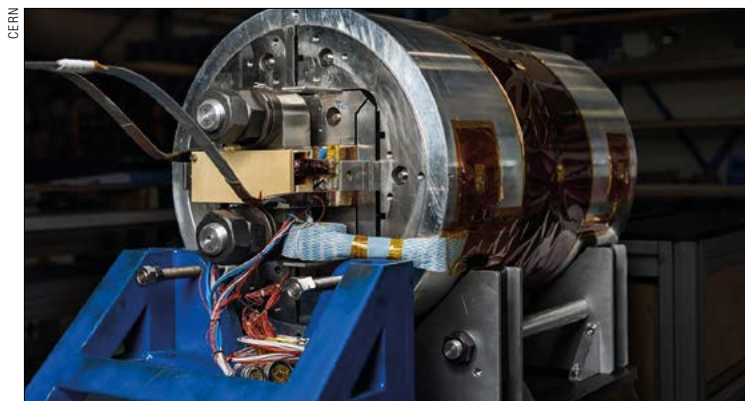


Viewpoint

Charting the future of CERN

The coming years will be crucial for the long-term future of particle physics.



This model magnet recently achieved a field of 16.2 T at CERN, twice the nominal field of the LHC dipoles, offering promise for a long-term accelerator-based future for the laboratory.

By Fabiola Gianotti

Over the next five years, key events shaping the future of particle physics will unfold. We will have results from the second run of the LHC, and from other particle and astroparticle physics projects around the world. These will help us to chart the future scientific road map for our field. The international collaboration that is forming around the US neutrino programme will crystallise, bringing a new dimension to global collaboration in particle physics. And initiatives to host major high-energy colliders in Asia should become clear. All of this will play a role in shaping the next round of the European Strategy for Particle Physics, which will in turn shape the future of our field in Europe and at CERN.

CERN is first and foremost an accelerator laboratory. It is there that we have our greatest experience and concentration of expertise, and it is there that we have known our greatest successes. I believe that it is also there that CERN's future lies. Whether or not new physics emerges at the LHC, and whether or not a new collider is built in Asia, CERN should aim to maintain its pre-eminence as an accelerator lab exploring fundamental physics.

CERN's top priority for the next five years is ensuring a successful LHC Run 2, and securing the financial and technical development and readiness of the High-Luminosity LHC project. This does not mean that CERN should compromise its scientific diversity. Quite the opposite: our diversity underpins our strength. CERN's programme today is vibrant, with unique facilities such as the Antiproton Decelerator and ISOLDE, and experiments studying topics ranging from kaons to axions. This is vital to our intellectual

life, and it is a programme that will evolve and develop as physics needs dictate. Furthermore, with the new neutrino platform, CERN is contributing to projects hosted outside of Europe, notably the exciting neutrino programme underway at Fermilab.

If CERN is to retain its position as a focal point for accelerator-based physics in the decades to come, we must continue to play a leading role in global efforts to develop technologies to serve a range of possible physics scenarios. These include R&D on superconducting high-field magnets, high-gradient, high-efficiency accelerating structures, and novel acceleration technologies. In this context, AWAKE is a unique project using CERN's high-energy, high-intensity proton beams to investigate the potential of proton-driven plasma wakefield acceleration for the very-long-term future. In parallel, CERN is playing a leading role in international design studies for future high-energy colliders that could succeed the LHC in the medium-to-long term. Circular options, with colliding electron–positron and proton–proton beams, are covered by the Future Circular Collider (FCC) study, while the Compact Linear Collider (CLIC) study offers potential technology for a linear electron–positron option reaching the multi-TeV range. To ensure a future programme that is compelling, and scientifically diverse, we are putting in place a study group that will investigate future opportunities other than high-energy colliders, making full use of the unique capabilities of CERN's rich accelerator complex, while being complementary to other endeavours around the world. Along with the developments I mention above, these studies will also provide valuable input into the next update of the European Strategy, towards the end of this decade.

Global planning in particle physics has advanced greatly over recent years, with European, US and Japanese strategies broadly aligning, and the processes that drive them becoming ever more closely linked. For particle physics to secure its long-term future, we need to continue to promote strong worldwide collaborations, develop synergies, and bring new and emerging players, for example in Asia, into the fold.

Within that broad picture, CERN should steer a course towards a future based on accelerators. Any future accelerator facility will be an ambitious undertaking, but that should not deter us. We should not abandon our exploratory spirit just because the technical and financial challenges are intimidating. Instead, we should rise to the challenge, and develop the innovative technologies needed to make our projects technically and financially feasible.



Fabiola Gianotti started her five-year mandate as CERN Director-General on 1 January.

Providing Positioning Solutions

Queensgate, a brand of Elektron Technology UK Ltd, specialise in offering nano-positioning and nano-measuring solutions to meet individual customer requirements. Queensgate pioneered the use of capacitive micrometry in nano-positioning. The capacitive sensors deliver high resolution, low noise and high linearity of movement with positional repeatability of less than 1nm.

