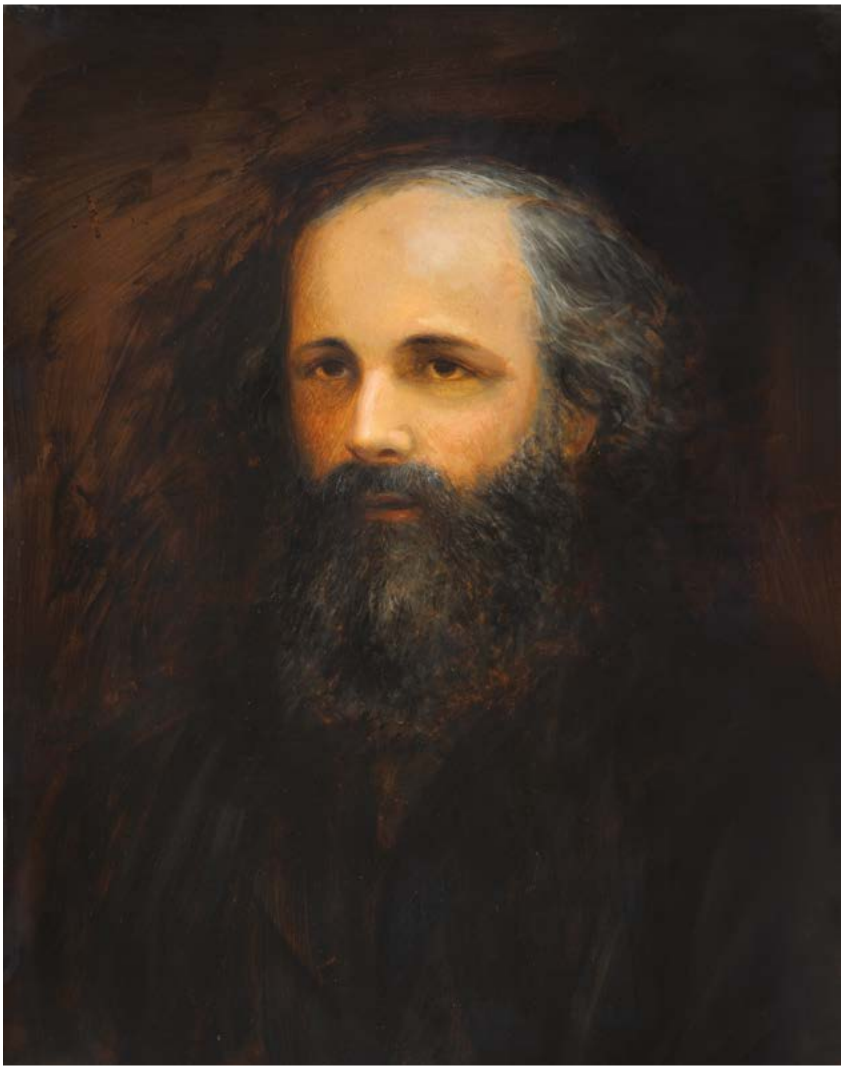
On 9 February 1871, the Council of the Senate agreed to accept the Chancellor's gift and to fund the posts needed to staff the laboratory. Finally in 1873, experimental physics incorporated into the Natural Sciences Tripos.

The electors to the Cavendish Professorship sought the best possible candidate for the new chair. An obvious choice was William Thomson, the most distinguished British physicist of his day, but with his well-furnished new laboratory in Glasgow and his industrial and domestic arrangements in the area, he was unwilling to accept the offer.

The electors turned to James Clerk Maxwell. His health had always been somewhat fragile and he had resigned his chair at King's College, London in 1865, returning to manage his family estate at Glenlair in Scotland, where he set about writing his monumental *Treatise on Electricity and Magnetism* (1873). In 1871, John William Strutt, who was to become the third Lord Rayleigh, wrote to Maxwell from Cambridge:

> 'There is no one here in the least fit for the post. What is wanted by most who know anything about it is not so much a lecturer as a mathematician who has actual experience of experimenting, and who might direct the energies of the younger Fellows and bachelors into a proper channel … I hope you may be induced to come; if not, I don't know who it is to be.'

Maxwell was ideally matched to the requirements of the professorship. As soon as his appointment was approved in 1871, he set about designing a state-of-the-art laboratory, visiting Thomson's lab in Glasgow and the Clarendon Laboratory in Oxford for inspiration. The site on Free School Lane was selected, which was sufficiently far from the main thoroughfares to minimise traffic vibrations. Plans drawn up by the architect William Fawcett were scrutinised by Maxwell, who altered the locations of walls and the disposition of the rooms according to his perceived needs. The cost of the building increased to £8,450, but Cavendish agreed to cover the shortfall.



James Clerk Maxwell (1831-1879). Oil painting by Jemima Blackburn, née Wedderburn.

Fawcett's plan for the ground floor of Cavendish Laboratory with Maxwell's changes indicated in his own hand in red pencil.

“Maxwell was ideally matched to the requirements of the professorship. As soon as his appointment was approved in 1871, he set about designing a state-of-the-art laboratory...”

The formal opening of the splendid three-floor building took place on 16 June 1874. On the ground floor, the highest stability was needed in the magnetism room. On the first floor, a large room for use by students contained ten tables, each containing a standpipe to which four Bunsen burners could be attached. The professor’s private room had two hatches opening onto the students’ laboratory, so that he could keep an eye on what they were doing. The lecture room had steeply raking seats for up to 180 students who could clearly observe the experiments being carried out on the long oak bench. Water was laid on in all the rooms. The height of the building allowed the construction of a Bunsen water pump with ‘a vertical fall of considerably more than 50 ft ... used to exhaust a large receiver, from which pipes will communicate with the different rooms’.

Maxwell acquired an extensive suite of instruments funded by Cavendish’s gift, as well as instruments he brought with him. Research activities got off to an encouraging start. Maxwell wrote to his uncle Robert Cay on 12 May 1874,

> ‘The Cavendish Laboratory is now open to students for practical work, and several good bits of work are being done already by the men. I expect some of them will have matter for publishing before long.’

Ten physics laboratories were founded in the period 1866 to 1874 in ‘British Institutes of higher learning’ but most of the new laboratory directors struggled to maintain their research output in the face of heavy teaching loads and underfunding. Maxwell, however, took full advantage of the collegiate structure at Cambridge. The normal route for students joining the Cavendish was to complete their studies in mathematics and then proceed to experimental research under Maxwell’s direction. They therefore had the mathematical skills to appreciate the most advanced problems in theoretical and experimental physics. Because of their success in the Mathematical Tripos, they would often win college fellowships or posts which enabled them to carry out substantial long-term research investigations.

The general view from outside was that Cambridge was too conservative to make a success of experimental physics. As Norman Lockyer, the influential founding editor of *Nature* remarked in 1874,

> ‘... it may take Cambridge thirty or forty years to reach the level of a second-rate German university in physical research.’

Lockyer had reckoned without the almost unique qualities of Maxwell, who set forth his agenda in his inaugural lecture in October 1871,

> ‘The characteristics of modern experiments - that they consist principally of measurements - is so prominent, that the opinion seems to have got abroad, that in a few years all the great physical constants will have been approximately estimated, and that the only occupation which will be left to men of science will be to carry on these measurements to another place of decimals.’

Maxwell immediately rejected this view,

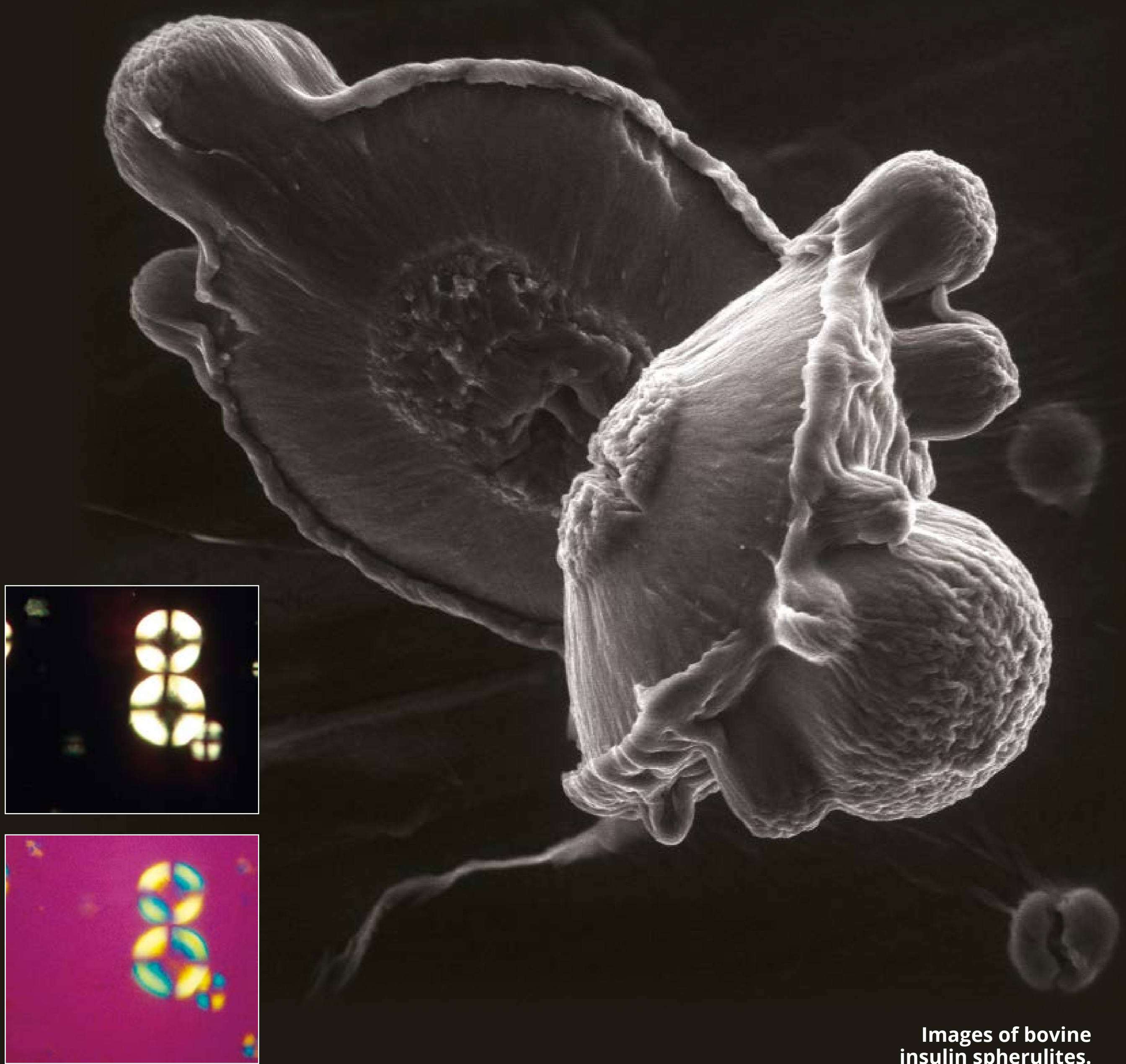
> ‘But we have no right to think thus of the unsearchable riches of creation, or of the untried fertility of those fresh minds into which these riches will be poured... the history of science shews that even during that phase of her progress in which she devotes herself to improving the accuracy of the numerical measurement... she is preparing the materials for the subjugation of new regions, which would have remained unknown if she had contented with the rough guide of her early pioneers.’

Within ten years the laboratory was operating at the frontiers of experimental physics. Sadly, Maxwell died in 1879, but he had laid the foundations for what would prove to be 150 years of scientific discovery.

Malcolm Longair is the Emeritus Jacksonian Professor of Natural Philosophy, former Head of the Cavendish Laboratory (1997 – 2005), and former Director of Development until his retirement in 2023.

Extraordinary fruit
the growth of soft matter research at the Cavendish

Athene Donald



Images of bovine insulin spherulites.

From her student days in the 1970s, to becoming the department's first female professor, Athene Donald reflects on her time at the Cavendish, the emergence of soft matter research and the experience of being a rare woman in a department where some regarded her research area as 'not physics'.

My time at the Cavendish coincides fairly closely with the lifetime of the 'New' Cavendish, soon to be vacated in favour of its new home in the Ray Dolby Centre. When it opened in 1974, I was one of the first cohort to be lectured in what later became known as the Pippard Lecture Theatre at Part II, then the third and final year of the course. I stayed on to do my PhD in the research group then known as Metal Physics (long deceased) headed by Archie Howie, who is still going strong as a sprightly 90-year-old. My research supervisor was Mick Brown, who is also still going strong, albeit a couple of years younger.

I had come up to Cambridge in 1971, at a time when there were no mixed colleges. As a girl, I only had the choice of three colleges and went to Girton. Had I come up a year later, there would have been a further three colleges available to me; Churchill, Kings and Clare all took some women from 1972. Of these Churchill, of which I have been Master for the last ten years, is very proud that it was the first college to vote to admit women, though too late for me.

The numbers of women back then were, naturally, low in my Part II class, but it is dismaying to find that even today only 25% or less of the graduating cohort in physics are women, which reflects the wider societal challenges facing girls who may want to take appropriate courses at school to get them into physics, engineering or computing. I find it deeply frustrating, and this sense of frustration led me to write *Not Just for the Boys: Why we need more women in science*, published last year. The number of women on the Cavendish faculty at all levels has, however, massively increased from zero in my day (although there were women teaching paid from soft money, so it wasn't entirely obvious there were no female lecturers), providing great role models for students coming through the system now.

