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Particle physics applications of the AWAKE acceleration scheme

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After a breakthrough year which saw acceleration of electrons up to 2 GeV in 10 metres of self modulated, proton driven plasma wakefields, the AWAKE experiment looks forward to further development in Run 2 (2021-4). The AWAKE experimental program plans to demonstrate scalability by the production high quality, high energy electron beams. With proton bunches provided by the SPS or the LHC, stable high energy electron beams of 50 GeV or multi TeV level respectively would be available and serve as a unique facility for novel physics applications. Here we discuss three possible future experiments. Dark photon searches in untested parameter regions would be possible due to the combination of high energy and high luminosity AWAKE electrons. New tests of non perturbative QED can be performed via interactions with an intense laser, by boosting the laser field to above the Schwinger level in the rest frame of AWAKE electrons. New electron-proton physics can also be envisaged by the combination of high energy AWAKE electrons and LHC protons. Further novel physics applications are sure to emerge in the coming years as the field develops.

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