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Hosing and self-modulation competition in self-modulated plasma acceleration JORGE VIEIRA, Instituto Superior Tecnico, Lisboa, Portugal, RICARDO FONSECA, DCTI, ISCTE, Lisbon University Institute, WARREN MORI, University of California Los Angeles, PATRIC MUGGLI, Max Planck Institute for Physics, Munich, Germany, LUIS SILVA, Instituto Superior Tecnico, Lisboa Portugal — It was recently proposed that large amplitude plasma waves could be resonantly excited by the self-modulation instability (SMI) of long particle bunches [Kumar, PRL 104 255003 (2010)]. Best conditions for particle acceleration are met after the saturation of the SMI when the driver and wake phase velocities are similar. It is therefore crucial to understand whether beam breakup due to the growth of the hosing instability (HI) can occur once the SMI has saturated. Here we show analytically and numerically that the HI is suppressed after the saturation of the SMI. We find that each self-modulated beamlet centroid performs harmonic betatron oscillations driven by the transverse wake associated with the preceding beamlets. Hence, resonances between beamlet centroids are avoided in the linear regime as the wake amplitude grows along the bunch, leading to different betatron frequencies for different beamlets. This suppression mechanism is analogous to the BNS damping [Balakin et al, Proc. 12th Int. Conf. High Energy Accel., Fermilab, 1983, p.119] used in conventional linear accelerators. These findings are confirmed by direct numerical solutions of the model. 3D particle-in-cell simulations confirm our predictions for a wide range of conditions.

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