My PhD was based around electron microscopy, concluding with a thesis entitled *Grain boundary embrittlement in copper-bismuth alloys*; like most theses it had a riveting title! However, by the time I returned to the Cavendish in 1983 after four years in the Materials Science and Engineering Department at Cornell in the USA and two on a fellowship in the Cambridge Materials Science Department, I had switched fields to work on polymers, better known to the public as plastics. However, my research continued with a strong emphasis on electron microscopy. These materials formed my introduction to the field that became known as *soft matter*, led from the outset in Cambridge by Cavendish Professor and Head of Department, Sir Sam Edwards.

Today, soft matter is a branch of physics that has broadened considerably from its roots in polymers. It now encompasses materials such as sand and paint, gels and complex fluids. In the Cavendish, we also extended towards biology, ultimately forming a sector known as Biological and Soft Systems in the early 2000s, with an increasing fraction of new hires working specifically in biological materials. Significant investment was required to make sure we had adequate facilities – specifically space for cell and bacterial cultures which require a degree of containment. This was realised in the Physics of Medicine building, opened in December 2008 by Aaron Klug, the first part of the redevelopment of the Cavendish which is completed with the Ray Dolby Centre.

For me, the excitement of this whole field is the obvious relationship to our daily lives and to practical problems. The length scales under investigation are not atomic, but molecular and supramolecular, up to around a micrometre in the case of colloids. These are a class of materials consisting of two or more phases with the characteristic length scales of the phases of one micrometre or less, so that surfaces play a crucial role in determining both structure and behaviour. They formed a major part of the research from 1992 onwards, when the group was awarded a large interdisciplinary and interuniversity grant, funded in part by industry and in part by what was then the Department of Trade and Industry. It allowed me to purchase the first of a series of a new type of electron microscopes, the Environmental Scanning Electron Microscope (ESEM), which – unlike conventional electron microscopes – allowed a sample to be kept hydrated, a crucial breakthrough. The group worked with these for many years, and collaborated with the manufacturers to improve the design, as well as our

Opening of the Tabor Laboratory, home of the Polymers and Colloids Group at the Cavendish in 1992.

“For me, the excitement of this whole field is the obvious relationship to our daily lives and to practical problems.”

Athene Donald in the Cavendish Laboratory in the late 1990s.

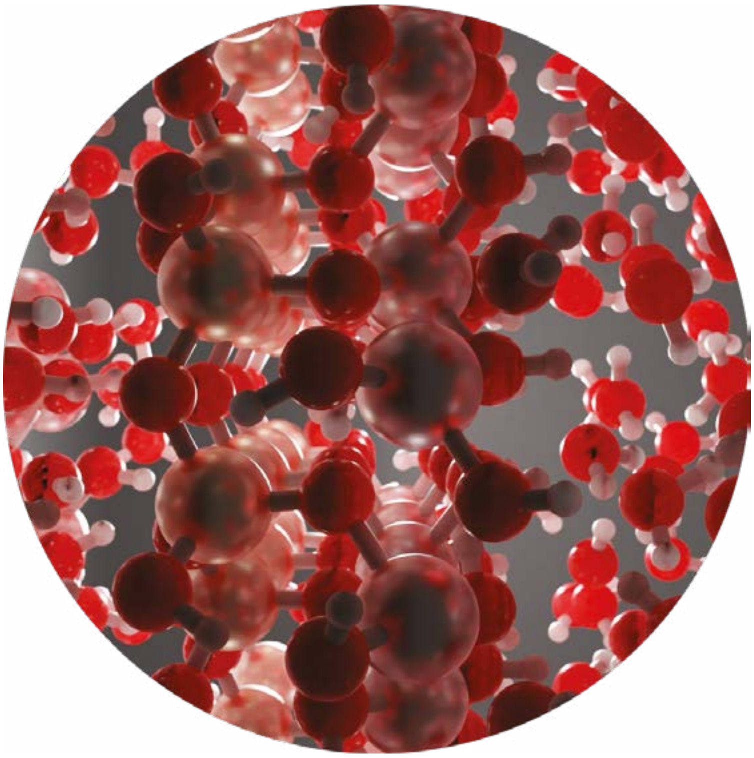
understanding of the physics of how images were formed. Ultimately developments in optical techniques meant ESEM was superseded as a breakthrough technique for imaging materials such as hydrated or biological samples at high resolution.

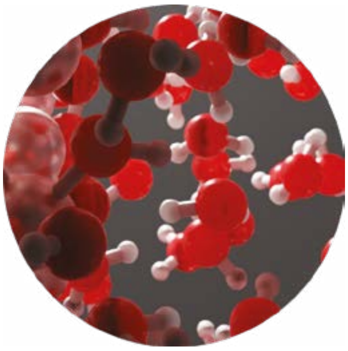
Microscopy was not the only focus of my research. For many years I studied the internal structure of starch granules – food was another key area of activity – using small angle X-ray scattering at the various national and international synchrotron facilities. This was the work that took me towards biology as I started collaborating with plant biochemists, but it has to be said some of my Cavendish colleagues were far from supportive of one of their members working on something so messy. Complexity is now a significant area of research in physics in its own right, but that was far from the case when I started working on food back in the 1980s. Like the colloid grant, this was a grant that Sir Sam had negotiated, in this case before I had even returned to the Cavendish, to work with the Institute of Food Research in Norwich.

As a rare woman in the department and the wider physics community, working in an area that many colleagues thought was ‘not physics’, much of my early to mid-career in the Cavendish felt quite tough. I wasn’t one of the boys and I wasn’t working in the ‘right’ area. Sir Sam believed in me and certainly in the research field, but often I was made to feel an outsider by others, even as my work was well regarded elsewhere, including recognition through prizes. Becoming the first female professor in the department in 1998 and an FRS in 1999 did not seem to improve the situation.

Despite that, the field of soft matter and biological physics has ultimately flourished. The work, particularly in the biological arena, has moved a long way both at the Cavendish and around the world. Now many physicists and physics departments appreciate this, and complexity in all its guises is seen as an exciting and important area. Sir Sam’s vision of this sort of interdisciplinary work, presaged by the original grant in food physics, has borne extraordinary fruit.

Athene Donald is Emeritus Professor of Experimental Physics, former Gender Equality Champion for the University of Cambridge and former Master of Churchill.

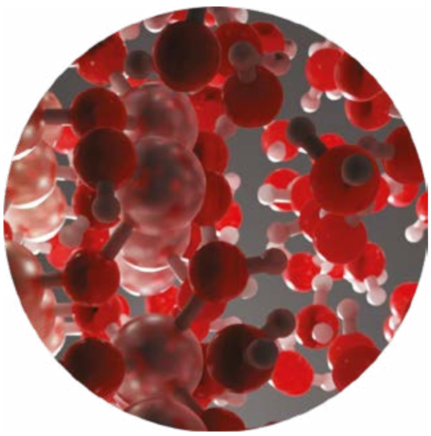




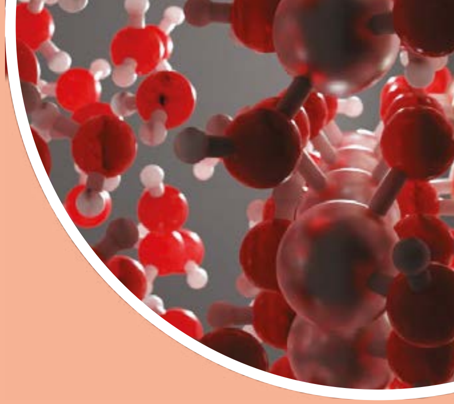
IMAGES ON THIS PAGE:
Molecular modelling illustration.

Seventy years of the Theory of Condensed Matter Group

Claudio Castelnovo, Nigel Cooper, Mike Payne and Volker Heine



Members of the Theory of Condensed Matter Group reflect on the history of one of the Cavendish Laboratory's longest standing research groups, whose pioneering work continues to push back the frontiers of our understanding of matter.



The TCM Group at its 50th birthday celebration.

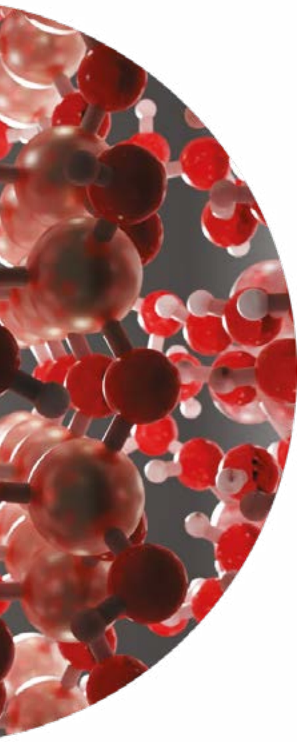
Maintaining a research group for 70 years is a significant accomplishment in itself, but the Theory of Condensed Matter (TCM) group's long and consistent track record of world-leading, seminal research is far more significant. This has been achieved by constantly innovating and moving to new research challenges, and by allowing our exceptionally bright young researchers the opportunity to develop their own research and to ensure that they receive recognition for doing so. Over the years, six Nobel prize winners (Mott, Anderson, Josephson, Thouless, Haldane and Jumper) and four Europhysics Prize winners (Khmelnitskii, Rice, Warner and Castelnovo) have come through TCM, alongside many other award winners. We are immensely proud of the successes of all the members of TCM - not just the world-leading academic researchers but also those who have created start-ups or gone on to high level positions in industry, finance and elsewhere. There are too many to list in a single article so we will mention just some of the notable events from the history of the group.

Condensed matter theory seeks to develop mathematical models and numerical approaches to understand and predict the behaviour of many-particle systems, where collective phenomena emerge that can differ markedly from the properties of their constituents. For instance, the hydrodynamics

Nevill Mott.

of water is not revealed in the dynamics of a single water molecule. “More is different” as Philip Anderson put it.

The origins of TCM can be traced back to 1st October 1954 when Nevill Mott came to Cambridge as the new Cavendish Professor of Experimental Physics – which was somewhat ironic as Mott was a theoretician. TCM was originally called the Solid State Theory Group but in 1972 changed its name to the Theory of Condensed Matter (allegedly Phil Anderson’s suggestion), reflecting its broader range of research and thereby coining the term ‘condensed matter’.



Mott’s approach to research was to talk to experimentalists and formulate interesting questions for theoretical research. Mott brought John Ziman from Oxford with him as a young lecturer, who quickly gathered a small group of research students around him, including Lu Sham, who is now well known for his seminal work on density functional theory with Walter Kohn. Other famed PhD students in TCM include Maurice Rice, Neil Ashcroft and Duncan Haldane. Ziman initiated the concept of formal graduate lectures as a central part of graduate education, which continue to this day.

Also in 1954, Volker Heine arrived in Cambridge as a PhD student from New Zealand, after a one-month boat journey, hoping to be supervised by Mott. However, their first meeting ended with Mott instructing him to “go down to the Low Temperature Physics laboratory and see if you can make yourself useful!”, leading to Volker’s move into computational physics and his battles with the EDSAC 1 computer. He pioneered a research field that nowadays is often referred to as ‘electronic structure’ which measures its annual publications in kilopapers!

Mott's presence provided a focus for theoretical physicists and TCM received a stream of distinguished academic visitors. In TCM’s early years, these included Hans Bethe, Phil Anderson, Marvin Cohen, Philippe Nozières. Bethe gave the first lecture course in Cambridge on many-body theory. Subsequently, Mott persuaded Anderson to split his time equally between Bell Laboratories and Cambridge, an arrangement that continued until the mid-1970s.

In the early 1960s, Brian Josephson started his PhD under the supervision of Brian Pippard. Extraordinarily talented at a young age, Josephson published a notable paper on the Mössbauer effect as an undergraduate student but is best known for his graduate student work on the eponymous effect, for which he received the Nobel prize a decade later.

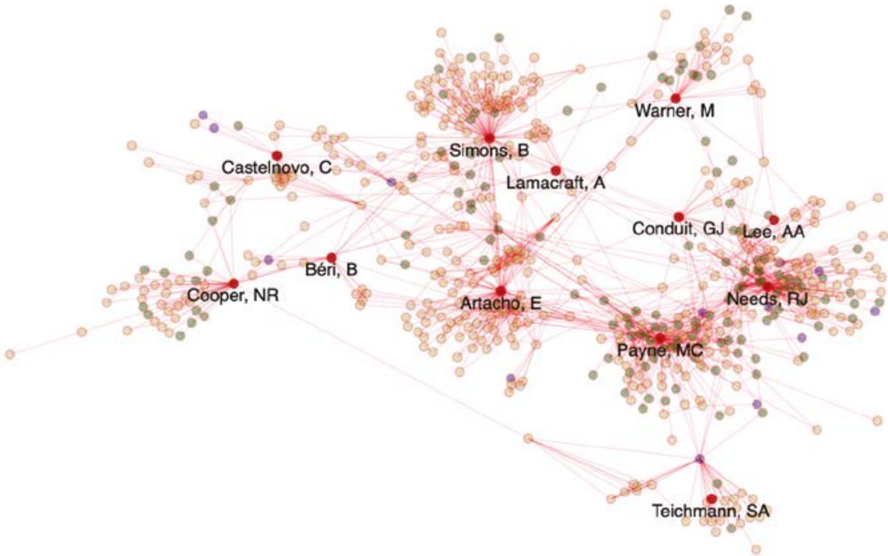
The role of topology in condensed matter systems is currently a significant area of research. David Thouless, the instigator of this field, was in TCM in the 1960s and again briefly in the 1980s. Duncan Haldane was a member of the group in the 1970s. They, with Michael Kosterlitz who was a Cambridge undergraduate, were jointly awarded the 2016 Nobel prize for ‘theoretical discoveries of topological phase transitions and topological phases of matter’. TCM has continued to innovate in this field, for example Nigel Cooper’s work making connections to cold atomic gases, Benjamin Béri to quantum information, and Anton Souslov to active matter. The recent significant growth in this field means that many PhD students, postdocs and research fellows in TCM currently work on topological problems. Two of them, Robert-Jan Slager and Nur Unal have just moved to permanent academic positions at leading UK universities.

