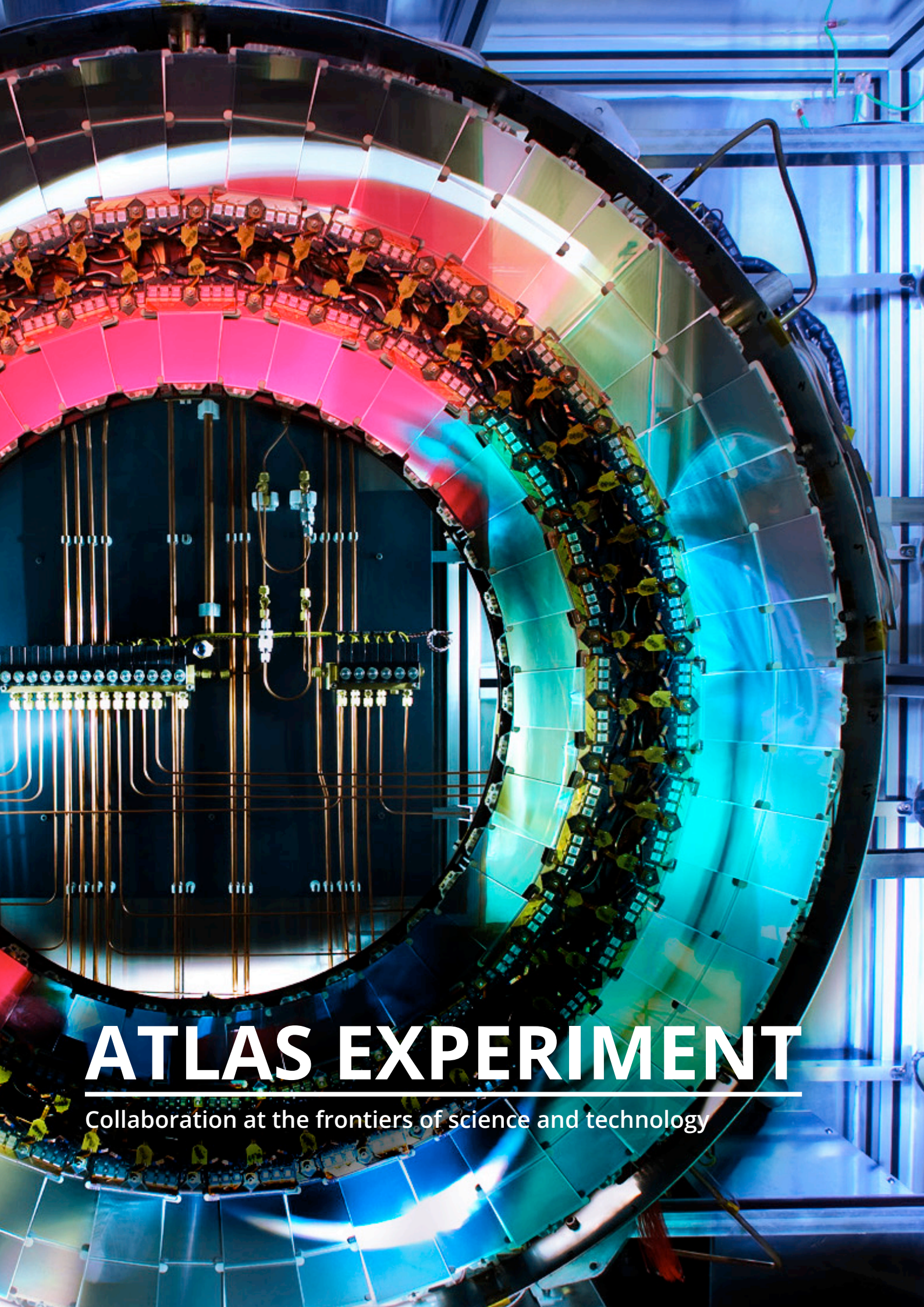


ATLAS EXPERIMENT

Collaboration at the frontiers of science and technology

AT THE FRONTIERS OF SCIENCE & TECHNOLOGY

The ATLAS experiment at CERN's Large Hadron Collider (LHC) explores the physics of fundamental particles and forces at the energy frontier, thus extending the boundaries of current knowledge. An important milestone was reached with the discovery of the long-sought Higgs boson in 2012.

However, many profound questions in particle physics, deeply related to the nature of our Universe, remain unanswered. The exploration of particle collisions at the highest energies and highest intensities might resolve some of these questions, and may lead to further ground-breaking discoveries in the years to come.

The unprecedented experimental challenges faced by ATLAS require the advancement of technology in electronics, computing and data processing. Work is carried out by a global collaboration of scientists, engineers and technicians. The stimulating international environment of ATLAS and CERN, combined with work on the frontline of physics and technology, form an exciting scientific endeavour that offers a unique training ground for students and young researchers.

Karl Jakobs
ATLAS Spokesperson
June 2018

ATLAS is a global collaboration pushing the boundaries of scientific research.

ABOUT ATLAS

ATLAS is a general-purpose particle physics experiment at the Large Hadron Collider (LHC) at CERN. It is designed to exploit the full discovery potential of the LHC, pushing the frontiers of scientific knowledge. ATLAS is seeking to answer fundamental questions: What are the basic building blocks of matter? What are the fundamental forces of nature? What is dark matter made of?

