



Future Circular Collider

PUBLICATION

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MILESTONE REPORT

INDUSTRY AND OUTREACH EVENT

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Abstract:

Report on a dedicated event bringing together potential partners from industry and informing different identified target audiences about the advancement of the design for a next generation, collider complex based large-scale research infrastructure for high-energy particle physics.

The event site, outlining the program can be found on Indico: <https://indico.cern.ch/event/747618/>

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Delivery Slip

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SUMMARY

Global FCC study discussed benefits of discovery science to society and industry at symposium “Particle Colliders – Accelerating Innovation”

Fundamental science benefits society by generating knowledge, but also by enabling unexpected and often transformative applications. Particle accelerators have been at the centre of many of the most advanced research infrastructures for decades. They have enabled many discoveries, such as the Higgs boson and also led to technologies that have changed our lives.

Future particle accelerators are expected to have similarly bold impact on science and society. To showcase and discuss the technologies that are currently being developed within the global Future Circular Collider (FCC) study, hundreds of researchers and companies from across Europe, university students and high school children participated in an international science symposium “Particle Colliders – Accelerating Innovation” that took place in Liverpool on Friday 22nd March 2019.

The event, which was hosted by the University of Liverpool, federated partners from the Future Circular Collider, from the EuroCirCol and EASITrain H2020 projects who investigated the opportunities that next generation colliders offer to industry, science and society.

In January 2019, CERN published the conceptual design report for the Future Circular Collider (FCC), a potential successor to the Large Hadron Collider (LHC), which aims to expand our current understanding of nature beyond the established physical model of the universe.

Professor Carsten Welsch, head of the University of Liverpool physics department, comments that particle physics is our generation’s equivalent of space exploration: “It has the potential to change the world and everyone should be involved and be able to believe that anything is possible.”

Prof. Welsch says: “Particle colliders improve our understanding of the fundamental building blocks and forces that make up our universe”.

“Developing the design concept for a future research infrastructure is not just about the science they would enable; it also requires us to accelerate technological progress for the benefit our everyday lives.”

Making the leap between fundamental science and economic value is often difficult to quantify, but air travel is an example that is benefiting from particle accelerator developments in various ways: Security checks at airports cause stress and delays. Improved screening of luggage and containers, precise identification of liquids, non-destructive testing of the aircraft, greater energy efficiency and powerful object identification with radiofrequency technology are just a few examples of real-world industrial applications for accelerator science that can make this mode of transport safer and more efficient.

Also among the benefits to wider society are medical imaging of proteins and live cells, advances in ion beam cancer therapy and other ways to diagnose and repair tissue damage. Finally, the World Wide Web was invented 30 years ago at CERN to support particle physics experiments and is now part of all aspects of life.

Further applications are expected to emerge and the FCC collaboration gives the example of verifying the authenticity of honey in its latest film *Busy bees and mighty magnets* (<https://youtu.be/IGImJmwiXo>).

The symposium in Liverpool included talks by research leaders that were live-streamed to institutions across Europe and which are now available for everyone to watch via the event website. It also featured an industry exhibition, a careers fair and interactive demonstrations.

A highlight for the hundreds of visually impaired and sighted students attending was a demonstration of the world's first interactive 'tactile particle collider', which uses touch together with real sounds from the LHC to create an immersive experience. Delegates also had the chance to play "proton football" and interact with visualisations of themselves in two different universes within "CERN's interactive Large Hadron Collider tunnel" - which had its UK premiere at the symposium.

An academia-industry co-innovation workshop followed in the afternoon, open for industry and researchers from across Europe. It further strengthened links between industry and academia and paved the way for future collaborative projects.

Oxford-based Adaptix, one of the partners in the H2020 European research and training network OMA (Optimization of Medical Accelerators), began life when a problem in search of a solution met a solution in search of a problem.

Working on laser-driven particle accelerators at UCLA (in Los Angeles, US), Adaptix co-founder Dr Gil Travish saw the potential to use the emitter arrays he had developed in 'gene-chips', to look for DNA unravelling. It was by chance that he was introduced to Mark Evans, who had been looking for a technology to bring radiology to the field and to the bedside. The two men met in a coffeehouse and began a collaboration that is now bringing a product to market.

The workshop at the symposium aimed to catalyse these types of interaction.

Dr Travish comments: "It is encouraging to see how a concept born out of the pursuit of basic research—advanced particle accelerators—could be adapted to a very applied field: medical imaging. "We hope to see our product on the market soon, bringing 3D imaging to all the places where today clinicians can only provide 2D imaging. We think this technology will touch everyone's lives and improve healthcare."

The "Particle Colliders: Accelerating Innovation" symposium was co-hosted by The University of Liverpool and CERN, together with partners from the Future Circular Collider and EuroCirCol projects, on Friday 22 March 2019 at the ACC Liverpool. All talks and further information are available via the event website: indico.cern.ch/event/747618



Figure 1: The first students arrived at the Symposium.



Figure 2: A full auditorium for the FCC innovation workshop



Figure 3: Future scientists meet industry technology leaders and innovators at industry exhibition and co-innovation workshop.



Figure 4: Dr Michael Benedikt FCC Study Leader on how the realisation of the next generation of particle collider calls for a major global training, technological and industrial programme.

ANNEX 01: ABOUT THE PHYSICS DEPARTMENT AT THE UNIVERSITY OF LIVERPOOL

Researchers at the Physics Department at Liverpool University lead world-class R&D programmes in fundamental science in particular in accelerator physics, condensed matter physics, nuclear physics and particle physics. They are also known internationally for work in applied fields such as semiconductor sensors, nuclear and renewable energy.

Particle accelerator scientists are collaborating with leading institutes and laboratories around the world, including CERN, an international organisation that spans France and Switzerland, the Diamond Light Source and the Daresbury Laboratory in the UK, the ESRF and GANIL research organisations in France, GSI and DESY in Germany, and TRIUMF in Canada.

Prof Carsten P. Welsch is head of Physics at Liverpool University and head of the Liverpool Accelerator Physics Group at the Cockcroft Institute in Daresbury. He has devised the concept of the training networks and has been leading several Marie-Curie Sklodowska training networks. These are creating early stage researchers with vital skills in particle accelerator technologies and applications as well as laser science.

ANNEX 02: ABOUT THE FUTURE CIRCULAR COLLIDER STUDY

On 10 September 2008 the Large Hadron Collider (LHC) launched its first beam and successfully steered it around the full 27 kilometres of the world's most powerful particle accelerator. Ten years on, an international collaboration of more than 135 academic institutions and more than 25 companies study the next particle accelerator-based research infrastructure, a Future Circular Collider (FCC).

The LHC will reach the limit of its scientific programme around 2035. A future particle collider would then expand the exploration of nature at its smallest scales.

Scientists and engineers from the EU co-funded EuroCirCol and EASITrain projects provided significant contributions to the FCC feasibility study, which published four volumes of conceptual in December 2018.

An inspirational film, produced by EuroCirCol as part of the FCC project, is available at youtu.be/3pPAcrLUGX0