Sam Edwards joined TCM in 1972 and eventually led a large group working primarily on understanding the behaviour of polymers, soft matter and related systems. In 1984, Sam was appointed Cavendish Professor, by which time the reference to ‘experimental physics’ had been dropped. This area was extremely active in the 1980s with Robin Ball, Mark Warner and Mike Cates holding lectureships. Sam was noted for his ability to attract industrial funding – though this did, at times, cause consternation elsewhere in the University.

Electronic structure came of age in the 1990s. Density functional theory and the development of computer codes allowed predictive calculations on systems containing hundreds of atoms and the ability to answer questions like 'what would happen if this atom were not allowed to move'. This development marked the end of the 'create whatever model you like' approach to explain experimental results - as models could, finally, be rigorously tested. Volker inspired the electronic structure community in the UK and Europe and fostered a spirit of collaboration that was critical to the field's success. TCM has had enormous strength in depth in this field for many years through Richard Needs, Mike Payne, Emilio Artacho and Christoph Schran.

Ben Simons started his PhD in TCM in 1987 and was appointed to a lectureship in 1995. His early research included work on high temperature superconductivity and quantum phase transitions. His research subsequently moved into biological physics and he was appointed to the Herchel Smith Chair in Physics in 2011.

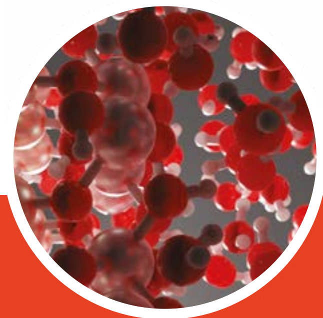
Much of TCM's pioneering research has become mainstream, in physics and in other disciplines. Just taking a few examples within Cambridge: soft active matter is now a significant research activity in the Department of Applied Mathematics and Theoretical Physics (DAMTP) where Mike Cates holds the Lucasian Chair; electronic structure is a major activity in Chemistry, Engineering and Materials, where former TCM member Chris Pickard holds the Sir Alan Cottrell Chair; and, in addition to his many links to biology departments and institutions,



A graph showing papers published by members of TCM, as recorded by the University's Symplectic database. Each circle represents an author, and each line denotes that the two authors it joins have co-authored one or more papers.

Ben Simons also holds a Royal Society professorship in DAMTP.

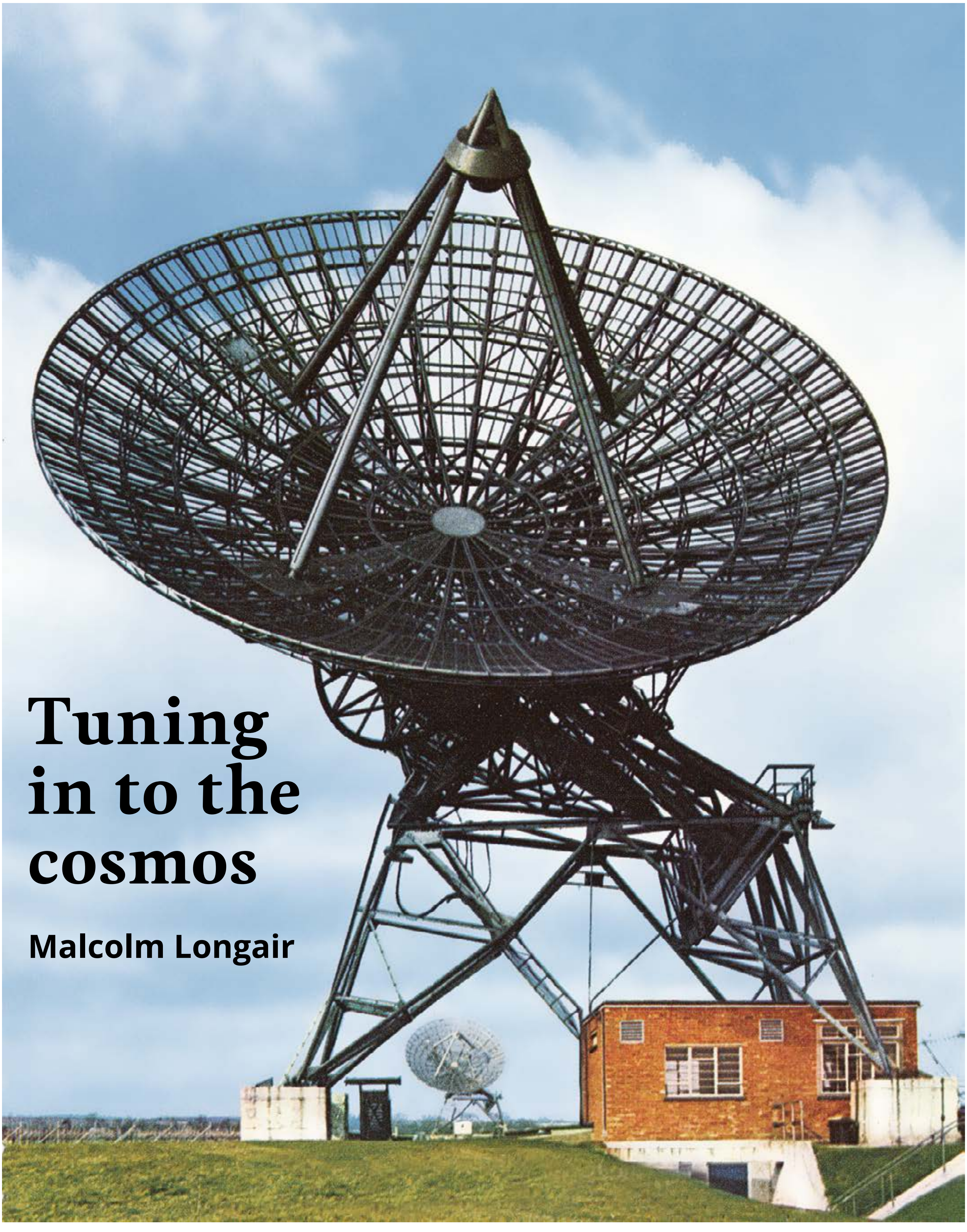
The research activities in TCM have grown and diversified throughout the years, with new members joining to work on low dimensional and disordered systems, machine learning and far from equilibrium phenomena (Austen Lamacraft); frustrated magnetism, quantum spin liquids and quantum computing, and glassy phenomena (Claudio Castelnovo); topological phenomena and Majorana states, quantum circuits and quantum information (Benjamin Béri); active solids, viscoelasticity, and topological states in mechanics and fibre optics (Anton Souslov). The group continues to interact closely with many experimental groups, drawing inspiration from experimental developments to make further advances in theoretical physics. The rapid developments across the growing breadth of TCM research promise future success, as attested by the Nobel Prize in Chemistry 2024 recently awarded to our alumnus John Jumper.



We will be celebrating TCM's 70th Birthday at the Cavendish Laboratory (Ray Dolby Centre) on the **25th July 2025**.

Further information will be provided in forthcoming CavMags and on the TCM web pages **tcm.phy.cam.ac.uk/events/tcm70**

Email **TCM70@tcm.phy.cam.ac.uk** to be added to the mailing list for the event.



Tuning in to the cosmos

Malcolm Longair

From its origins in wartime radar research, to the latest international radio telescopes, Malcolm Longair charts the history of radio astronomy at the Cavendish.

The first radio waves from our galaxy were discovered by Karl Jansky in 1934 while studying extraneous sources of radio noise at the Bell Telephone Laboratories. These were followed up by Grote Reber who used his home-made radio telescope to produce a radio map of the galaxy in the 1940s, but this aroused little interest in the astronomical community.

The huge efforts made during the Second World War to develop radar had a major impact upon radio technology. Future Cavendish radio astronomers, Martin Ryle, Tony Hewish and Graham Smith were all involved in this work. Because of the urgency of the need for innovation and imaginative solutions, the war years left an indelible mark on Martin's technical and leadership abilities. Bernard Lovell remarked,

> "… Ryle's extraordinary inventiveness and scientific understanding soon became evident. Under the stress of urgent operational requirements, he became intolerant of those who were not blessed with his immediate insight."

By the end of the war, radio emission from the Sun had been discovered as well as the very bright radio source Cygnus A. Ryle was encouraged by Jack Radcliffe to accept a fellowship to start up a radio astronomy group at the Cavendish immediately after the war. There was scarcely any money for equipment, but Martin and his colleagues were able to buy considerable amounts of surplus war electronics very cheaply. They also acquired large amounts of high-quality German radar equipment that had been requisitioned, including two 7.5-metre Würzburg antennae, several 3-metre dishes and vast lengths of high quality coaxial cable.

In 1946, Martin and Eric Vonberg made interferometer measurements of radio emissions from the Sun and established that the bursts were associated with sunspots. Their remarkable short paper in Nature included three of the basic principles of radio interferometry. The greater challenge was to establish the nature of the discrete radio sources. By the early 1950s, it was apparent that a number of them were associated with rather strange massive galaxies.

Martin and Graham Smith measured accurate positions for the sources Cas A and Cygnus A with the pair of 7.5-metre Würzburg antennae used as an interferometer. This resulted in the identification of Cas A with a supernova remnant in our own galaxy and Cygnus A with a distant galaxy. Jennison and Das Gupta at Jodrell Bank showed that it had a strange double radio structure extending far beyond the optical image of the galaxy, which proved to be from synchrotron emission of ultra-relativistic electrons. These discoveries marked the dawn of high energy astrophysics and showed the enormous potential for new approaches to understand the universe.

As early as 1950, the burgeoning radio astronomy group completed their first catalogue, known as '1C', of about a hundred radio source in the northern sky. This was followed by the 2C survey with a four-element interferometer located on the University's rifle range site to the west of the rugby ground, and conveniently right next to Martin and Graham's house on Herschel Road. The catalogue contained about 2000 sources and, most surprisingly, a very large excess of faint sources, implying that there were many more sources in the early universe. In Ryle's 1955 Halley Lecture in Oxford, he concluded:

> "This is a most remarkable and important result, but if we accept the conclusion that most of the radio stars are external to the galaxy, and this conclusion seems hard to avoid, then there seems no way in which the observations can be explained in terms of a steady state theory."

The result was a surprise to the astronomical community. The physical nature of the sources was not understood and only 20 of them could be associated with relatively nearby galaxies. A somewhat bitter controversy with the proponents of steady-state cosmology ensued, particularly with Fred Hoyle, the Cambridge Plumian Professor of Astronomy. In Australia, the Sydney group led by Bernard Mills carried out similar surveys of the southern sky around the same time but found

Opposite: The Cambridge One-Mile Telescope, the world's first fully steerable Earth- rotation aperture synthesis array.

Graham Smith with the interferometer which used the two Würzburg antennae in about 1950.

that their counts did not show such a large excess. In 1957, Mills and Bruce Slee stated:

> "We therefore conclude that discrepancies, in the main, reflect errors in the Cambridge catalogue, and accordingly deductions of cosmological interest derived from its analysis are without foundation … there is no clear evidence for any effect of cosmological importance in the source counts."

Immediately after the war, the UK was broke, but by the 1950s funding improved through the establishment of the research councils. What Harold Wilson famously described as "the white heat" of a technological revolution, saw major increases in research funding of about 5% per year in real terms between 1956 and 1970. In 1956, the radio observatory moved to a disused wartime Air Ministry bomb store at Lord's Bridge outside Cambridge. Supported by a grant of £100,000 from the electronics company Mullard Ltd, the new 'Mullard Radio Astronomy Observatory' (MRAO) opened in 1957. A large aperture synthesis interferometer, the 4C radio telescope, was constructed to carry out deeper radio surveys of the sky. An excess of faint radio sources was still found but not to the extent of the 2C survey.

Martin's contribution of genius was the practical implementation of Earth-rotation aperture synthesis which resulted in high angular resolution and high sensitivity images of the radio sky. The first pioneering survey was carried out using the two-dimensional mapping technique of the region about the North Pole by Martin and Ann Neville, demonstrating the technique's remarkable power. Construction of the One-Mile Telescope followed, the first fully steerable Earth-rotation aperture synthesis radio telescope. For this invention, Martin was awarded the 1974 Nobel Prize in Physics jointly with Tony Hewish.

At the same time, Tony constructed a 4-acre low-frequency array to study the 'scintillation' of radio sources. The object was to study interplanetary scintillation as a means of discovering quasars and characterising the properties of the interplanetary medium. His graduate student Jocelyn Bell joined the project in 1965 and was deeply involved in the construction and commissioning of the array. With great skill and tenacity, she made the remarkable discovery of pulsars, which were soon associated with magnetised, rotating neutron stars.

With the great success of the One-Mile Telescope, the next step was to extend these techniques to higher frequencies with larger numbers of telescopes. The 5-km radio telescope, arguably Martin's greatest achievement, resulted in higher angular resolution and sensitivity. Over a 25-year period, the sensitivity of radio observations increased by a factor of about one million and the imaging capability from several degrees to a few arcseconds, comparable to that of ground-based optical telescopes.

