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Dynamics of nonlinear laser-plasma accelerators (LPA) probed by frequency-domain holography(FDH) P. DONG, HAI-EN TSAI, S.A. YI, G. SHVETS, M.C. DOWNER, Univ. Texas at Austin, S. KALMYKOV, Univ. Nebraska, N.H. MATLIS, LBNL, C. MCGUFFEY, S.S. BULANOV, V. CHVYKOV, G. KALINTCHENKO, K. KRUSHELNICK, A. MAKSIMCHUK, T. MATSUOKA, A.G.R. THOMAS, V. YANOVSKY, Univ. Michigan — We report three new results from the probing of nonlinear LPA structures by FDH. 1.The amplitude of sinusoidal wakes driven by mildly relativistic(a_0 $\sim$1.5)laser pulses is observed to grow monotonically with increasing distance behind the drive pulse, before the wave breaks. The growth in amplitude correlates with growth in wavefront curvature. Both effects are explained by the coherent mixing of trajectories of plasma fluid elements possessing slightly different initial plasma frequencies as a result of radial variation of the relativistic gamma-factor across the drive pulse profile. 2.We reported that LPA structures ("bubbles") reshape co-propagating probe pulses into optical "bullets". Here we report direct observation of the bubble by FDH. Correlation of the phase-modulated bubble image with the optical bullets reveals a temporal offset that is explained by beam loading of the plasma bubble accelerator. 3.Optical bullets are shown to possess a flat temporal phase, signifying efficient pulse compression, in contrast to the chirp of the rest of the probe pulse. The result suggests an application of bubbles as compressors for intense pulses.

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