COLLABORATION

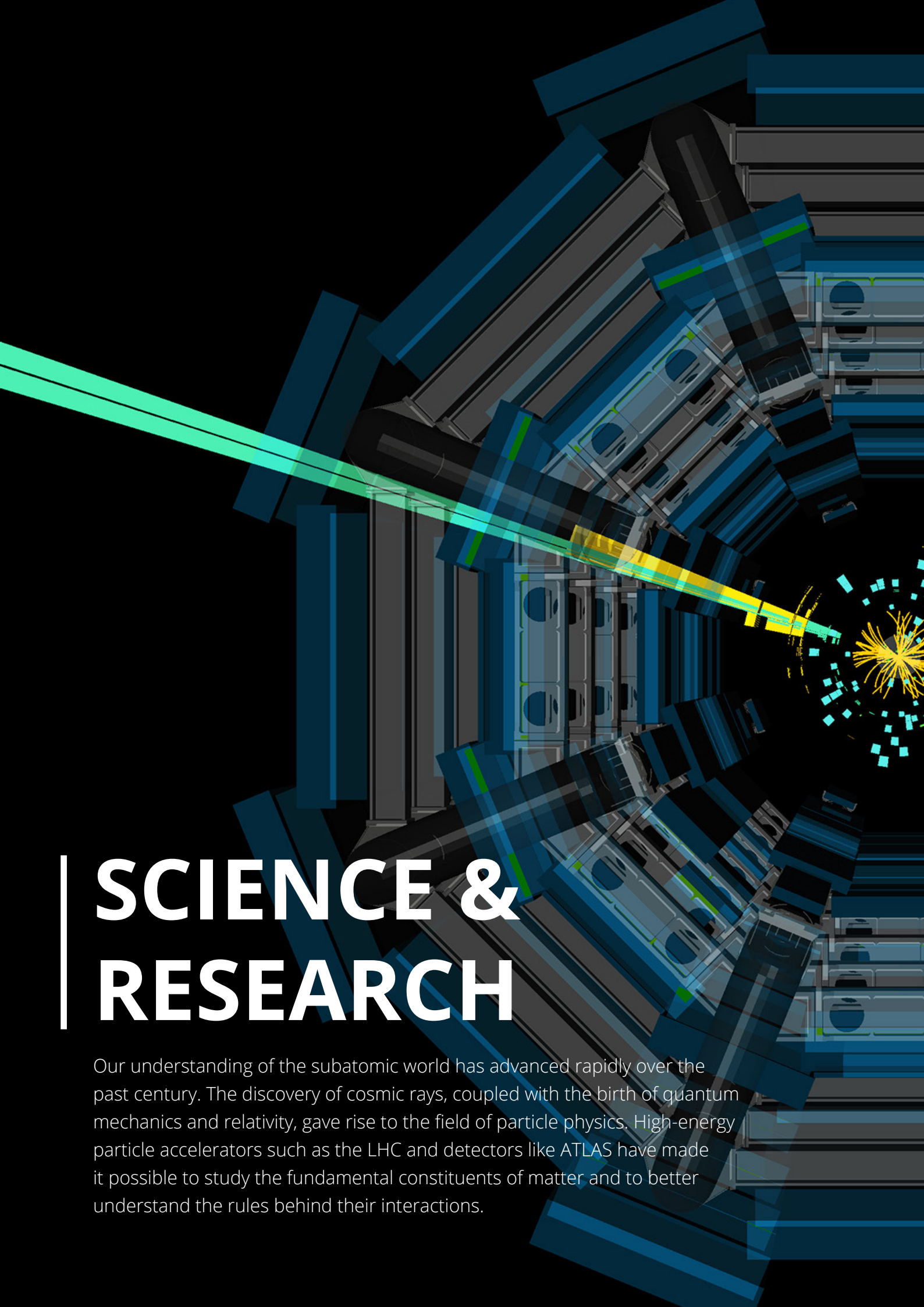
ATLAS is run by a collaboration of physicists, engineers, technicians and support staff from around the world. It is one of the largest collaborative efforts ever attempted in science, with over 5000 members and almost 3000 scientific authors. The success of ATLAS relies on the close collaboration of research teams located at CERN, and at member universities and laboratories worldwide.

EXPERIMENT & TECHNOLOGY

ATLAS is the largest detector ever constructed for a particle collider: 46 metres long and 25 metres in diameter. Its construction pushed the limits of existing technology. ATLAS is designed to record the high-energy particle collisions of the LHC, which take place at a rate of over a billion interactions per second in the centre of the detector. More than 100 million sensitive electronics channels are used to record the particles produced by the collisions, which are then analysed by ATLAS scientists.

