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Evidence of a Nonlinear Dispersion Relation for Langmuir Waves[1]

D.S. MONTGOMERY, J.L. KLINE, Los Alamos National Laboratory — Langmuir waves (LW) are driven to large, nonlinear levels by stimulated Raman scattering (SRS) in experiments using an intense diffraction-limited laser beam to interact with a preformed plasma. The LW frequency and wave number (ω, k) are inferred both from the SRS scattered light spectrum, and from Thomson scattering of the driven LW. In addition, Thomson scattering from thermal-level ion wave fluctuations is used to infer the time-dependent plasma conditions. In the experiment, the plasma temperature drops from 700 to 500 eV while the LW is driven by SRS, thus providing a time-dependent change of kλ_D. Further evidence indicates that an assumption of constant electron density during this time is valid. Using these plasma conditions, the inferred LW dispersion is compared to the linear kinetic dispersion relation. At k$\lambda_D \sim 0.34$, the LW frequency is $\sim$ 6.5% lower than that predicted by the usual linear dispersion relation. However, (ω, k) inferred from the experimental data compare favorably to the nonlinear dispersion relation of Rose and Russell [Phys. Plasmas 8, 4784 (2001)] for a LW average amplitude e$\Phi/T_e \sim 0.6$.

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