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Hosing of a long proton bunch induced by short electron bunch

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Hosing is a transverse oscillation of centroid position of a particle bunch [1] (or a laser pulse) that grows along the bunch and along the plasma [2]. It might impose limits on the quality and efficiency of the acceleration process [3]. It is therefore important to understand hosing. We study experimentally hosing of a long proton bunch in plasma. We induce this process with the relative misalignment between the trajectories of a short electron bunch driving initial wakefields and that of the proton bunch following it. This non-axi-symmetric effect of the wakefields on the proton bunch leads to hosing in the plane of misalignment. At the same time, we observe self-modulation (SM) in the perpendicular plane. Both hosing and SM [4] are reproducible from event to event, and grow from similar initial amplitudes of the transverse wakefields with similar predicted growth rates [2]. Furthermore, the frequencies of hosing and of SM are similar to plasma electron frequency and thus scale with plasma density. We show that the amplitude of hosing increases along the bunch, depends on the charge of the proton bunch, and is affected by the extent of misalignment. The direction of hosing reverses with the direction of misalignment.

We will present preliminary results obtained in the AWAKE experiment.

References

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