Martin was personally involved in every aspect of these complex telescope systems. As remarked by Peter Scheuer, the development of aperture synthesis

> 'was the story of one remarkable man, who not only provided the inspiration and driving force but actually designed most of the bits and pieces, charmed or savaged official persons according to their deserts, wielded shovels and sledgehammers, mended breakdowns, and kept the rest of us on our toes.'

In the mid-1970s, John Baldwin and Peter Warner published two important papers on phaseless could be reconstructed from the cross-correlation of intensity signals between pairs of telescopes. The technique was experimentally demonstrated in 1978 by Julia Riley and Guy Pooley who used it to produce a high-resolution image of the source 3C123. A second paper generalised the technique to the case in which there was no single dominant source. Further developments included closure phase and self-calibration techniques, which are now the standard data reduction techniques in radio astronomy.

John recognised that the same techniques could be used to implement interferometry at optical and near infrared wavelengths. Optical aperture synthesis is more challenging than at radio wavelengths for two reasons. First, the wavelengths are typically about 100,000 times smaller than those of radio waves and so the path compensation must be accurate to better than a thousandth of a millimetre. Second, the atmosphere is not stable and changes the arrival phases of the waves - this blurring is known as ‘astronomical seeing’.

John led the efforts to build the imaging Cambridge Optical Aperture Synthesis Telescope (COAST). The path corrections are introduced by very precisely moving trolleys in an underground laboratory. The COAST Interferometer had four telescopes, and their signals were taken along pipes to the underground laboratory to be combined. An image of the red giant star Betelgeuse made using COAST showed bright spots due to huge holes in the star’s upper atmosphere. Equally impressive was the image of the binary star Capella, the separation of the stars being only 25 milliarcseconds. The success of the project led to involvement in the construction of a large optical-infrared interferometer at the Magdalena Ridge Observatory in New Mexico, which aims to achieve 100 times higher angular resolution than the Hubble Space Telescope.

The discovery of the cosmic microwave background radiation (CMB) by Penzias and Wilson in 1965 opened up new approaches to cosmology and the origin of structure in the universe. In 1966, John Shakeshaft and Tim Howell made the earliest low frequency measurements

Moving element of the 4C interferometer.

Jocelyn Bell with the discovery records of the first pulsar CP1919.

of its spectrum, confirming its black body nature. Then, the group led a series of millimetre radio telescope arrays to measure the spatial fluctuations in its distribution over the sky. The Very Small Array located on Tenerife in the Canary Islands at a high dry site, succeeded in measuring the detailed CMB power spectrum on small angular scales.

The success of these experiments led to the construction of the Arcminute Microkelvin Imager (AMI) at Lord's Bridge, the principal objective of which was to image the very small decrements in the CMB due to the presence of very hot gas in clusters of galaxies. This involved reconfiguring the 5-km telescope as a compact array to complement the observations made by the higher frequency small AMI array.

In the early 1970s plans were developed for a national large millimetre-submillimetre telescope. This was a new venture for the MRAO since the team was not experienced in the science of molecular line astronomy. Richard Hills joined the Observatory in the 1980s and became the project scientist for what was named the James Clerk Maxwell Telescope located on Mauna Kea in Hawaii. Richard and the MRAO team were central to the development of the telescope which opened up many new areas in millimetre and submillimetre astronomy.

In turn this led to involvement in the international Atacama Large Millimetre Array (ALMA). There was significant MRAO involvement in this very large project. Richard Hills became the overall project scientist for the project in Chille, while

The 5-km radio telescope.

The AMI Small Array.

became project scientist for the UK's participation in the project. ALMA has done for submillimetre astronomy what the HST has done for optical astronomy.

The group's next major international radio astronomy project is the Square Kilometre Array, which involves locating huge aperture-synthesis radio telescope arrays in Australia and South Africa, each with collecting areas of about 1 km2, giving a sensitivity gain of a factor of 100.

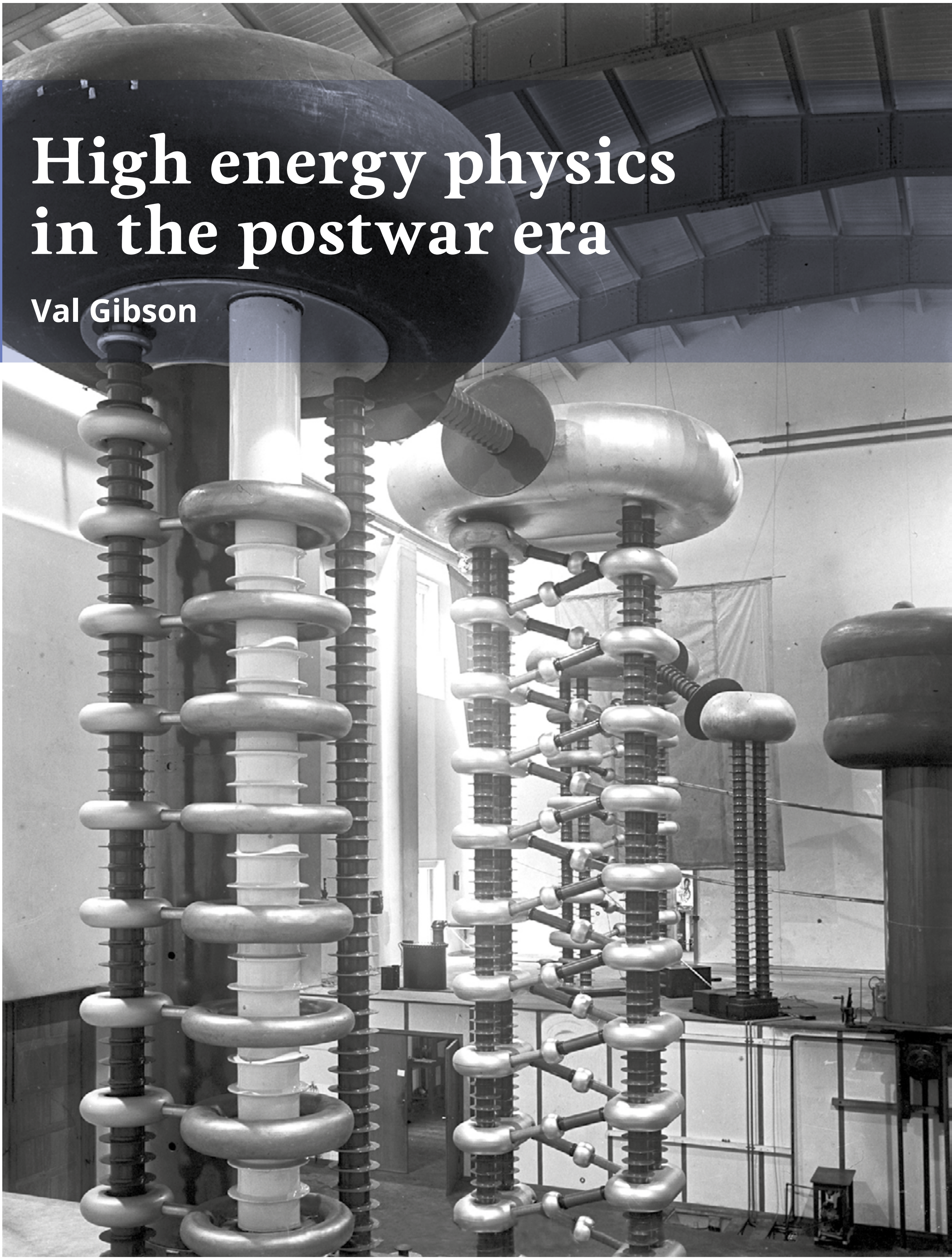
Since 2010, there has been a shift in the emphasis of the research programme in response to evolving priorities. In 2012, Roberto Maiolino was appointed Professor of Experimental Astrophysics, bringing involvement in many of the most important observational programmes in the origin and evolution of distant galaxies, including the James Webb Space Telescope and the European Extremely Large Telescope. These studies are now a major part of the programme of what is now called the Cavendish Astrophysics Group.

The other major change of direction came with the appointment of Didier Queloz in 2013, now the Jacksonian Professor of Natural Philosophy in the Cavendish. He was the co-discoverer of the first example of an extra-solar planet orbiting a sun-like star with his supervisor Michel Mayor – both were awarded Nobel prizes in 2019 for this discovery. He now leads a large research team and is directing a major international ten-year research programme supported by the Leverhulme Foundation on the search for life in the universe.

Martin Ryle in his element.

High energy physics in the postwar era

Val Gibson



Having led the world in the 1920s and 30s, nuclear research at the Cavendish went into decline following the death of Rutherford in 1937 and the departure of many of the lab's leading physicists. After the Second World War, Cavendish high energy physics increasingly turned towards large international facilities, as Val Gibson explains.

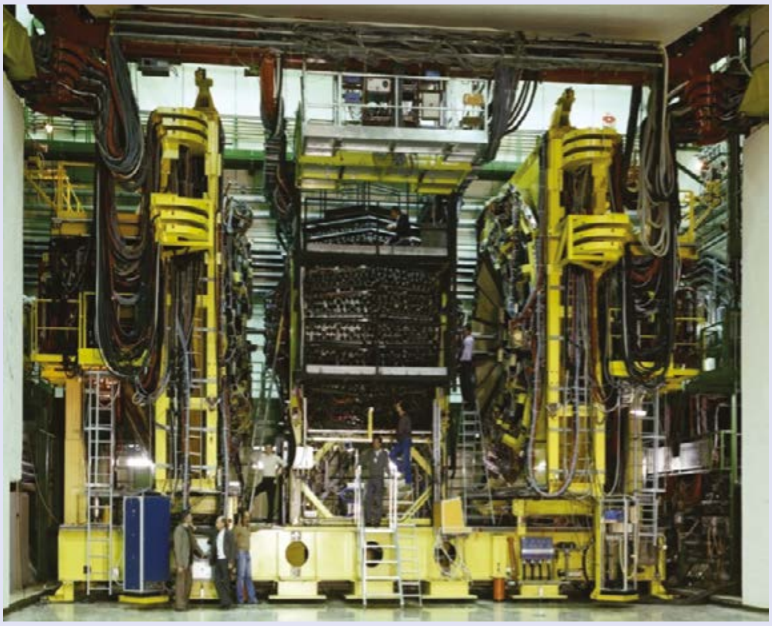
Otto Robert Frisch was the father of high energy physics in Cambridge. Having been central to work on the atomic bomb and the Manhattan Project, he succeeded John Cockcroft as Jacksonian Professor in 1947 and became Head of the Cavendish in 1954. By the late 1950s, the Cavendish housed a cyclotron, two 'MeV' Cockcroft-Walton machines, and a Van de Graaff electrostatic generator, capable of accelerating particles up to 3 MeV. Housed in the newly built High Tension Hall, these machines were beloved of the media as being the shape of science to come, with tall columns of polished metal electrodes that could generate crashing sparks. All three machines were used to study energy levels of light nuclei until decommissioned when they became uncompetitive. This marked the demise of nuclear physics in Cambridge and the dawn of the era of high energy particle physics.

The 1950s also saw the development of billion-volt 'GeV' machines. In Cambridge, attempts were made to build a linear electron accelerator, which was terminated by Cavendish Professor Nevill Mott, who concluded that it was "too little too late". Likewise, Cockcroft and Frisch's proposed electron synchrotron was not approved. Cambridge also failed in its bid to host a new European laboratory with a large circular accelerator to be built in Norfolk, which eventually went to Geneva with the establishment of CERN in 1954. How UK high energy particle physics could have been so different!

Frisch met the inventor of the bubble chamber, Donald Glazer, who was concerned that, although his invention could photograph tracks of particles from high-energy collisions in large numbers, there would be a serious bottleneck unless equipment was developed to cope with the flow of film. In 1964, Frisch's responded by inventing SWEEPNIK, a semi-automatic measuring machine, which benefitted from new commercial lasers with intense small spots of light and cheap computing. SWEEPNIK was an amazing success and Frisch, alongside Australian PhD student John Rushbrooke went on to found Laser Scan Limited in 1969, the first company to take premises in the Cambridge Science Park.

ABOVE: SWEEPNIK.

OPPOSITE: The High Tension Hall at the Cavendish.



The UA2 experiment.
© CERN

By the 1970s, the High Energy Physics (HEP) group numbered eight people in the Austin Wing of the Old Cavendish, carrying out research on accelerators run by the (inter)national laboratories RAL and CERN. Experiments were small scale by today's standards, based on one or two groups. Frisch had retired but was still around. Led by academics Rushbrooke and Bill Neale were post-docs Richard Ansorge and Janet Carter, PhD students David Ward and David Munday; and Sven Katvars and Patrick Elcombe, who provided technical and computing support. An electronics engineer, Maurice Goodrick, joined in 1973 to replace the SWEEPNIK engineer who went to Laser Scan. Bubble chamber pictures were scanned in the New Exams Hall, which had space for the scanning machines and up to 20 staff, while data analysis was performed on the University IBM mainframe, conveniently situated on the New Museums Site. By the time of the move to West Cambridge in 1974, the group's research focus was hybrid bubble chamber and electronic detector experiments at SLAC and Fermilab.

