PARTICLE PHYSICS

Plans for LHC's super successor

CERN envisages the most powerful collider ever built.

BY DAVIDE CASTELVECCHI

CERN has unveiled its bold dream of building a new accelerator with a path nearly 4 times that of its 27-kilometre-circumference Large Hadron Collider (LHC) — currently the world's largest collider — and up to 6 times more powerful. CERN, Europe's particle-physics laboratory near Geneva, Switzerland, outlined the plan in a technical report released on 15 January (see https://fcc-cdr.web.cern.ch).

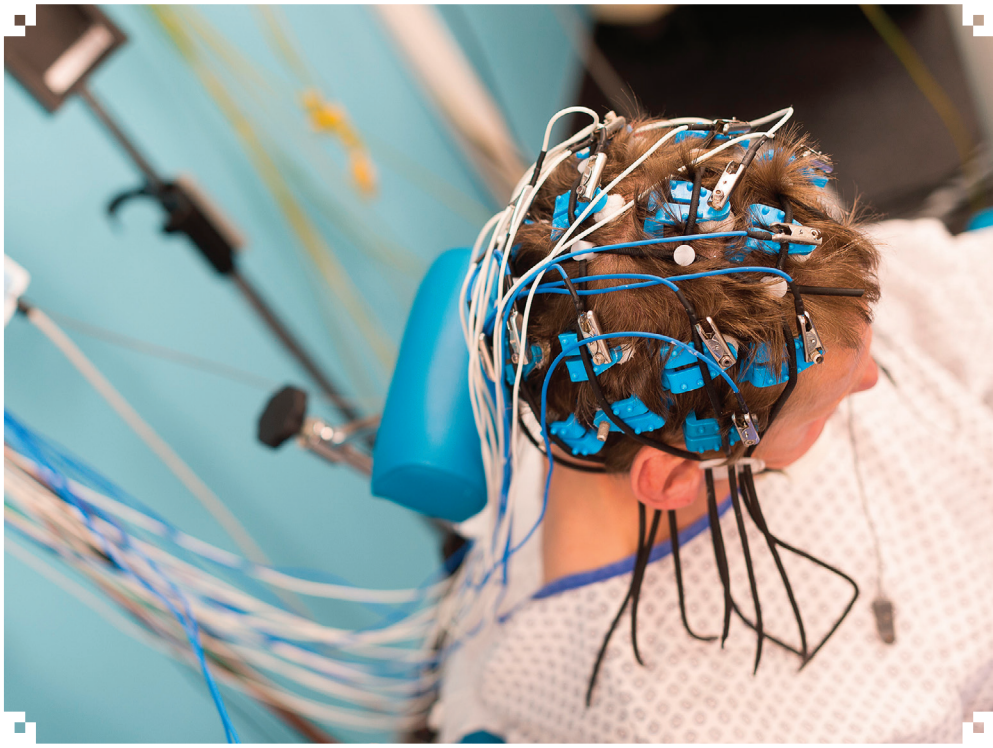
The document offers several preliminary designs for a Future Circular Collider (FCC) — one of which would be the most powerful particle smasher ever built — with different types ranging in cost from around €9 billion (US$10.2 billion) to €21 billion. It is the lab's opening bid in a priority-setting process called the European Strategy for Particle Physics Update, which will take place over the next two years and will affect the field's future well into the second half of the century.

"It's a huge leap — like planning a trip not to Mars, but to Uranus," says Gian Francesco Giudice, who heads CERN's theory department and represents the laboratory in the Physics Preparatory Group of the strategy-update process.

Since the LHC's historic discovery of the Higgs boson in 2012, the collider has not found any new particles. This points to a need to push collider energies as high as possible, Giudice says. "Today, exploring the highest possible energies with bold projects is our best hope to crack some of the mysteries of nature at the most fundamental level."

The potential for a machine such as the FCC is "very exciting", says Halina Abramowicz, a physicist at Tel Aviv University in Israel who heads the European strategy-update process. She adds that the FCC's potential will be discussed in depth as part of that exercise, and compared with other proposed projects. The CERN Council, which includes scientists and delegates from the governments of CERN's member countries, will then make the final decision on whether to fund the project.

But not everyone is convinced that the super-collider is a good investment. "There is no reason to think that there should be new physics in the energy regime that such a collider would reach," says Sabine Hossenfelder, a theoretical physicist at the Frankfurt Institute for Advanced Studies in Germany. "That's the nightmare that everyone has on their mind, but doesn't want to speak about." ■ SEE EDITORIAL P.398



People with epilepsy had the activity of single neurons tracked during surgery.

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NEUROSCIENCE

Brain study probes primate 'software'

Pioneering research tracked single neurons to reveal differences in human and monkey brain activity.

BY ALISON ABBOTT

Neuroscientists have for the first time discovered differences between the 'software' of human and monkey brains, using a technique that tracks single neurons.

They found that human brains trade off 'robustness' — a measure of how synchronized neuron signals are — for greater efficiency in information processing. The researchers suggest that the results might help to explain humans' unique intelligence, as well as their susceptibility to psychiatric disorders. The findings were published in *Cell* on 17 January (R. Pryluk *et al. Cell* http://doi.org/gfthv2; 2019).

Scientists say that this kind of unusual study could help them to translate research in animal models of psychiatric diseases to the clinic.

The research exploited a rare set of data on the activity of single neurons collected deep in the brains of people with epilepsy who were undergoing neurosurgery to identify the origin of their condition. The technique is so difficult that only a handful of clinics around the world can participate in this type of research. The study also used similar, existing data from three monkeys and collected neuron information from two more.

Over the decades, neuroscientists have discovered many subtle and significant differences in the anatomy — the hardware — of the brains of humans and other primates. But the latest study looked instead at differences in brain signals.

"There is a clear difference in behaviour and psychology between humans and non-human primates," says Mark Harnett, who studies how the biophysics of neurons affect neural computation at the Massachusetts Institute of Technology in Cambridge. "Now we see this difference in the brain's biology — it's a tremendously valuable study."

The study was a collaboration between Rony Paz at the Weizmann Institute of Science in Rehovot, Israel, who studies the dynamics