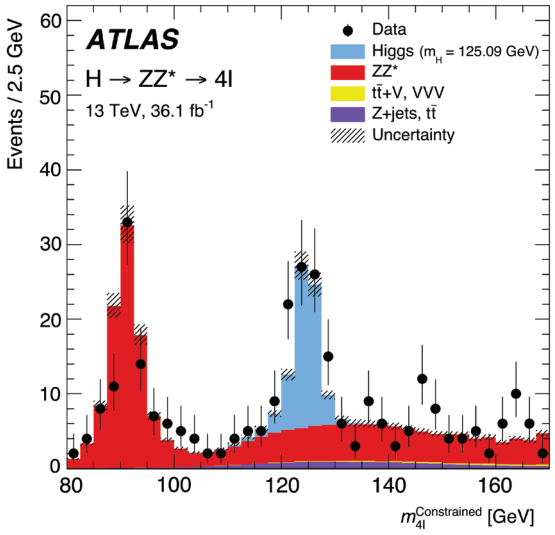
JOIN ATLAS

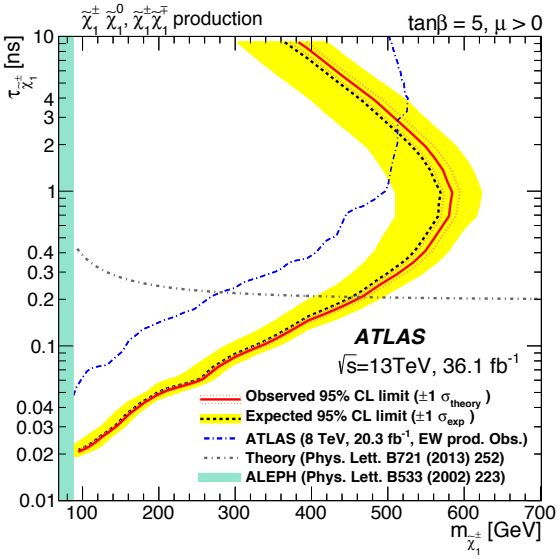
Increase the global visibility of your institution by becoming part of ATLAS. The ATLAS Collaboration welcomes new collaborators for long-term engagement in the experiment. The different kinds of participation are described in this brochure. In case of interest, you are encouraged to contact the ATLAS Spokesperson.



SCIENCE & RESEARCH

Our understanding of the subatomic world has advanced rapidly over the past century. The discovery of cosmic rays, coupled with the birth of quantum mechanics and relativity, gave rise to the field of particle physics. High-energy particle accelerators such as the LHC and detectors like ATLAS have made it possible to study the fundamental constituents of matter and to better understand the rules behind their interactions.





STUDYING THE STANDARD MODEL

Our current best description of the Universe – based on quantum field theories – is summarised in the Standard Model. This theory describes all known elementary particles and the forces that govern their interactions, except for gravity. ATLAS is studying the properties and interactions of these particles to a high level of precision, in order to improve our understanding of the theory and to test its limits.

EXPLORING THE HIGGS SECTOR

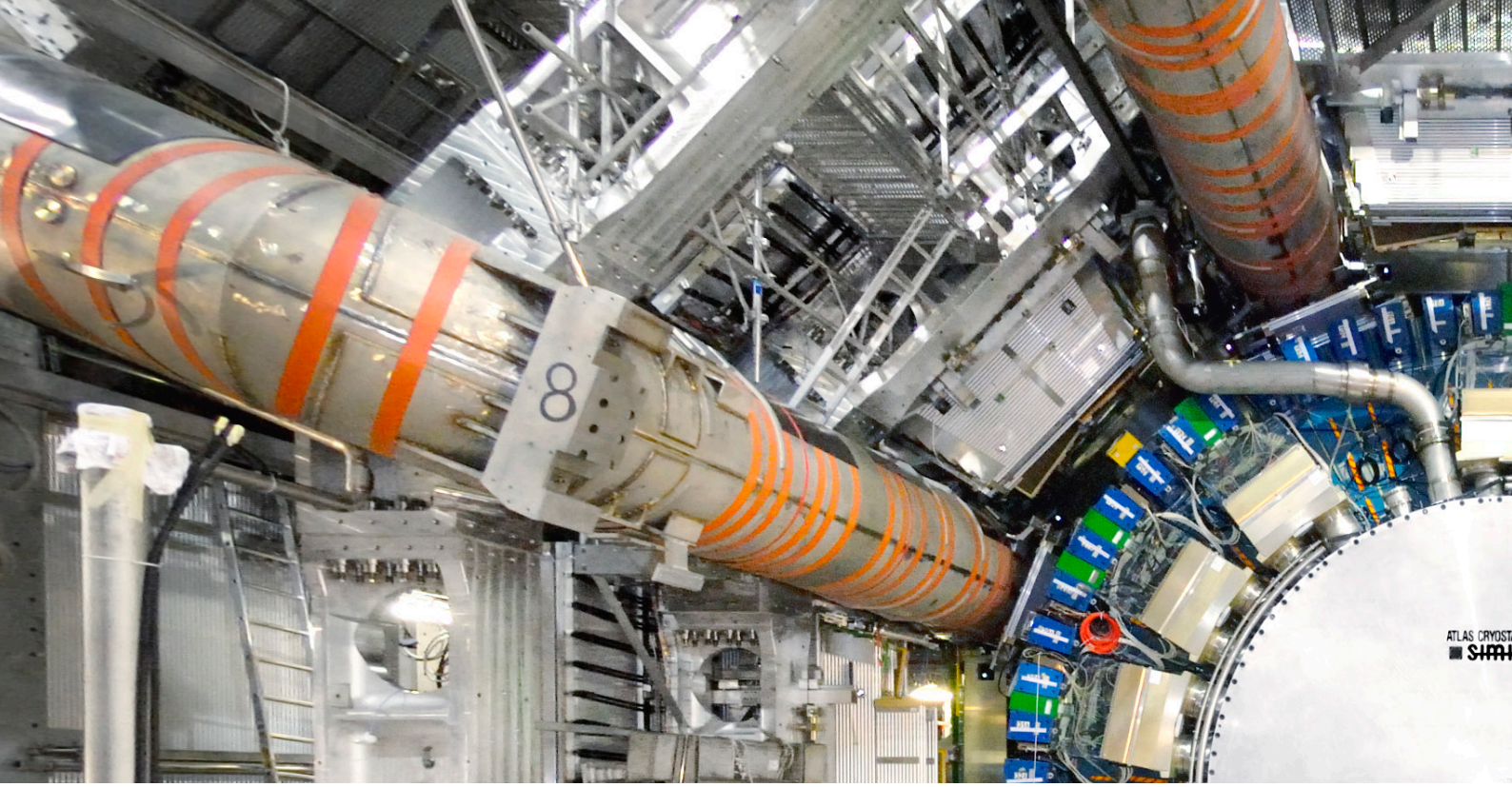
On 4 July 2012, the ATLAS and CMS experiments announced independent observations of a new particle: the Higgs boson. This discovery opened a new window of exploration, allowing physicists to gain new insight and to further the search for new physics. Studies of the Higgs boson's properties and interactions, which depend on different theoretical models, are an essential part of ATLAS research.

