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AWAKE: a proton-driven plasma-based accelerator for high-energy physics applications

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AWAKE is a plasma-based acceleration experiment aiming at accelerating electrons to multi GeV to multi-TeV energies with a gradient of around 1GeV/m. Such a high gradient and large energy gains are in principle possible by using relativistic proton bunches to drive wakefields in plasma. Proton bunches, such as those produced by the CERN SPS or LHC carry large amounts of energy, allowing for large energy gains. However, they are too long to drive large amplitude wakefields. AWAKE [1] uses a seeded self-modulation process to transform the long bunch in a train of bunches shorter than, and separated by the wakefields period. Experimental results demonstrate many of the characteristics of the self-modulation process [2,3]. External electron injection experiments showed energy gains from 19MeV to 2GeV [4]. Plans are being drawn for future experiments aiming at producing bunches with parameters suitable for fixed target experiments in the mid-term and electron/proton collision experiments.

[1] P. Muggli et al. (AWAKE Collaboration), Plasma Physics and Controlled Fusion, 60(1) 014046 (2017)

[2] M. Turner et al. (AWAKE Collaboration), Phys. Rev. Lett. 122, 054801 (2019)

[3] AWAKE Collaboration, Phys. Rev. Lett. 122, 054802 (2019)

[4] AWAKE Collaboration, Nature 561, 363–367 (2018)

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