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Proton Synchrotron prepared for higher injection energies

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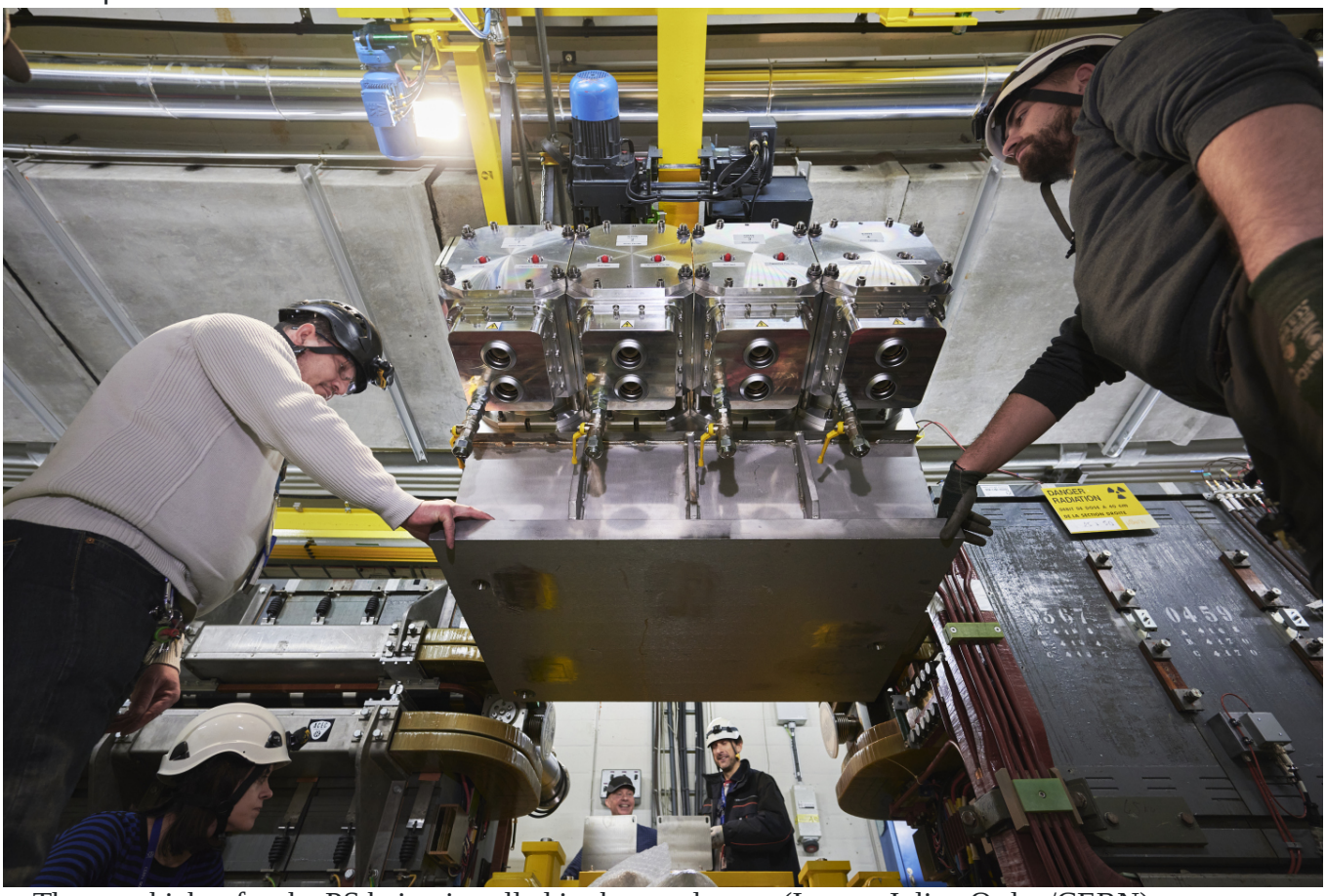
accelerators Proton Synchrotron

CERN’s oldest working accelerator has a new injection kicker magnet and will soon receive a new septum as well.



The new kicker for the PS being installed in the accelerator (Image: Julien Ordan/CERN)

Proton beams entering the Proton Synchrotron (PS) from the PS Booster have to be deflected into a

circulating orbit before they can be accelerated. This is done by two specialised beam-line elements: a strong magnetic septum and a fast injection-kicker magnet. The latter is a precisely synchronised electromagnet that can be switched on and off in about 100 ns, providing a stable and uniform kick that only affects the injected beam batches, while leaving the already circulating beam unperturbed.

After the ongoing second long shutdown of CERN's accelerator complex (LS2), the PS Booster will accelerate particles to 2 GeV, almost 50% higher than the pre-LS2 value of 1.4 GeV. The PS therefore needed a new septum and a new kicker capable of coping with this increased injection energy. On 31 January, as part of the LHC Injectors Upgrade (LIU) project, the new kicker magnet was installed, replacing the kicker that had operated since 1979. The magnet will soon be aligned, connected to the vacuum system and then connected to the power and control cables.

Like the magnet it replaced, the PS's new kicker is made of four identical modules sitting in a 1-metre-long vacuum tank. Each module receives power from a separate pulse generator that consists of two high-power electrical switches – a main switch and a dump switch to control the pulse length – and around 280 metres of a so-called "pulse-forming line", wound and stored on gigantic drums. These lines are thick, coaxial cables filled with sulphur hexafluoride (SF6) at a pressure of 10 bars, to provide the necessary insulation for the charging voltage of 80 kV. Since SF6 is a strong greenhouse gas, special care has to be taken to ensure that it is safely manipulated and recuperated, and that the system has no leaks.

In order to reduce the dependence on the SF6-based cables, part of the transmission line between the pulse generator and the magnet was replaced with conventional cables. "Disconnecting the SF6 cables from the magnet to connect the reserves was a two-person job, and required time-consuming gas-handling procedures to be followed," explains Thomas Kramer from the TE-ABT (Accelerator Beam Transfer) group. "On the other hand, the new conventional cables have quick-release connectors and can be operated by one person fairly quickly."

Kramer and colleagues also replaced the old analogue control system for the kicker, parts of which had been in place since the system was constructed in the 1970s. "Things made back then still work reliably," smiles Kramer, while noting that the new digital systems make it possible to monitor the situation remotely.

One element that remains to be installed is the new septum. This is a delicate device used in the injection system, composed of two cavities separated by a thin wall: one cavity allows the beams from the PS Booster to enter the PS while the second is meant for the circulating beams. The new septum, which required construction of a novel power converter, will be installed upstream of the magnet in the coming weeks.

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