SEARCHING FOR NEW PHYSICS

Despite the success of the Standard Model, there are many open questions for physicists to explore: What is dark matter? What were the conditions like in the early Universe? What happened to the antimatter produced during the Big Bang? Could new symmetries allow Standard Model forces to be unified at large energy? What is the relation between the Standard Model and gravity? ATLAS physicists are seeking answers to these questions through searches for new particles and interactions, and precise measurements.

COLLABORATION & OPEN ACCESS

Modern collaborative tools facilitate the active participation of every member of the ATLAS Collaboration, regardless of their physical location. The data analysis process involves several stages of internal peer review, with the last stage being publication of the results in international open access physics journals. As of mid-2018, ATLAS has released more than 750 publications.



TECHNOLOGY & COMPUTING

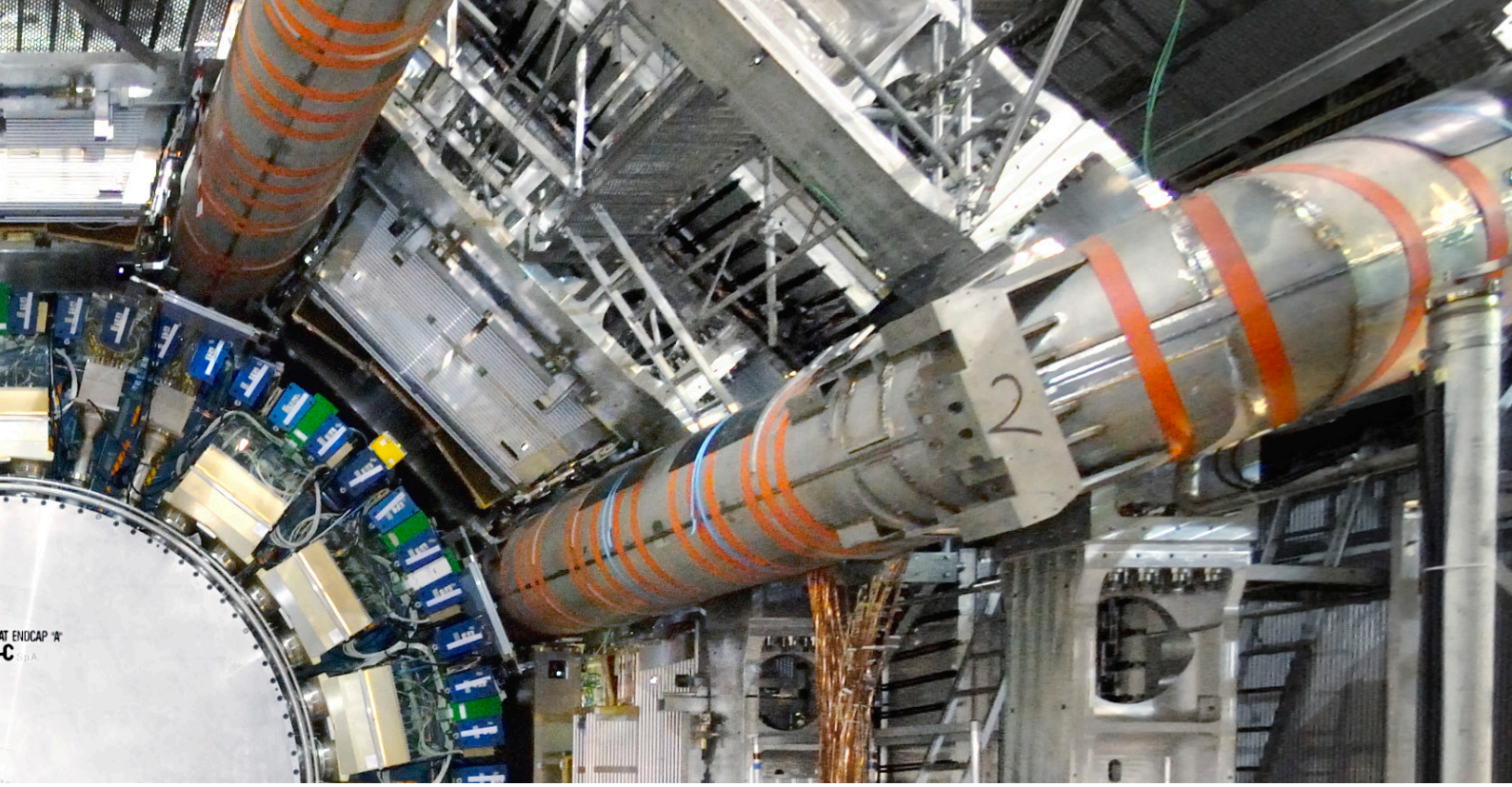
Exploring the frontiers of science often requires the development of tools and techniques that are beyond industry standards. ATLAS has pushed – and continues to push – the limits of technology in many key areas, including electronics, mechanical engineering, software, computing, and networking.

