Clayton *et al.* Respond: The authors of the Comment[1] are quite correct when they point out that the ruby-laser scattering system used in our study[2] can only respond to beat-excited density fluctuations with $k_y = k_z$, where the CO_2 (ruby) beam propagates in the z (y) direction. Thus the data in Fig. 2(a) of the Letter[2] do not represent the k_z spectrum with $k_y = 0$ as supposed, but rather the k_z spectrum at $k_y = \omega_p/c$, where ω_p is the plasma frequency.

Before revising the conclusions of Ref. 2, we would like to clarify a few points. In the Comment the authors conclude that "plasmons . . . near c await measurement and confirmation still." According to their Eq. (3) these plasmons can only be seen when the scattering angle θ_s is near zero, which requires that the probe beam be coaxial with the CO_2 beam. But this was precisely the case for the forward-Thomson-scattered CO_2-light measurements. The forward-scattered CO_2 signals (Stokes and anti-Stokes lines) were found with the following properties: (1) were observed only under the two-frequency illumination; (2) had a density (pressure) resonance; (3) had a growth time of approximately 400–500 psec, consistent with the time to saturation predicted by fluid theory; and (4) were correlated with an (independent) ruby Thomson-scattered signal. These are properties that one expects of light scattered from a collinear beat-excited plasma wave. [The sideband observations of Lavigne *et al.*[3] mentioned in the Comment do not include items (2)–(4) listed above, nor were those measurements made in the forward direction with an underdense plasma, and so we do not find those observations relevant to this discussion.] The scattered CO_2 light was collected in an approximately $f/15$ cone which, with use of Eq. (3) of the Comment, implies contributions to the scattered light from plasmons with phase velocity v_p in the range $c \geqslant v_p \gtrsim 0.85c$. Thus we feel that high–phase-velocity plasma waves have indeed been detected in this experiment, as concluded in the original Letter.

In regard to the interpretation of Fig. 2(a) from the Letter, we note that in the real, three-dimensional world, the two-frequency CO_2 pump can excite plasmons over a broad region in k space, as shown in Fig. 1. The shape and extent of the k_y spectrum $S(k_y, k_z = k_p)$, where $k_p = \omega_p/c$, depends on the profile of the input CO_2 beam and the focusing f number, respectively. Our $f/7.5$ focusing implies that plane-wave components of the pump beams can mix at angles up to 7.6°, which gives a cutoff of the k_y spectrum at $k_y = 1.23k_p$. Note that a symmetric k_y spectrum such as shown in Fig. 1 implies that the plasma wave has not a periodicity in the y direction but rather a finite radial extent. Note also that the velocity of phase

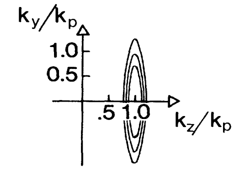

FIG. 1. Representative contour plot of a beat-excited plasma-wave k spectrum $S(k_y, k_z)$ where the pump beams propagate in the z direction.

fronts due to the interference of plasmons with $k_p\hat{\mathbf{z}} \pm k_y\hat{\mathbf{y}}$ is approximately c, so that these k components are indeed associated with the high–phase-velocity electron plasma wave. If the pumps were plane waves, the plasma-wave amplitude would be proportional to the product $E_0(\mathbf{k}_0)E_1(\mathbf{k}_1)$. If, however, the pumps are focused beams with plane-wave spectra[4] $F_0(k_{0y})$ and $F_1(k_{1y})$, where $k_{jy} = \mathbf{k}_j \cdot \hat{\mathbf{y}}$, the plasma-wave amplitude at a certain k_y [i.e., $S(k_y, k_z = k_p)$] is proportional to the convolution of $F_0(k_y)$ with $F_1(k_y)$ up to relativistic saturation. From Fourier optics calculations, we can estimate the $F_j(k_{jy})$ from our radial pump-intensity profiles at the CO_2 input lens. By performing the convolution, we get an estimate for $S(k_y, k_z = k_p)$ which is down a factor of 3–5 for $k_y = k_p$ compared to $k_y = 0$. Collective Thomson scattering probes this k-space representation of the plasma-wave density fluctuations, giving a scattered field proportional to $S(\Delta\mathbf{k})$. Here, $\Delta\mathbf{k}$ is the wave vector to which the scattering geometry is matched, which, for our case, was $\Delta\mathbf{k} = k_p\hat{\mathbf{y}} + k_p\hat{\mathbf{z}}$. Thus the value of the plasma-wave amplitude $\tilde{n}/n_0$ given in the Letter as 1%–3% should probably be revised upward to something like 9% ± 6%, a range more consistent with the fluid theory.

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