the bending magnets were upgraded to safely handle the current required for 7 TeV per beam (14 TeV).[6][102] However, the bending magnets were only trained to handle up to 6.5 TeV per beam (13 TeV total), which became the operating energy for 2015 to 2017.[82] The energy was first reached on 10 April 2015.[103] The upgrades culminated in colliding protons together with a combined energy of 13 TeV.[104] On 3 June 2015, the LHC started delivering physics data after almost two years offline.[105] In the following months, it was used for proton-proton collisions, while in November, the machine switched to collisions of lead ions and in December, the usual winter shutdown started.

In 2016, the machine operators focused on increasing the luminosity for proton-proton collisions. The design value was first reached 29 June,[39] and further improvements increased the collision rate to 40% above the design value.[106] The total number of collisions in 2016 exceeded the number from Run 1 – at a higher energy per collision. The proton-proton run was followed by four weeks of proton-lead collisions.[107]

In 2017, the luminosity was increased further and reached twice the design value. The total number of collisions was higher than in 2016 as well.[40]

The 2018 physics run began on 17 April and stopped on 3 December, including four weeks of lead–lead collisions.[108]

Long Shutdown 2 (2018–2021) and beyond

Long Shutdown 2 (LS2) started 10 December 2018. The LHC and the whole CERN accelerator complex is being maintained and upgraded. The goal of the upgrades is to implement the High Luminosity Large Hadron Collider (HL-LHC) project that will increase the luminosity by a factor of 10. LS2 is projected to end in 2021, followed by Run 3.[109] The HL-LHC should be operational by 2026. The Long Shutdown (LS3) in 2020s will take place before HL-LHC project is done.

Timeline of operations