GLOBAL CONNECTIONS

The detector components used to record the collisions are designed, constructed and maintained by collaboration members from institutions located around the world. The data are processed and analysed in computing facilities at CERN, ATLAS institutions and dedicated centres, which are part of a global network that provides equal access to the entire collaboration. This distributed environment is an important and necessary feature of ATLAS, allowing all members to actively contribute to the experiment.

NEW TECHNOLOGY FRONTIERS

To cope with the demanding physics environment, ATLAS develops high-resolution detection techniques and ultra-fast electronics. These custom designs push the capablities of local industry, thus establishing infrastructure in participating countries. The analysis of ATLAS data requires the development of fast and well performing algorithms as well as detailed physics and detector simulation. ATLAS stays on the frontline of technology, employing advanced machine learning and high-speed computing.



THE LHC COMPUTING GRID

The challenge of processing and distributing LHC data for analysis led to the development of the tier-based LHC Computing Grid. Data from the ATLAS detector are processed by a Tier-0 computing centre at CERN, and then distributed to Tier-1 and Tier-2 centres around the world. ATLAS member institutions participate in the development and operation of these facilities, often partnering with computing and network industry leaders, to develop and improve the local infrastructure. This model is now used by other computing-intensive scientific fields and has served as a prototype for future development.

PARTNERSHIPS WITH INDUSTRY

Detector research and development has benefitted from partnerships between contributing ATLAS institutions and local industry. ATLAS scientists and engineers provide specifications and expertise to the companies, who are then able to refine or develop new professional facilities for production. Participating companies improve their competitiveness in the field, while faculty, staff and students involved in the projects foster long-term links with industry.

KNOWLEDGE TRANSFER

Innovative technologies developed for the ATLAS detector are used in a variety of applications affecting our everyday lives, including medical imaging, hadron therapy, augmented reality and sound reproduction using optical imaging. Other developments, such as superconducting magnetic energy storage and recording systems for large-scale neural activity, could lead to key breakthroughs in the future. CERN technologies and know-how have made significant contributions to the field of computing, most notably the development of the World Wide Web and Grid computing.

ATLAS BY THE NUMBERS

The ATLAS Collaboration is one of the largest collaborative efforts ever realised in science, with thousands of members located in institutions around the globe.

182 INSTITUTIONS

The ATLAS Collaboration is comprised of 182 institutions with physicists of 89 nationalities.

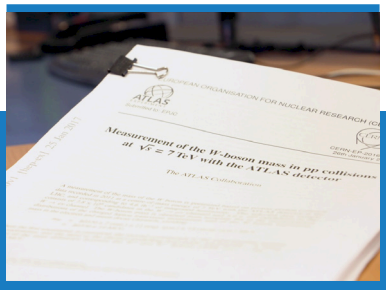
5500+ MEMBERS

ATLAS has over 5500 active collaboration members.

38 COUNTRIES

ATLAS institutes are located in 38 countries, representing every populated continent.

750+ SCIENTIFIC PAPERS



ATLAS has published over 750 scientific papers in scientific journals.

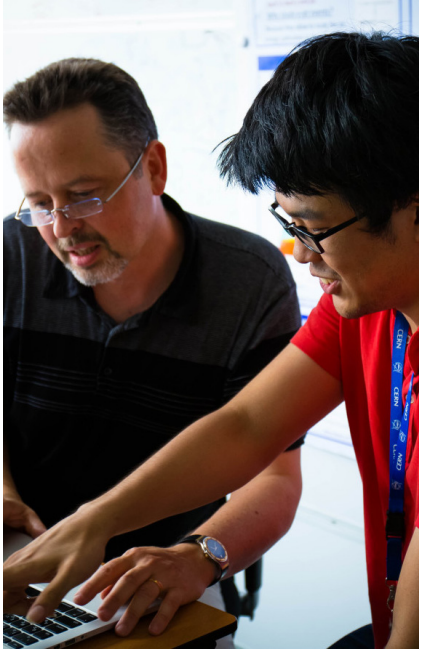
3000 SCIENTIFIC AUTHORS

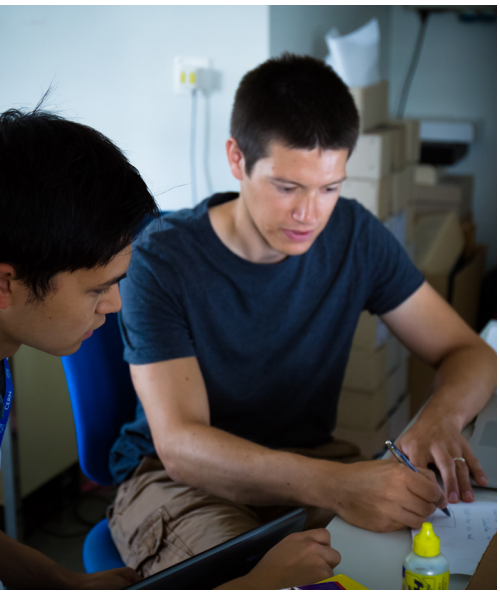
ATLAS publications are signed by almost 3000 scientific authors.