Positioning and Active Optics

Resolution in large earthbound telescopes is limited by atmospheric turbulence and vibrations. Piezoelectrically driven active secondary mirrors can improve the effective resolution by correcting for these image shifts in real time. In addition momentum compensation systems integrated into the tip/tilt platforms can cancel undesirable vibrations and thus offer significantly better stabilization. Mirror edge sensors detect the attitude of neighbouring mirror segments and feed into the control system.

High speed Beam-steering mechanisms

Vibrational stability in Beamline optics continues to evolve to comply with the improved brilliance of low emittance storage rings around the world. This requires that the vibrational performance of the beamline be characterised, monitored and often compensated for during operation to nanometre levels of performance.

Queensgate beam steering mechanisms offer nanoradian levels of resolution as well as high bandwidths. Our patented Dual sensor technology, doubles the bandwidth that can be achieved using traditional PID & Notch filter control for a given resonant frequency. This coupled with the capacitive positioning sensors delivers unparalleled speed and accuracy of positioning.

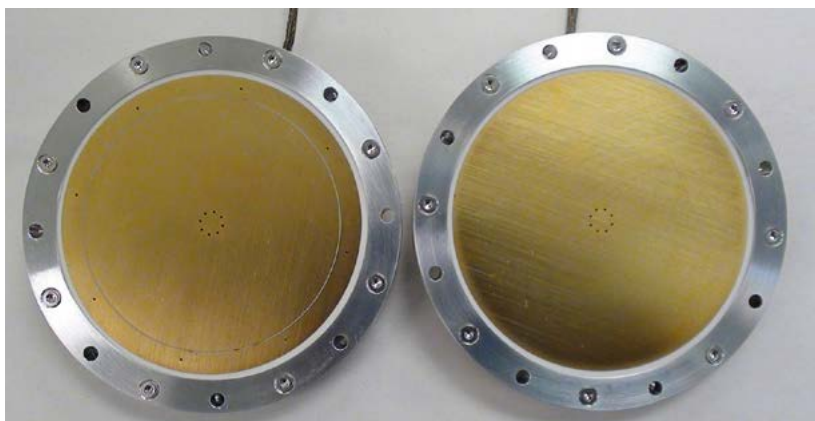
- Tip mechanisms – these offer a single axis of rotation with the highest operational bandwidth and nanoradian levels of resolution.
- Tip-tilt mechanisms – these offer two axis of rotation with nanoradian levels of resolution.

Crystal Bending Applications

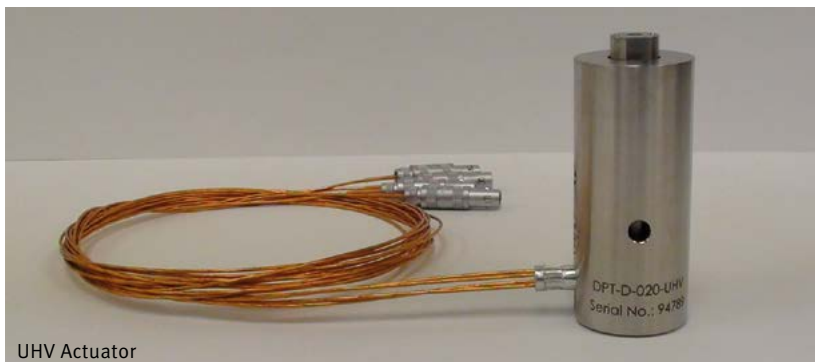
The Queensgate NPS-Z-500A-UHV was developed as an extra-long range flexure guided piezo actuator offering over 4 times the range of standard actuators to operate in UHV for crystal bending applications. Its companion NPS-Z-15L-UHV was developed to sustain loads of up to 600Kg with a high resonant frequency, and it has a blocking force of 35,000N.

DPT-D and DPT-E Actuators

The DPT-D and DPT-E range of actuators are designed with capacitive feedback control to give precise positioning. They are capable



NCG-1-AL-UHV Nanosensor™



UHV Actuator

of moving loads of up to 60 kg over the full travel range with low electronic noise and high linearity. This gives confidence that the actuator is positioned with precision, speed and accuracy. High thermal stability super invar construction gives superior position stability.

Beamline Insertion Device

The NCG-1-AL-UHV Nanosensor™ was developed to measure over an 11mm range with 80nm (typical) resolution to provide accurate positioning of two parallel magnetic beams. Designed to be radiation stable to 10^7 Gy, UHV compatible to 10^{-10} Torr, the gold plated ceramic sensors are designed so they can be used from -273 to +150 Degrees C and operate in a high magnetic field.

NX/NZ/NC NanoSensors®

The Nanosensor® is a non-contact measuring system based on the principle of capacitance micrometry to enable highly accurate displacement measurement. Two Nanosensor plates (Probe and Target) are mounted facing each other; the probe is secured to a fixed reference and target to the moving part. The

spacing of these two plates can be measured to better than 0.1nm resolution and with linearity of up to 0.02%.

They are available for ranges from 20 microns to 15mm in a variety of materials including Aluminium, Super Invar, Gold on Zerodur and Gold coated Alumina.

By encouraging engineering partnerships, Queensgate Instruments work to deliver the best solution, delivering performance at the right price. We offer a comprehensive service and support consistently achieving the best performance for the price.

If you have a positioning application where you require a nano-positioning solution please contact us



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