

Wakefield regeneration in a plasma accelerator

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The AWAKE experiment at CERN makes use of a high-energy proton beam to drive plasma wakefields. The long drive bunch self-modulates in the plasma, resulting in a train of microbunches. However, nonlinear effects shift the plasma resonance, causing the wakefield amplitude to saturate after only a fraction of the microbunch train. In this work, we use particle-in-cell simulations to show that the microbunches trailing an accelerated witness bunch can act to regenerate the wakefields, allowing a subsequent witness bunch to be accelerated. A train of witness bunches can thus be used to overcome the limitations of saturation, increasing the total accelerated charge and the overall efficiency. We discuss how such a scheme could be implemented in AWAKE, and the implications for related acceleration schemes.

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