1200 DOCTORAL STUDENTS

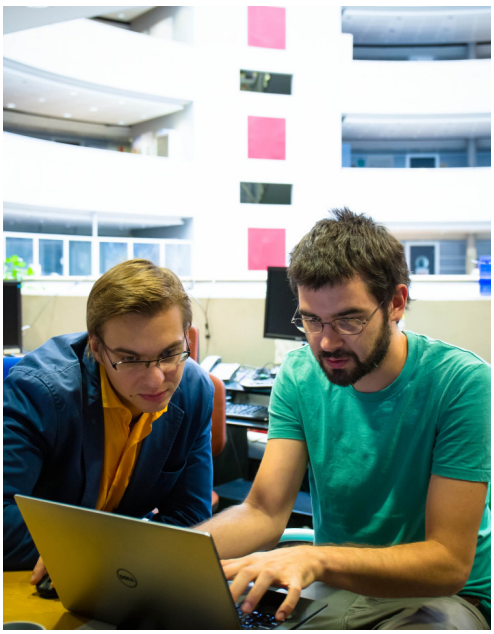
Doctoral students contribute significantly, making up over one third of ATLAS authors.

Figures as of June 2018.







TRAINING

ATLAS provides an excellent training ground for early career scientists. In addition to increasing their knowledge of physics and technology, young researchers are immersed in a diverse international environment, developing skills that facilitate their future careers and contributions to society.

Developing a skilled workforce with expertise in data analysis, computing and international collaboration.

TRAINING UNDERGRADUATES

Undergraduate students in physics, engineering, computing and related fields participate actively in the ATLAS Collaboration. Under the mentorship of senior researchers – often as part of a summer or semester programme – the students gain invaluable training and experience and collect academic credit or thesis material. These programmes foster the recruitment of young talent at member universities.

TRAINING PHD STUDENTS

Around 1200 post-graduate students currently participate in ATLAS member university PhD programmes. These students contribute significantly to the operation and physics exploitation of the experiment while learning valuable skills for their degrees. Upon graduation, they form an experienced, international workforce that contributes to research. Many go on to contribute to other key economic areas, including industry and finance.

THESIS AWARDS

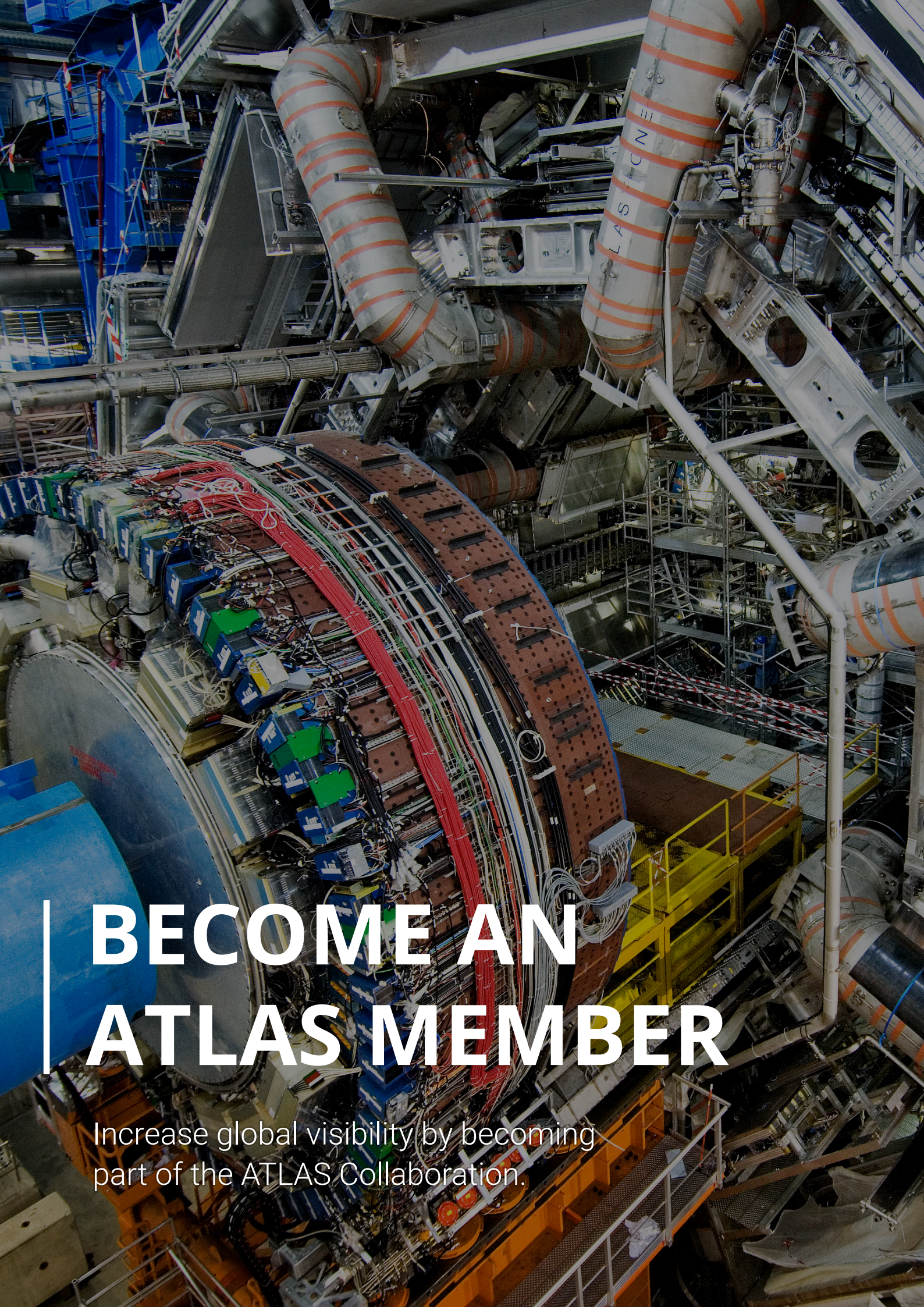
The collaboration celebrates the contribution of its students every year, during the ATLAS Thesis Awards. These are selected annually by a dedicated committee to recognise outstanding contributions in the context of PhD theses.

