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AWAKE₊₊: the AWAKE Acceleration Scheme for New Particle Physics Experiments at CERN

The AWAKE experiment reached all planned milestones during Run 1 (2016-18), notably the demonstration of strong plasma wakes generated by proton beams and the acceleration of externally injected electrons to multi-GeV energy levels in the proton driven plasma wakefields. During Run 2 (2021 - 2024) AWAKE aims to demonstrate the scalability and the acceleration of electrons to high energies while maintaining the beam quality.

Within the Physics Beyond Colliders (PBC) study AWAKE₊₊ has explored the feasibility of the AWAKE acceleration scheme for new particle physics experiments at CERN. Assuming continued success of the AWAKE program, AWAKE will be in the position to use the AWAKE scheme for particle physics applications such as fixed target experiments for dark photon searches and also for future electron-proton or electron-ion colliders. With strong support from the accelerator and high energy physics community, these experiments could be installed during CERN LS3:

Integration and beam line design studies show the feasibility of a fixed target experiment in the AWAKE facility, downstream of the AWAKE experiment in the former CNGS area. The expected electrons on target for fixed target experiments exceeds the electrons on target by three to four orders of magnitude with respect to the current NA64 experiment, making it a very promising experiment in the search for new physics.

Studies show that electrons can be accelerated to 70 GeV in a 130 m long plasma cell installed in an extended TI2 extraction tunnel from SPS to the LHC and transported to collision with protons/ions from the LHC. The experiment would focus on studies of the structure of matter and QCD in a new kinematic domain.

The AWAKE scheme offers great potential for future high energy physics applications and it is the right moment now to support further development of this technology leading to unique facilities.

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