The Cavendish is renowned for exchange of ideas between experimentalists and theorists, including Paul Dirac, a father of quantum physics. One of Dirac's PhD students, Richard Eden, created an HEP theory group in the Cavendish when many chose to move to the new Department of Applied Mathematics and Theoretical Physics in 1959. One of Eden's students, Michael Green became a co-founder of String Theory, succeeded Stephen Hawking as Lucasian Professor, and received the 2013 Breakthrough Prize in Physics. In 1971, Eden also persuaded Bryan Webber, a postdoc at Lawrence Berkeley Laboratory, to join the theory group.

The 1970s was a game-changing period. The standard model of particle physics was being formed and neutral currents, the charm quark, and the bottom quark were all discovered. At CERN, the first hadron collider, the Intersecting Storage Rings (ISR), had been commissioned in 1971, the Super Proton Synchrotron (SPS) in 1976, and the proton-antiproton collider ($Sp\bar{p}S$) in 1981. Following the move to West, CERN was the natural place for the Cambridge group's research.

In 1976, Rushbrooke, now Head of HEP and was joined by a new academic staff member, the effervescent Tom White. Whilst on sabbatical leave at CERN in 1977, Rushbrooke proposed the UA5 experiment at the $Sp\bar{p}S$ to provide an inclusive overview of hadronic interactions at the centre-of-mass energy of 540 GeV. A selling point were the uexplained 'Centauro events' claimed by cosmic ray emulsion experiments, which if validated, would have been a sensational discovery. The idea was to mount a pair of streamer chambers above and below the collision point, with light from the streamers be photographed using image intensifiers and the images analysed in Cambridge. A collaboration was formed, Rushbrooke became Spokesperson, and Cambridge led the physics analysis until about 1986.

Around the same time, Carter, now a senior member of HEP, joined the WA42 hyperon experiment at the SPS, followed by the Axial Field Spectrometer (AFS) at the ISR in 1983. The AFS was the first hadron collider experiment designed to study pp and $p\bar{p}$ collisions, making the first measurement of jet production cross-sections at a centre-of-mass energy of 45 GeV.

In 1983, Webber started to develop the world-acclaimed HERWIG Monte Carlo generator, which simulates quantum chromodynamic (QCD) processes in particle collisions. Over 40 years later, HERWIG remains at the forefront of event generator development and is used by all the major Large Hadron Collider (LHC) experiments. Webber received the 2021 European Physical Society High Energy Particle Physics Prize for this outstanding achievement.

The discoveries of the W and Z bosons in 1983 by the UA1 and UA2 experiments at the Sp$\bar{p}$S had a major impact on particle physics. In the late 1970s, CERN had started thinking about its next major project – the Large Electron Positron Collider (LEP), designed to make detailed measurements of W and Z bosons, to be constructed between 1983 and 1988. Cambridge joined the Omni Purpose Apparatus at LEP (OPAL), one of four large experiments. Carter led the group into OPAL (with Pat and David Ward, Goodrick and John Hill) to work on the central vertex tracking chamber, the track trigger, and the endcap lead glass calorimeters. Ward meanwhile became OPAL software coordinator in 1986 when the experiments were moving from large mainframe computing to workstations and PCs allied to data farms.

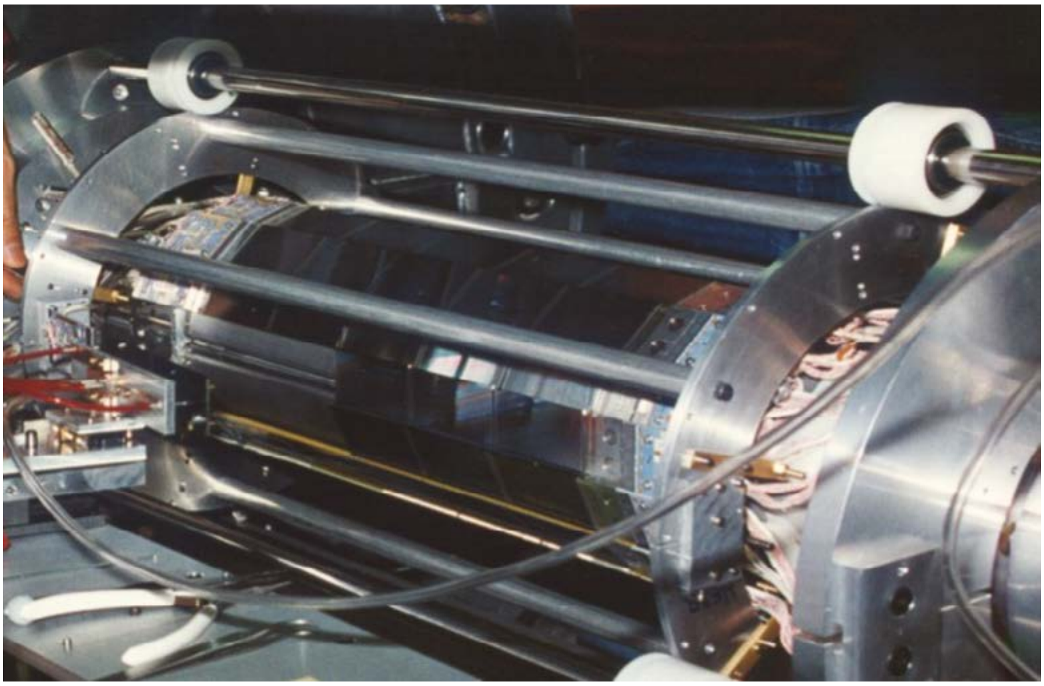
Meanwhile White and Munday made a major contribution to the 1985 upgrade of the UA2 experiment, allowing more precise measurements of the W and Z bosons. The team built a novel scintillating fibre detector that improved the tracking and electron identification significantly.

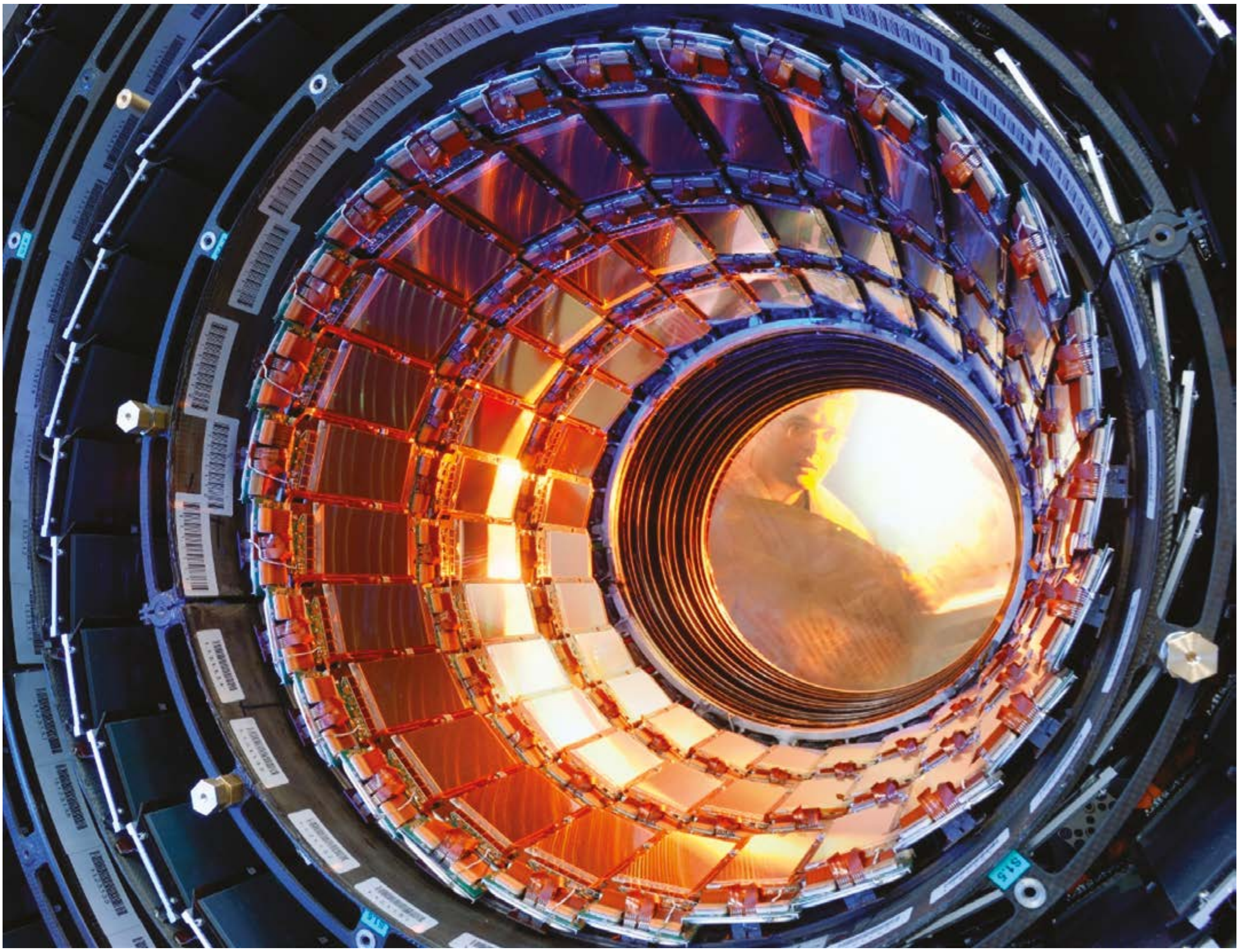
By 1989, Rushbrooke had resigned to become Head of Physics at Australia's Bond University, Neale had also retired, and Carter became Head of HEP. The departures led to new academic appointments: Richard Batley to work on OPAL and Andy Parker to work on the UA2 upgrade which would search for the top quark. They were joined by senior post-docs Phil Allport and I to also work on OPAL. These arrivals provided the means to expand into the novel area of silicon detectors. Parker and Munday led the development of the UA2 silicon pad detector, installed in 1989, which further improved electron identification. This was the first silicon tracker at a collider experiment.

Together with Carter, Allport and Batley, we played a lead role in the OPAL silicon micro-vertex detector, placed around the beam-pipe.
The detector provided very accurate measurements of particle trajectories close to the interaction point allowing for the recognition of short-lived particles, especially tau leptons and hadrons containing bottom quarks.

The first phase of LEP and OPAL ran between 1989 and 1995, collecting millions of Z events, as the group led precision electroweak measurements, studied the underlying events to understand QCD, and measured bottom meson (B) production and decay processes. During the second phase of LEP, with the collision energy increased to produce WW pairs, the group made precision electroweak measurements and searched for new particles, until the collider completed data-taking in 2000. The UA5, UA2 and OPAL

The OPAL silicon micro-vertex detector.
© CERN





ATLAS semiconductor tracker.
© CERN

experiments saw a plethora of PhD students passing through, including current researchers Chris Jones, Dave Robinson and Steve Wotton.

I also brought expertise in experiments that measure charge-parity (CP) symmetry violation to address the question 'why is our universe made of matter and not antimatter'? This provided impetus for Batley, Munday, White and Wotton to join the NA48 kaon experiment at CERN, for which they were responsible for large planes of muon detectors and associated high-speed electronics, and understanding kaon beam backgrounds. The muon detector was so large that White took great pleasure in constructing it in the Rutherford building stairwell. NA48 started taking data in 1997, discovering 'direct' CP violation in the process.

During the 1980s, CERN was already considering its next major project – the LHC – to search for the Higgs boson and physics beyond the standard model. Parker became a key player in the development of the ATLAS experiment, which Cambridge joined in 1992 to work on the semiconductor tracker with the expertise of Dave Robinson and later Bart Hommels. Construction on the LHC and ATLAS began in 1998 with first collisions in 2009.

While many ATLAS institutes searched for the Higgs boson, the Cambridge team made a strategic decision to seek out exotic new physics, including mini black holes, extra

“The muon detector was so large that White took great pleasure in constructing it in the Rutherford building stairwell.”

dimensions, supersymmetry (SUSY) and dark matter, developing strategies in collaboration with the Cambridge Phenomenology (then SUSY) Working Group. The ATLAS team expanded with the arrival of new academics: Mark Thomson who proposed an upgrade to the calorimeter trigger; and Christopher Lester who significantly enhanced the combined ATLAS/Phenomenology Working Group.

I was appointed to an academic position in 1994 and led Cambridge alongside Jones and Wotton into the LHCb experiment, designed to study charm and bottom quarks, make precision measurements of CP violation and search for new physics. The Cambridge team became major players in particle identification, providing readout electronics for the ring-imaging Cherenkov detectors, and the global pattern recognition.

The LHC scored its first major triumph with the discovery of the Higgs boson in 2012, resulting in a Nobel Prize for Peter Higgs and Francois Englert. Today, the ATLAS team continues its search for new physics and while conducting benchmark measurements of the standard model and the Higgs. Meanwhile, the LHCb team makes precision measurements of CP violation in B decays, has discovered very rare B decays and rattled the standard model with enticing anomalies.

Alongside the success of the LHC, the HEP group continued to expand. James Stirling arrived as Jacksonian Professor in 2008, becoming Head of the Cavendish in 2011. Parker succeeded Carter as Head of HEP in 2009 and Stirling as Head of the Cavendish in 2013. Stirling appointed me as Head of HEP in 2013. The HEP theory group also had new appointments: Ben Gripaios (2011) and Alex Mitov (2013), international leaders in theories of new physics and top quarks, respectively. With these appointments the theory group was in excellent hands when Webber retired in 2010 and Stirling became Provost of Imperial College London in 2013.

Thomson also expanded the HEP group’s research into neutrino physics, developing an event reconstruction tool, PANDORA, that identifies energy deposits from individual particles in fine granularity detectors, with applications in several neutrino experiments. Thomson took leave from Cambridge in 2018 to become Executive Chair of STFC and is currently the UK’s delegate for the next Director General of CERN.