TRAINING RESEARCHERS, TECHNICIANS & ENGINEERS

ATLAS also serves as a training facility for early career scientists, engineers and technicians. Post-doctoral researchers gain the experience and exposure required to seek tenure-track positions at universities, while engineers and technicians gain the skills and leadership experience required to achieve senior-level positions in industry or public research facilities. All benefit from the challenges and rewards of international collaboration.

ATLAS PHD GRANT

The ATLAS PhD Grant Scheme aims to encourage young, talented and motivated PhD students in particle physics research and computing for physics. The grants offer students an opportunity to enhance their studies in a world-class research environment under the supervision and training of ATLAS experts. The grants, supported by the CERN & Society Foundation, are awarded annually. Find out more at: **cern.ch/ATLASPhDGrant**



BECOME AN ATLAS MEMBER

Increase global visibility by becoming part of the ATLAS Collaboration.

BEING PART OF ATLAS

ATLAS elects its leadership and has a collaborative organizational structure with self-managed teams and membership directly involved in decision-making processes. Scientists usually work in small groups, choosing the research areas and data that interest them most. Results are shared by all collaboration members and are subject to rigorous review and fact-checking processes before being made public.

The success of the collaboration is driven by individual commitment to physics and the prospect of exciting new results that can only be achieved with a complete and coherent effort. Institutes joining the ATLAS Collaboration become part of a worldwide collaboration of scientists and engineers participating in a unique scientific endeavour.

PATH TO INSTITUTIONAL MEMBERSHIP

› A new group usually starts working with ATLAS before any formal engagement is taken. This happens most efficiently by being hosted by an existing Institution, e.g. as an Associated Institute (see overleaf). This initial work helps establish and foster mutual interest for future long-term Institutional Membership.

› After about one year, the new group may submit an Expression of Interest (EoI) to join the ATLAS Collaboration, describing its general structure (staff, students, engineers), planned activities, expertise, and contributions to ATLAS, as well as its projected evolution. At this stage, the group must demonstrate a critical size, i.e. it should have permanent staff and typically more than one faculty member.

› The EoI is presented and discussed at the ATLAS Collaboration Board, and an admission vote is taken. Statements of support are required from the National Contact Physicist of the respective nation (if already in ATLAS), and from the Project Leader or Activity Coordinator of the areas where the new group plans to be engaged.

TYPES OF MEMBERSHIP

There are several types of institutional membership in the ATLAS Collaboration. **Full Institutional Membership** can either be obtained by single institutes or by several smaller institutes that work together and join the ATLAS Collaboration as a **Clustered Institution**. In addition, institutes can be associated to a full-member Institution as an **Associate Institute**.

JOIN AS AN INSTITUTION

Full Institutional Members (**Institutions**) have full rights and obligations in the Collaboration. In particular, they are represented in the Collaboration Board. This is an assembly of all ATLAS Institutions, where major decisions for the collaboration are discussed and voted on. Every Institution is equal, with one vote each.

ATLAS Institutions are expected to contribute to the Operation and Maintenance (M&O), and physics programme of the ATLAS experiment, as well as to the detector upgrade programme for operation at the High-Luminosity LHC. ATLAS Institutions have the following obligations:

- To enter the ATLAS Collaboration as a full Institutional Member, a financial contribution must be paid. This contribution can, in part, be delivered “in-kind”, by providing well-defined deliverables in technical areas, e.g. software or firmware.
- There is a yearly share of M&O costs of around 10 kCHF per author (or qualifying author) holding a PhD or equivalent. In addition, a common fund contribution of about 1.5 kCHF per author, per year is paid during the High-Luminosity LHC detector upgrade phase (2018–2025).
- Institutions take on a share of the operation tasks and corresponding institutional commitments.

JOIN AS A CLUSTERED INSTITUTION

Clustered Institutions (**Clusters**) are typically intended for institutes in nations where the High-Energy Physics community is still developing, and

where it may be difficult to form individual university groups large enough to stand alone in ATLAS. It is expected that clustered institutes work closely together and build up a coherent effort in ATLAS.

Each Cluster will have one vote in the ATLAS Collaboration Board. Clusters appear on the list of institutes in ATLAS publications. The individual cluster institutes are listed consecutively.

The requirements for a new Cluster to join ATLAS are the same as for single Institutions. The obligations on joining fees, M&O and OT contributions, listed on the previous page, have to be fulfilled by the Cluster as a whole.

The requirements for a new institute joining a Cluster as an additional institute are less stringent. No entrance fee has to be paid, however the financial and effort obligations (M&O and OT contributions) of the Cluster increase according to the number of additional authors.

The application should benefit the Cluster being joined, as well as the ATLAS Collaboration as a whole. Initial contact should be made with the leader of the Cluster team the new institute proposes to join, or directly with the ATLAS Spokesperson.

