

Abstract Submitted
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The Hosing Instability of a Long Proton Bunch in Plasma

MATHIAS HUETHER, Max Planck Institute for Physics, MARIANA MOREIRA, IST/CERN, PATRIC MUGGLI, Max Planck Institute for Physics, AWAKE COLLABORATION COLLABORATION — The Hosing Instability (HI) of a charged particle bunch in a plasma is a fundamental interaction mode. It has often been posited as imposing a limitation on beam and plasma parameters with which large energy gain can be achieved in plasma-based particle accelerators. We analyze time-resolved images of a 250 ps-long proton bunch after propagation in a 10 m-long plasma with density in the $10^{13} - 10^{14} \text{ cm}^{-3}$ range. The bunch experiences symmetric, self-modulation of its envelope¹ along the plasma. However, non-axisymmetric events, where the centroid of the proton bunch is periodically oscillating across its propagation axis, are also observed. We attempt to determine whether these events follow predictions for HI from theory² and simulations. We also study the effect of misalignment between the proton bunch and the ~ 1 mm-radius plasma column. Detailed experimental results obtained in the AWAKE experiment³, their analysis and comparison with theory and simulation results will be presented.

¹AWAKE Collaboration, Phys.Rev.Lett.122, 054802(2019);M. Turner et al.(AWAKE Collaboration), Phys.Rev.Lett.122, 054801(2019)

²C. Schroeder et al., Phys.Rev.E 86, 026402(2013)

³P. Muggli et al.(AWAKE Collaboration), Plasma Phys. & Contr.Fus., 60(1) 014046(2017)

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