The HEP group today stands at about 50 academics, post-docs, PhD students, engineers and technicians. Parker and I retired at the end of 2023, and Tina Potter took the reins as Head of HEP. As we move to the Ray Dolby Centre, the group remains very much at the heart of the LHC and neutrino experimental programmes. We also have significant roles in AI applications, searching for long-lived dark matter, and emerging quantum technology detectors. We also lead preparations for the Future Circular Collider at CERN and the Deep Underground Neutrino Experiment at Fermilab. Throughout our history, HEP has continued Frisch’s interest in developing particle detectors that get the best physics from experiments, nurturing a culture for collaboration between the theory and experiment, and producing world-leading physics results.

Val Gibson is an Emeritus Professor of High Energy Physics and former Head of the HEP Research Group. She was awarded an OBE in 2021 “For services to Science, Women in Science and to Public Engagement.

Your Cavendish memories

We asked our readers to share their recollections of their time at the Cavendish Laboratory, and received tens of submissions, from detailed memories to funny anecdotes (and even a love story). Here is a non-exhaustive selection. You can read more personal histories on our blog (phy.cam.ac.uk/blog) and social media channels.

Caught out!

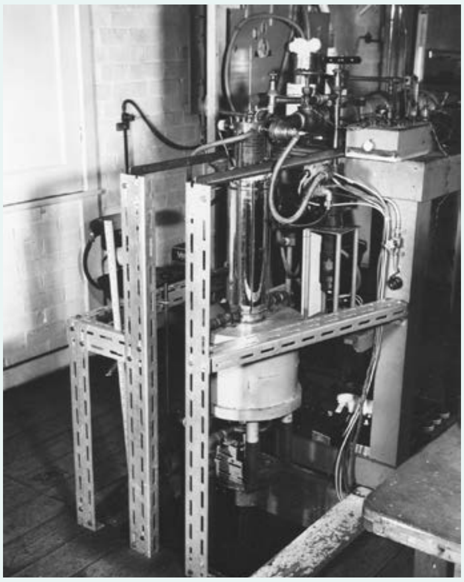
In 1966, I opted to do Part II Physics which required a Long Vac Term of 8 weekly experiments in the old Cavendish. I soon learned that you only needed to spend a day or so setting up the experiment and taking preliminary readings. You could look up the result in a text book and invent the rest of the readings, thereby freeing yourself to do what all proper undergrads should do - rowing and partying.

This went well until the final week when I looked up the wrong result and hence invented quite spurious readings.

When I got my write-up back from my supervisor, he had written in red ink a large "See me". Luckily it was the last day of term and I never had to face the music!

Perhaps this is why I forsook science for a career in finance.

David Ewart-James



Cryostat for cooling large volumes of superfluid helium below 1 K.

I was a research student in the Royal Society Mond Laboratory within the Cavendish from 1954 to 1957. I had the use of this unique cryostat developed by John Ashmead and Donald Osborne to cool relatively large volumes of superfluid helium below 1 K by adiabatic demagnetisation. At such temperatures, the phonon excitations within the liquid were shown to behave very much like a classical gas with a mean free path comparable to the size of the apparatus. The laboratory had its own helium liquefier and precise measurements were made against the clock by hand-balancing a potentiometer as the helium warmed up. Deliveries of liquid helium and automatic recording instrumentation were not then available.

It was a wonderful experience to be in the Cavendish at this time. We were well aware of developments in things like DNA, protein structure, radio astronomy, electron microscopy and the like but only later did I realise how significant these topics were and what a privilege it had been to be there.

Robert Whitworth

Cavendish Lab Fall 1988 – as seen from my regular biking approach from St Edmund's College.

On my very first day, Oct 1988, I was bidden to Head of Administration, a dignified person both in title, and all appearances; fully expecting a lecture on the importance of adhering to Lab regulations, safety, or some such. Quite contrary, the guy explained to me in some friendly length that the only reason for his existence was to help achieve *my* scientific goals and, to this end, serve me to the best of his, and his full department's, abilities. I was quite struck - there sat this Boss of some umpteen people, at least double my age, and told a 4th-year no-grader from abroad that he would do his damnedest to support him, not expecting anything *from* him. And the key to success is: he meant it!

Christian Naundorf

In 1974 I was at Newnham so the move to the new labs meant a less congested bike journey for morning lectures. Lecture rooms were lighter, more comfortable and I suspect most of us were pleased to know there was no mercury under the floorboards!

In my final year the new option of Medical Physics was introduced for the first time and I believe I was the first Cavendish student to undertake my final year project in the subject. The project supervisor was Dr P Dendy and my data on the calibration of the new technique of thermoluminescence dosimetry were used by the medical physics department at Addenbrookes for several years.
The only medical physics jobs available at the time were in Scotland and my Selwyn-physicist fiancé was heading for a teaching job down south. I thus ended up having a few years in biophysics – at one stage using pulsed NMR to study protein-water interactions in an experimental meat substitute now filling supermarket freezers as Quorn.

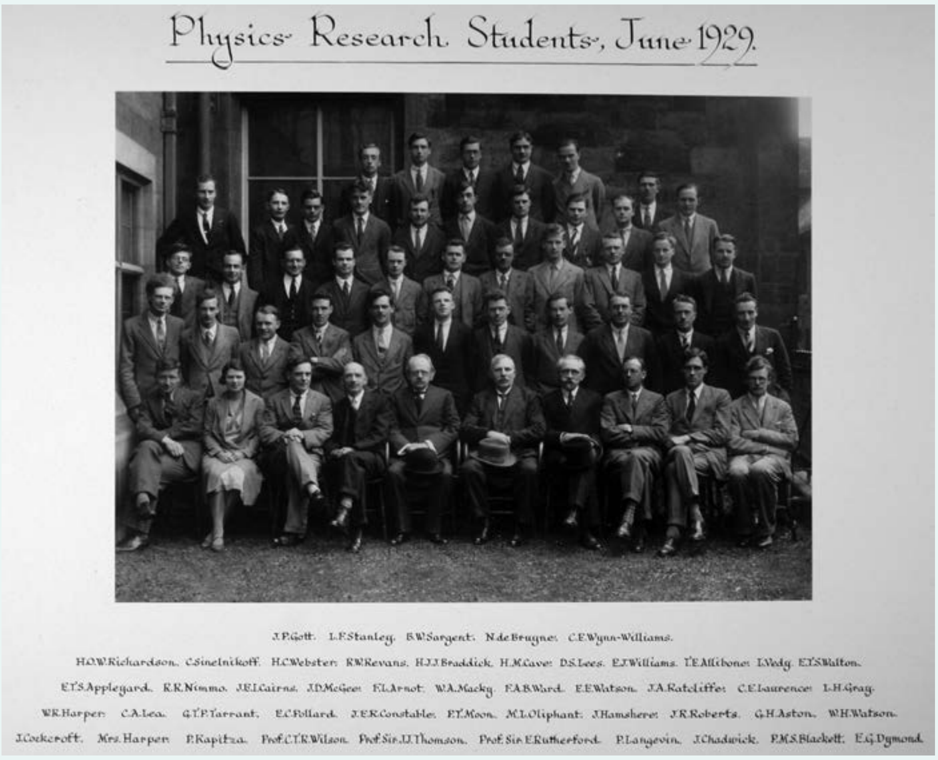
Another school move resulted in me swapping the very complex biological macromolecules for the relatively simpler synthetic versions and a PhD at Cranfield Institute of Technology (later Cranfield University). My main contribution was to the development of high performance resins for aerospace composites – a field I stayed in for over 30 years, rising through the academic ranks to full professor at the University of Bristol. I may never have understood, let alone remembered, much real physics but the resilience and analytical confidence gained in the years in the Cavendish have been invaluable.

Ivana Partridge
(nee Shott, Newnham 1972)

Every Wednesday we went to the Cavendish for sessions in Brenda Jennison's Physics Education room. Outside was an old desk with a cardboard folded notice saying "This desk belonged to Ernest Rutherford" and every Wednesday we'd all sit on the desk, hoping something would make us better Physicists.

The whole place was full of objects and people like that. Before coming up to Cambridge I had been a government scientist at the National Physical Lab and I had used Josephson junctions to define the volt and every Wednesday Brian Josephson would be sat in the canteen, usually with Sir Neville Mott. It was like being let into a Physics theme park made real.

Steven Chapman
(Postgraduate student, 1993/94)



Wallace Harper, first left in the second row and Gladys (Mac) Harper, front row second from left at the Cavendish in 1929.

A brief history of a physicist couple from the Cavendish

My grandparents, Gladys Isabel Mackenzie Harper (Mac) and Wallace Russell Harper, met and were married while studying in the Cavendish Laboratory in the late 1920s, a time when my grandmother was often the only woman in pictures with dozens of men. She came from Edinburgh to study at the Cavendish under Professor Lord Rutherford and Dr J. Chadwick with a Newnham College Fellowship and Lectureship. However, she was awarded her PhD by the University of Edinburgh since Cambridge did not confer PhD degrees to women at that time. In 1930 she co-authored a paper with visiting researcher Esther Salaman (*G.I. Harper and E. Salaman. 1930. Measurements on the ranges of alpha-particles. Proc. Roy. Soc. A127: 175-185*), which might be the first paper in physics co-authored by two women. My grandparents enjoyed cars, dancing, skiing and travelling – they wrote a series of letters about dancing and seeing a Grand Prix car race from a trip to Germany in 1936 just before the war. At that time they were living in Bristol working at Bristol University and had a son (my father, Colin) soon after. During the war Wallace worked on radar in the Admiralty and Mac apparently ran the Physics Department at the University of Bristol while the men were away at war. Later in her 70s Mac was a part-time lecturer in Physics at Queen Elizabeth College in London. Wallace wrote a couple of textbooks including 'Contact and Frictional Electrification', a mystery novel about a murder in a Physics laboratory 'Scientists Under Suspicion' and a play about the safety of nuclear energy 'Not for a Cat' – to be produced at the 2025 Cambridge Festival!

Karen Harper
Granddaughter and professor in Biology and Environmental Science, Saint Mary's University, Halifax, Canada

Frozen to the spot

I was a PhD student in the Low Temperature Physics group from 1977 to 1980. To reach temperatures to within a degree of so absolute zero it was necessary to have a double cryostat; the outer containing liquid nitrogen (77K) the inner liquid helium (4.2K). By reducing the pressure above the liquid helium temperatures of around 1.3K could be achieved.

To reach such low temperatures was a slow process. The liquid nitrogen would be added in the morning with the liquid helium following in the late afternoon; the actual experimental data being collected from then until the early hours of the next morning.

After normal working hours, the Cavendish was patrolled by Securicor. One night, I was busy collecting data when I heard a loud, low pitched *grrrr*. Turning round, I saw an Alsatian at the open door staring directly at me baring its large, sharp teeth and poised to attack. I froze, terrified. After what seemed like an eternity, the handler arrived saying the less than comforting words "Don't move and you'll be OK". Believe me, I had no intention of moving!

Once back on its lead, my heart rate slowly returned to normal and I was able to continue my work but the image of that dog, poised to attack, remains with me to this day.

Keith Gilroy
(Churchill College alumnus)

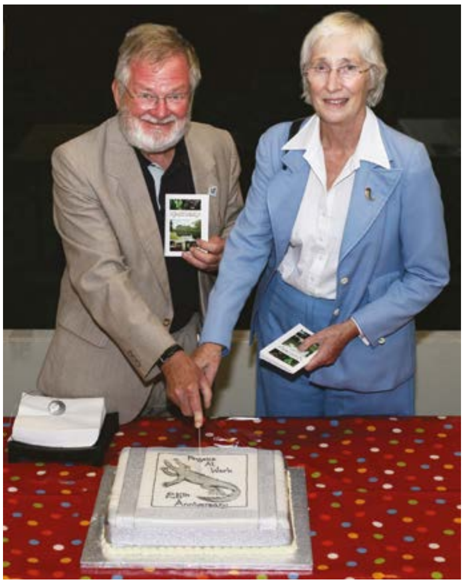
A potted history of Cavendish outreach

Lisa Jardine-Wright and Nicki Humphry-Baker

From the pioneering work of Brenda Jennison to the ever-evolving programme run by today's outreach team, Lisa Jardine-Wright and Nicki Humphry-Baker trace the history of the Cavendish Laboratory's work to inspire the next generation of physicists.

The Cavendish Physics Outreach programme is probably the longest running outreach initiative in the country, if not in the world. For more than 40 years, Cavendish Outreach has been working with students and teachers, raising students' aspirations to study physics at the next stage of their career and supporting teachers to build their students' confidence and deliver inspiring lessons.

It all began with the pioneering work of Brenda Jennison MBE who trained physics teachers in the Cavendish Laboratory, rather than at the Faculty of Education. Outreach was not a common term used around this time and the 'programme' began with a series of meetings for local physics teachers to discuss teaching ideas and to provide mutual support and enthusiasm over a cup of tea and a biscuit or a cake. These later developed into a lecture series especially for teachers and their students hosted by the Cavendish – The Cambridge Physics Centre Lectures. The first lecture was given on the 3rd October 1979 by O Heavens and M Ebison about 'Careers in Physics'. These lectures encouraged up and coming researchers to talk about their work, providing not only inspiration for the next generation but enabling researchers to develop and hone their communications skills. The series is still going strong and has a history of eminent speakers including Stephen Hawking, Athene Donald, Brian Pippard, Herman Bondi and Simon Singh. The series continues and this year's programme can be seen at **outreach.phy.cam.ac.uk/programme/cpc**



In 1984, Mick Brown returned from an IOP meeting and spoke with Brenda about the idea of running exhibitions at universities to demonstrate the applications of physics in research and industry to school students. That same year Physics at Work was born at the Cavendish, whose milestone 40th anniversary will be celebrated at an event in the Ray Dolby Centre next year.