JOIN AS AN ASSOCIATE INSTITUTE

The **Associate Institute** status is intended for universities or research labs that are on the path to joining ATLAS as a full institutional member.

The Associate Institute is hosted by a current ATLAS full-member Institution, which takes some responsibility for the associated group. Members of the Associate Institute will collaborate with the host Institution. There should be clear benefit shown to the Institution being joined, as well as to ATLAS, from the application.

Initial contact should be made with the team leader of the Institution proposed, or directly with the ATLAS Spokesperson.

Associate Institutes do not appear on the list of Institutions in the ATLAS author list. Scientific authors from Associate Institutes instead appear as authors of the host Institution, with an "Also at [Associate Institute]" footnote upon request. Associate Institutes are generally not a visible part of the ATLAS Collaboration.

FOR MORE INFORMATION

More details on the obligations and the joining procedures can be found at: **atlas.cern/join**

CONTACT

Interested in becoming an ATLAS member?
More information available at: **atlas.cern/join**
Contact the ATLAS Spokesperson at **atlas-spokesperson@cern.ch**

Looking for more information?
General ATLAS: **atlas.cern**
Latest news and statements: **atlas.cern/updates**
Careers and opportunities: **atlas.cern/jobs**

Want to visit the ATLAS Experiment?
For general visits, contact the CERN Visitor centre: **visit.cern**
High-level visits for heads of laboratories and institutes are organised by the CERN Protocol Office: **protocol-office.web.cern.ch**

General inquiry?
Direct all correspondence to **atlas.public@cern.ch** or
ATLAS Experiment CERN, CH-1211 Geneva 23, Switzerland

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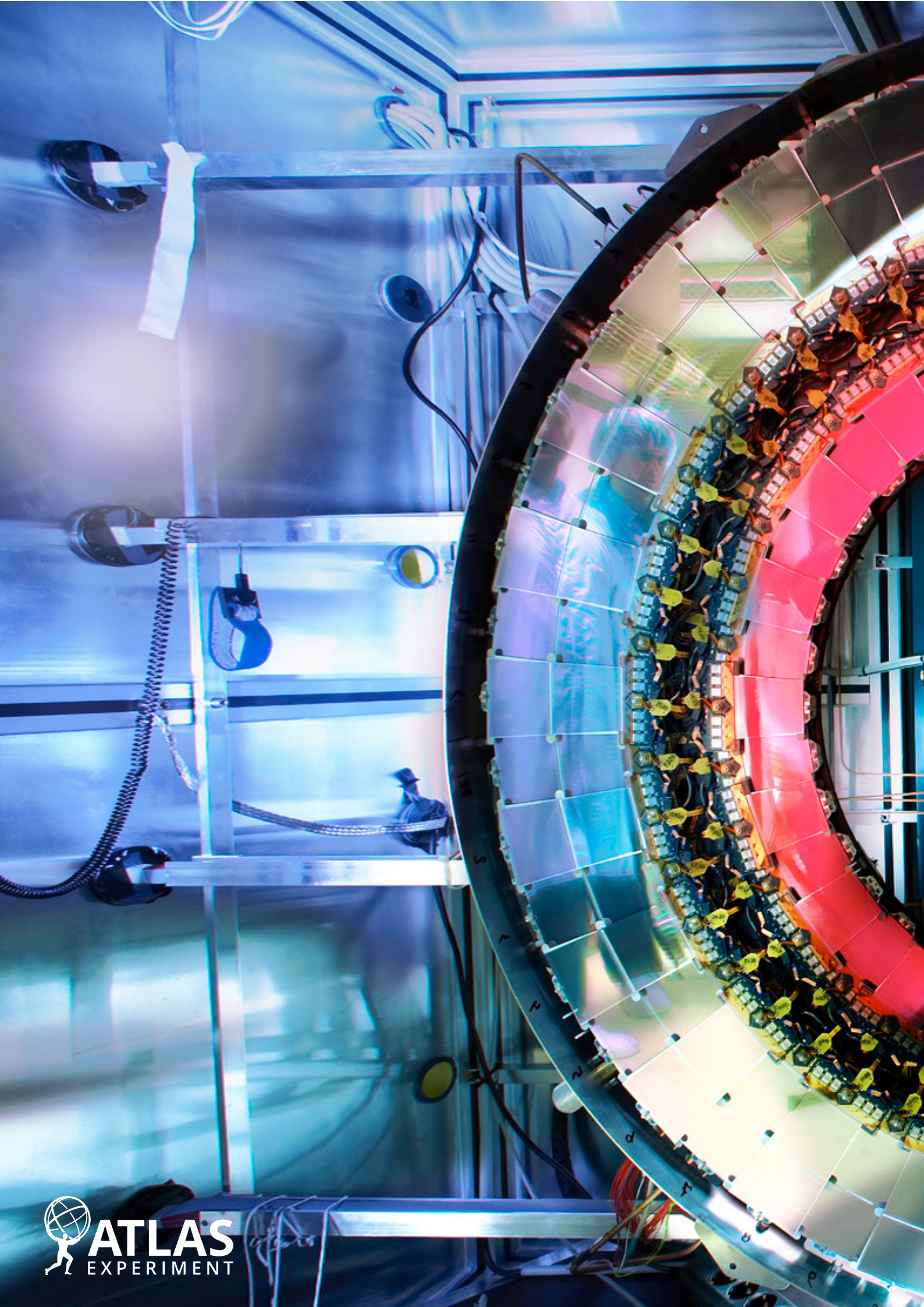
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