Vibration tests for High-Luminosity LHC project begin

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A seismic truck at Point 1 generated wave-like vibrations measured by EN/MME. Credit: Sophia Bennett/CERN

These measurements will help engineers understand how works could impact the LHC's operation, and will provide crucial details about the

site's geology before construction begins.

The High-Luminosity LHC is a major upgrade to the Large Hadron Collider (LHC) that will increase its discovery potential from 2025.

From R&D into state-of-the-art magnets, to developing innovative, robust material capable of withstanding beam impact, the High-Luminosity LHC is a multi-faceted project involving many teams across CERN.

One of these teams has been mandated to measure vibrations at point 1 of the LHC ring where the ATLAS experiment is installed to see if civil engineering work for the High-Luminosity LHC can begin while the LHC is running. While civil engineering work for the LHC was carried out during Large Electron-Positron collider (LEP) operation, the LHC is much more sensitive to vibrations.

"While the main civil engineering work will, of course, take place during the long shutdown scheduled for July 2018, we would like to identify which parts of it could be carried out during LHC operation," says Paolo Fessia, who is in charge of the HL-LHC integration. It is a tricky endeavour. Imagine a massive digger pounding away just 40 metres from the beam. Meanwhile, the LHC beam stability would need to remain within the micrometre level, that is, one millionth of a metre.

Could this be feasible?

The team in charge of the study began in an ATLAS tunnel, installing four sensors to measure vibrations in the ground. Further sensors were placed on the surface, and linked to the sensors underground.

"The first vibrations we studied were generated by a core-drilling machine, used to examine the site's geological make-up," says Paolo.

"This information will be essential for designing and constructing the new underground caverns and technical galleries needed for the HL-LHC, as construction companies need to know exactly what they will find when they dig (hard rock, sand, water, etc.). While this is the main purpose of the drilling, it has also been used to study the effect of pulsed vibrations."

A few days later, the seismic truck arrived. This unique, 24-tonne machine uses its entire weight to push down on the ground, generating wave-like vibrations up to 100 times per second.

"We created waves with a wide range of frequencies and looked at their attenuation," says Michael Guinchard, who is in charge of the mechanical measurement lab. Measurements were also taken with the LHC beam and will provide a valuable data set for more detailed analysis.

So, while the HL-LHC is still many years away from operation, its impact on the LHC can already be felt… in this case, quite literally.

Provided by CERN