On her appointment in 1970, Brenda aimed to address these problems by:

- Training more good physics teachers.
- Providing schools with lectures on cutting edge science to inspire students and teachers alike.
- Enabling students to experience 'the point of physics' and its wide range of potential applications.
- Showing that physics is for everyone, irrespective of background, gender or ethnicity.

These aims are still poignant and central to our strategy.

The Cambridge Physics Centre Lectures and Physics at Work continue to be flagship events of Cavendish Outreach in a landscape where what it means to 'do outreach' has significantly evolved. Sadly, the problems for physics education in schools have not improved as much as might have been hoped given the effort and resources that has been put into outreach over the last 30 to 40 years. The number of students studying physics remains lower than they were in the 1950s, although 2024 has shown a glimmer of hope with a 12% increase in the number of students taking A level physics in England. However, there was little movement on the proportion of women taking A level physics which remains at around 23%. There continues to be a shortage of physics graduates going into teaching, resulting in more than 20 years of under-recruitment, compounded by the fact that too many new teachers leave after a relatively short time. The National Foundation for Educational Research school workforce census data shows that about 10% of science and mathematics teachers leave the teaching profession each year.[1]

When I [Lisa] began in educational outreach at the Cavendish in 2006, I was able to review our offer and consider what other initiatives we might include in our portfolio. Arranging a scientist to visit a school is a lot easier logistically for teachers than arranging a school trip but experience had shown that visiting a university department was a key factor in encouraging future undergraduates and changing their perspective that 'it is just not for me'.

We began two new programmes, one for teacher continuing professional development and one for their students – the Cambridge Physics Experience. The Cambridge Physics Experience (CPE) was designed to address two factors. The first factor was meeting the need from Cambridge colleges to provide departmental visits and experiments for their visiting school students. Secondly, to provide a sustained programme of multiple interventions and engagements for students as they progress through their secondary education from year 7 to 11 and on to sixth form. It is perhaps unsurprising that research has shown that one off interventions can be inspirational but struggle to achieve long term impact or to change student perspectives. CPE engages students regularly throughout their education, embedding the impact of our work.

The Cambridge Physics Experience continues today with half-day interactive experiences for students in year 7, 8, 9 (key stage 3) and year 12 (sixth form) with Physics at Work providing an interactive experience for year 10 and 11 students. The original objective of the Cavendish outreach programmes was to provide opportunities for those schools and students within a sensible travel time of Cambridge – perhaps up to a 70-mile radius. However, the programmes have become so successful that schools are travelling from far and wide.

Brenda's legacy lives on through her donation to provide funding for_travel bursaries and teacher cover bursaries for schools and students who would otherwise struggle to be able to attend our events. **(outreach.phy.cam.ac.uk/bursaries)**

The evolution of the Cavendish's outreach continues, endeavouring to increase the flow of budding physicists with new programmes for primary schools delivered by the current outreach team of Jacob Butler, Steve Martin and Nicki Humphry-Baker. These programmes aim to counter the drop off in interest in science that occurs in early secondary. Locally, primary school teachers are offered training and class sets of experiments to nuture the scientific inquisitivenouss in primary school students, so that they can build on that as they progress through secondary school.

Further afield, a primary programme with similar aims called Think Like a Scientist is developed with primary schools in Rochdale in collaboration with the University of Cambridge's Admissions Office, the University of Oxford and the Rochdale local authority. This programme will take a cohort of students chosen from primary schools in Rochdale and build their skills and confidence in the physical sciences throughout a year-long series of activities. Both programmes will raise aspirations, while giving the students the tools to achieve their ambition, which is an idea that runs through all of the outreach programmes. The pipeline of future physicists is vital for our UK economy and long may the Cavendish continue to encourage the next generation of problem solvers and world-leading scientists

1. www.nfer.ac.uk/media/2044/nufs01.pdf

Students' reactions to Cavendish Outreach Events

'Now I am definitely likely to pick physics for my GCSE's. Also the speeches which were given really inspired me to actually try really hard in my physics.'

'I found out that Physics has a huge variety of uses that I never knew about. I am definitely more interested in it and I really enjoyed the visit.'

Y9 Visitors

'The tour of the museum in Cavendish labs really emphasized the impact that physics has had on our society. I found it really inspiring.'

'It showcased what living in a university would be like, which I found incredibly inspiring.'

Y12 visitors

'I was really worried about staying away from home but now that I see the opportunities and good atmosphere this factor seems smaller.'

Two different Y11 visitors

PHOTOS, LEFT TO RIGHT:

Brenda Jennison and Mick Brown in 2009 celebrating the 25th Anniversary of Physics at Work.

Dara Ó Briain getting in on the 25th Anniversary Physics at Work action.

Example of school locations of those visiting Cambridge Physics Experience events.

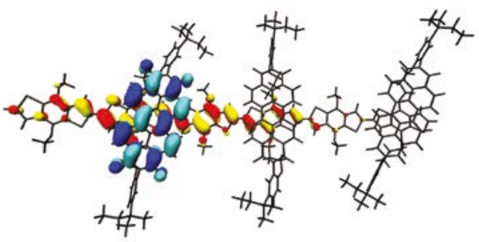
Research news

Sound and vision – how photoacoustics could transform cancer detection and monitoring

Cambridge physicists, led by Sarah Bohndiek are developing devices that go beyond the visible spectrum for cancer detection. Photoacoustic imaging captures ultrasound produced when light is absorbed by matter and heats up. This approach is especially valuable for measuring blood oxygen levels – a key indicator for cancers, which often have lower oxygen levels.

However, there is a challenge: it doesn't work as well on darker skin tones due to melanin absorbing light, leading to inaccurate readings and lower-quality images and potentially causing misinterpretation of scans. To tackle this, Bohndiek and her team at the VISION Lab are trying to improve the technology to ensure it's effective for all skin tones.

Better arranged molecules improve solar panel efficiency

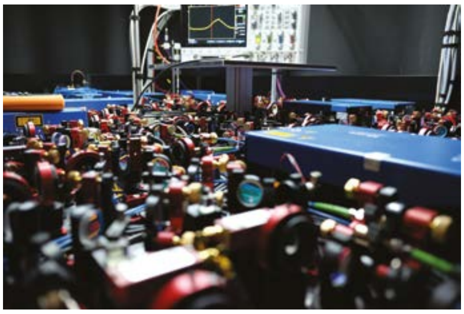


ABOVE: Top view of organic model-interface simulation. Credit: Hanbo Yang and Jarvist Frost.

A study published in Nature Chemistry by Hugo Bronstein and colleagues from Imperial College and Queen Mary University reveals that varying molecular arrangements in organic solar cells can enhance light absorption, potentially leading to better and cheaper solar panels. While organic solar cells are lightweight, flexible, and cost-effective, their efficiency has traditionally lagged behind silicon-based cells due to their complex molecular structures. The researchers have developed new model interfaces to study these structures in detail, demonstrating that their arrangement significantly affects electric charge separation, a key factor for improving solar cell performance.

Discovery of a 2D new phase of matter that defies normal statistical mechanics

Researchers led by Ulrich Schneider have created the first 2D version of a Bose glass, a novel phase of matter that challenges statistical mechanics. In a Bose glass each particle in the system sticks to itself and are localised, not mixing with its neighbours. If coffee was localised, then after stirring in milk the intricate pattern of black and white stripes would remain forever.



ABOVE: Close-up of a laser table in the lab. Credit: Many-body Quantum Dynamics Lab

The team used overlapping laser beams to create a quasiperiodic pattern – structured like a crystal but non-repeating – into which they introduced ultracold atoms at near absolute zero, leading to the formation of the Bose glass. Their study was published in Nature.

Five hubs launched to ensure UK benefits from quantum future

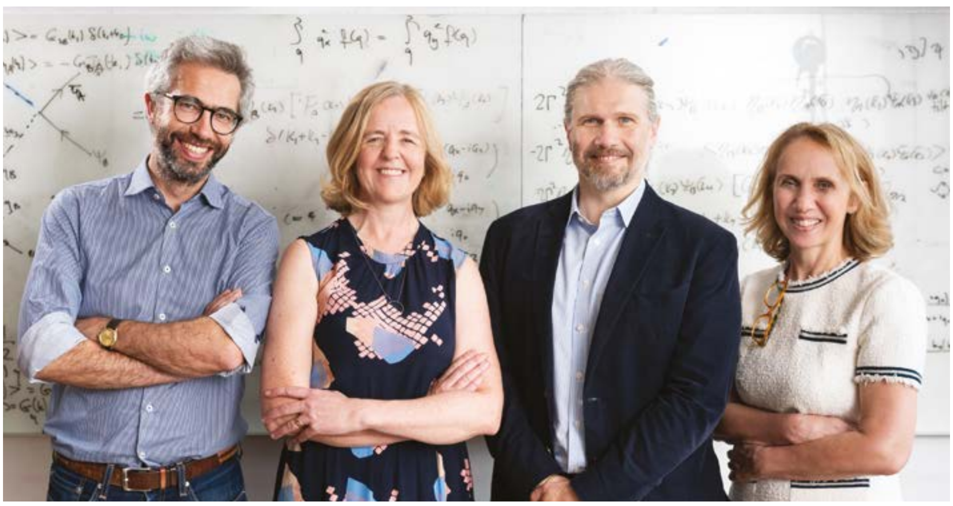
A new research hub called Q-BIOMED led by Cambridge and UCL aims to harness quantum technology for early disease diagnosis and treatment. It is one of five quantum research hubs announced by the government last summer and supported by £160 million in funding.

Co-directed by Mete Atatüre, the hub will exploit advances in quantum sensors capable of detecting cells and molecules with much greater sensitivity than traditional methods. This includes developing portable blood testing instruments to diagnose infectious diseases and cancer quickly and cheaply, and sensors measuring tiny changes in the magnetic fields in the brain that could potentially detect early markers of Alzheimer's disease.

Cavendish researchers are also participating in three other quantum hubs that will transform sectors such as healthcare, communications and security.

Find more information about this research and many more news articles on our website: **phy.cam.ac.uk**

BELOW: L-R: John Morton (UCL), Rachel McKendry (UCL), Mete Atatüre (Cambridge), Eleni Nastouli (UCL). Credit: James Tye/UCL



Department news

Tribute sculpture unveiled in honour of Brian Josephson

A tribute sculpture titled 'The First Atom in the Universe II' was unveiled in the TCM seminar room to honour Nobel Laureate Emeritus Professor **Brian Josephson**. The unveiling ceremony was attended by Brian Josephson himself, alongside the artist, Nigel Fleming, Mete Atatüre, Head of the Cavendish Laboratory, and many members of the TCM group.

'The First Atom in the Universe II' symbolises hydrogen as the 'Mother of all matter,' highlighting the origins of elements and life from cosmic processes. Hydrogen, the universe's first atom, is the cornerstone from which all atoms and isotopes in the periodic table were formed. These atoms were constructed through combinations of hydrogen atoms within the furnaces of distant stars and subsequently dispersed across the cosmos by supernova explosions. These elements then engaged in chemical reactions to form complex compounds, eventually leading to the transition from chemistry to biology, giving rise to the diverse array of life.

The sculpture poignantly depicts the hydrogen atom's crucial role in the creation of matter. Its intricate design, featuring the 'popcorn effect' in the electron orbitals, vividly illustrates the constant creation and destruction of quantum matter, driven by gauge force fields that swirl around matter.

ABOVE: Head of Department Mete Atatüre, Brian Josephson and artist Nigel Fleming

LEFT: The first Atom in the Universe II

Tomi Baikie announced as one of the 2024 Schmidt Science Fellows

Tomi Baikie, former Research Fellow at the Cavendish in Akshay Rao's group, has been announced as one of the thirty-two scientists comprising the 2024 Schmidt Science Fellows cohort.

Schmidt Science Fellows are early-career researchers who drive transformative change across various sectors through their interdisciplinary research. As a 2024 Schmidt Science Fellow, Tomi will pioneer new understanding of how the body works through non-contact electrical measurements. Our skin has a map of different electric potentials. But it is not known why these exist, primarily because they are very difficult to measure. By translating techniques from the world of semiconductor physics, Tomi aims to measure these maps without even touching the skin. The work has direct implications for people who suffer from the death of small nerve fibres.

The fellows undertake a year-long Science Leadership Program to develop the skills, experience and networks necessary to become the next generation of interdisciplinary science leaders alongside a one to two-year research placement at a new institution, which will kick off later this year.

Tomi will be moving to MIT for his work and will additionally hold an affiliation with the Cavendish Laboratory during this period.

Isaac Physics team hosts 10th annual Teacher Symposium

The Isaac Physics team was delighted to welcome 75 UK secondary school teachers to its tenth annual Teacher Symposium in July. Teachers were shown the latest features to enable them to support learning in their schools using the Isaac Physics platform.

Isaac Physics tenth annual Teacher Symposium

They were especially enthusiastic about the new resources prepared for age 11-13 students to build numerical intuition for physics concepts, as well as new resources for the sixth form teaching of Chemistry and Biology as well as GCSE and sixth form mathematics. Teachers also enjoyed four sessions of physics problem solving with Isaac Physics' Director, Lisa Jardine-Wright, and a plethora of demonstrations thanks to Project Physicist Robin Hughes.

