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Highlights of the AWAKE Plasma Wakefield Acceleration Experiment

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AWAKE [1] uses the self-modulation (SM) [2] of a long, relativistic proton bunch in plasma to drive wakefields. We have measured many characteristics of the SM process [3]. We have demonstrated it can be seeded, and thus made reproducible, using a relativistic ionization front [4] or using wakefields driven by short electron bunch [5]. Low-energy, externally-injected, test electrons have been accelerated to 2GeV [6].

Based on these results, we have developed a plan [7] to produce electron bunches with parameters suitable for particle physics applications, such as dark photon searches [8].

We can also induce hosing of the long bunch, at the same time as its SM, by misaligning the seed electron bunch with respect to the proton bunch. Preliminary results also indicate that filamentation [9] occurs when we make the proton bunch wide at the plasma entrance.

I will introduce AWAKE and present the highlights of the experimental results obtained so far. I will describe plans for experiments with a discharge plasma source [10] and with a source with a step in plasma density to "freeze" the amplitude of wakefields over long distances. Longer-term plans include operation with a plasma for SM, followed by a plasma for external injection of a witness electron bunch, and acceleration to high energies in a scalable plasma source.

References

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