There were many opportunities to share good practice within the very positive atmosphere of the event, which is regarded as the highlight of the year for many teachers and 'the best CPD ever' by at least one participant! The costs of attending (including food and accommodation) were covered by the Isaac Physics team enabling teachers to attend even at a time of tight school budgets.

Top Physics student wins Prize for exceptional theoretical physics work

Many congratulations to **Ziyou Lu** (above), who has been awarded the Mark Warner Prize for talented theoretical physicists, for his outstanding work in Experimental and Theoretical Physics in his 3rd year of the Natural Sciences Tripos.

The prize, sponsored by The Ogden Trust, is awarded in memory of Professor Mark Warner, FRS, theoretical physicist, and pioneer in the field of liquid crystal elastomers who inspired and mentored generations of physicists.

Reflecting on his love of physics, Ziyou, who is a 3rd-year Physics student at Trinity College, said: "Initially, I was drawn to physics as it felt the most quantitative and concrete out of the sciences in high school. As I learned more, I started to appreciate the role of mathematics in physics more. Finding applications of abstract mathematical topics like group theory in physics is always surprising and often leads to very beautiful results."

Cambridge Welcomes QuanTour: A Quantum Journey Across Europe

The Cavendish Laboratory is excited to be the host of QuanTour, an exciting European outreach initiative celebrating the International Year of Quantum Science and Technology 2025.

QuanTour brings a cutting-edge quantum light source to 12 top laboratories working on quantum dots across Europe. It aims to provide insights into quantum communication research and promote public engagement with quantum science's transformative potential.

Cambridge is the 6th stop on the journey, marking its halfway point. Arriving directly from the Centre de Nanosciences et de Nanotechnologies in Paris, the light source will be hosted in **Mete Atatüre's** and **Dorian Gangloff's** labs for a few weeks in October.

At the heart of the experience lies the quantum light source that produces single photons – the smallest quantity of light. "The quest of producing single photons keeps scientists around the world engaged. Here, these single photons are generated by a quantum dot – a tiny structure made of semiconductor material," said Mete Atatüre, head of the Quantum Optical Materials and Systems Research Group and 'QuanTour Hero'.

"Its size is just a few nanometres – think of it like the size of a tennis ball compared to the Earth. The quantum dot is embedded in a bull's eye-like structure, designed to get those photons out."

At every lab along the QuanTour journey, hosting scientists are carrying out measurements on the quantum light source to check whether it is actually emitting individual photons. "We also want to use this opportunity to give the public a peek behind the curtain at how quantum physicists work, and show how quantum technologies will lead to groundbreaking advancements in our society that will shake up our everyday life," said Atatüre.

QuanTour is a project of the German Physical Society (DPG), organised by Dr Doris Reiter (TU Dortmund University, and Dr Tobias Heindel (TU Berlin University)

Congratulations to Cavendish staff reaching 25 years of service

We would like to express heartfelt gratitude to our 10 staff members who have dedicated 25 years to the Cavendish and are marking this impressive milestone this year: **Mark Ashdown** (Astrophysics), **Harvey Beere** (Semi-Conductor Physics), **David Buscher** (Astrophysics), **John Ellis** (Surfaces, Microstructure and Fracture), **Debbie Hall** (Finance), **Christopher Jones** (HEP), **Barry Shores** (Technical Services), **Vladislav Stolyarov** (Astrophysics), **Martin Underwood** (Stores), and **John Young** (Astrophysics).

Some of them, along with their guests, joined the Vice-Chancellor, Professor Deborah Prentice, at a celebratory event held at the Cambridge Union Society in the summer.

In her speech, the Vice-Chancellor took a moment to reflect on the world as it was in 1999, highlighting how both the University and the global landscape have transformed over the years.

She thanked staff for their commitment and service to the University, recognising their vital role and experience. "A university can only be as good as its people – Cambridge is an excellent university, and we rely on excellent people," she said.

"Reaching this milestone of 25 years is not just about longevity, or persistence. It is also about embodying the culture of the place. In an institution as complex as collegiate Cambridge, experience counts for a lot, and you are the keepers of that institutional memory."

Farewell to Nevenka Huntic

Nevenka Huntic with Richard Batley (left) and Richard Ansorge (right), both former academic librarians.

Nevenka Huntic retired from her post at the Rayleigh Library earlier this year after nearly 25 years of dedicated service in the Physics Department. A farewell event was held in the Cavendish Common Room, where colleagues gathered to celebrate her contributions over coffee and cake.

Nevenka's tenure at Cavendish has been distinguished by significant achievements and deep professional relationships. Reflecting on her career, she remarked, "I felt welcomed from the start. Everybody was so nice and friendly, which was the main reason why I stayed for 25 years."

As a trained architect and librarian, Nevenka used her dual expertise to redesign the layout of the Rayleigh Library upon her arrival in 1999, enhancing its functionality and aesthetics. More recently, she played a crucial role in changing the layout of the future library in the Ray Dolby Centre to provide to provide an exceptional resource and study environment for current and future generations of physics staff and students.

We thank Nevenka for her incredible contribution over the years and wish her all the best for the future!

Mariusz Naguszewski from the Cryogenics Facility retires

Mariusz Naguszewski retired from the Cavendish in May this year. Dan Cross, Cryogenics Facility Manager, has shared the following about him:

"Mariusz has been with us since 2010 and has been invaluable in keeping the Cryogenics Facility going – always with a smile and a joke and nothing was ever too much trouble. He will be missed but we're happy to see him go to his idyllic dotage back in native Poland – even though he'll probably be working even harder on the family smallholding (if that was possible)!"

We wish Mariusz the very best for the future.

Teuta Pilizota joins Cavendish Laboratory

We are delighted that Professor **Teuta Pilizota** joined the Department in September.

Teuta obtained her diploma in physics at the University of Zagreb before moving to do a DPhil in single-molecule biophysics of rotary molecular at the University of Oxford. After completing postdoctoral work from the Princeton University, where she established the experimental and theoretical framework needed to study bacterial pressure regulation at a single-cell level, she joined University of Edinburgh. She has been leading her research group at the University of Edinburgh since 2013, focusing on free energy regulation in bacterial cells.

Teuta has recently secured a prestigious Human Frontier Science Program (HFSP) grant to study the physico-chemical forces within bacterial cells that affect growth and survival. She will begin this collaborative research here at the Cavendish Laboratory alongside an international team of researchers. The study will focus on how the environment created inside bacteria effectively raises/lowers the temperature and influences the rate at which all reactions occur. The team hopes to shed light on this little-explored yet fundamental relationship between the intracellular physico-chemical environments and the overall rate of cell growth.

We extend a warm welcome to Teuta as she embarks on this exciting new chapter of her research with us during our significant 150th anniversary year.

New appointment to the Professional Staff

Rob Ingram-Brown – HR Manager

Rob Ingram-Brown joined the Cavendish Professional Service team on 1st July 2024 as our new HR Manager.

Rob has over 30 years' experience in HR, having previously headed up teams in the chemical, manufacturing and pharmaceutical industries. During his career Rob and his teams have provided a full HR service to a wide range of employees including some 2000 strong scientific community at Johnson Matthey.

Other appointments

Louise Basham – Maxwell Centre Administrator
Dmitrii Buravlev – Procurement Supervisor
Debbie Fatibene – Purchasing Administrator
Khin Mon – System Developer/Administrator
Kevin Robinson – Senior Stores Assistant
Vicki Sparkes – Mott Hub Manager

“We have the keys!”

The Ray Dolby Centre construction reached completion in May, a significant step in the University's vision to transform the Cambridge West Innovation District into a connected, beautiful and sustainable place, open to all.

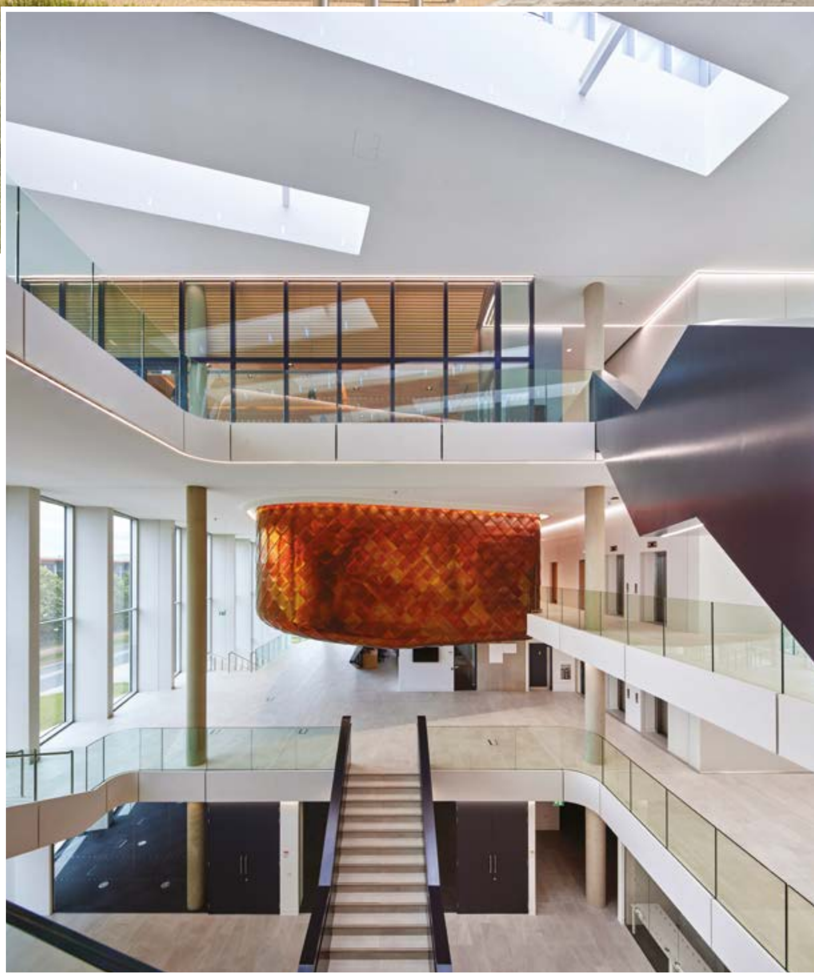
The stage is now set for this state-of-the-art building to transform scientific research and teaching, and significantly enhance the Cavendish’s world-leading facilities.

In recent months, attention has turned to the upcoming relocation of around 1,100 Cavendish staff members and students. This move involves the careful migration of research laboratories, scientific equipment, technical instruments, and undergraduate teaching laboratories.

“This landmark building, several years in the making, is built to serve our community, the University, the city, and the country,” said Mete Atatüre, Head of the Cavendish Laboratory. “It will help to foster the passion and excellence that our staff and students demonstrate in their work, while providing access to our best-in-class equipment, resources and expertise to any university or industry researcher.

“It is incredibly satisfying to see the practical completion of this impressive building and now we must bring it to life. Our move is a hugely complex task that we have carefully planned, and we are impatient to get to this final stage.”

The Ray Dolby Centre is expected to be fully operational by the summer of 2025, with an official opening ceremony slated for spring, coinciding with our 150th anniversary celebrations.



ABOVE LEFT:
Handover: (L-R) Peter Norman (RDC Project Team), Sam Stokes (RDC Project Lead), Mete Atatüre (Head of the Cavendish Laboratory), Marie Chuet (Bouygues UK), Matt Allen (Estates Division) and David Hunt (RDC Project Team).

ABOVE RIGHT:
Exterior view of the Ray Dolby Centre.
© Ståle Eriksen / Jestico + While

BELOW RIGHT:
Atrium.
© Paul Raftery / Bouygues UK

CavMag goes digital

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We are accompanying this launch with a new Alumni e-newsletter, which will be sent to you around the same time as CavMag arrives in your mailbox, to highlight some of the exciting articles included in the newest issues.

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Tell us what you think

We will continue developing this platform over the coming year to improve it even further for our next issue in the autumn. If you have any feedback, please get in touch to let us know what you think at **cavmag@phy.cam.ac.uk**

How you can contribute

Online giving

The University's Office for Development and Alumni Relations (CUDAR) has made it easier to make donations online to the Department and to two of our special programmes. If you wish to make a donation to the Department, please go to: **campaign.cam.ac.uk/giving/physics**

If you wish to support the graduate student programme, please go to: **campaign.cam.ac.uk/giving/physics/graduate-support**

If you wish to support our outreach activities, please go to: **campaign.cam.ac.uk/giving/physics/outreach**

If you would like your gift to be applied to some other specific aspect of the Development Programme, please contact the Head of Department.

A gift in your will

One very effective way of contributing to the long-term development of the Laboratory's programme is through the provision of a legacy in one's will. This has the beneficial effect that legacies are exempt from tax and so reduce liability for inheritance tax. The University provides advice about how legacies can be written into one's will. Go to: **campaign.cam.ac.uk/how-to-give** and at the bottom of the page there is a pdf file entitled **A Gift in Your Will.**

It is important that, if you wish to support the Cavendish, or some specific aspect of our development programme, your intentions should be spelled out explicitly in your will. We can suggest suitable forms of words to match your intentions. Please contact Samantha Stokes (**departmental.administrator@phy.cam.ac.uk**) who can provide confidential advice.

If you would like to discuss how you might contribute to the Cavendish's Development Programme, please contact Mete Atatüre (**hod@phy.cam.ac.uk**), who will be very pleased to talk to you confidentially.

Contact

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