**Comment on "Generation of Electromagnetic Pulses from Plasma Channels Induced by Femtosecond Light Strings"**

In a recent Letter [1] Cheng, Wright, and Moloney (CWM) calculated/predicted several new effects as follows: (a) that the fraction of the short laser pulse momentum can be imparted to plasma electrons via collisional damping of the laser, thereby exciting a long-lived plasma wave, which (b) gives rise to a spatially uniform dipole moment of a plasma, which (c) emits far-field narrow-band radiation at the plasma frequency $\omega_p$. We claim that the calculation of (a) is in error and the predicted effects of (b) and (c) do not occur as described. In fact, (c) would not occur even if (a) and (b) were calculated correctly.

(a) CWM calculated that an electron absorbing laser radiation due to collisions at a rate $\gamma$ is displaced by a distance $\xi_0$, given by Eq. (8), independent of $\gamma$ because it is proportional to the product of the gained momentum [ $\propto \gamma$, according to Eq. (7)] and the drift time $T \approx \gamma^{-1}$. This argument holds only if there is no restoring force $-\omega_p^2 \xi$ from the plasma ions over this period of time. Because the restoring force can be neglected only for $t \ll \omega_p^{-1}$, the calculation of CWM is valid only if $\gamma \gg \omega_p$. For such highly collisional plasmas it is not sensible to talk about plasma oscillations since they decay within less than one period. CWM's claim in the accompanying Reply [2] that the decay rate of the plasma oscillations is much longer than $\gamma^{-1}$ is improbable: the jellium model they refer to is a degenerate quantum fluid.

Plasma oscillations are possible if $\gamma \ll \omega_p$, but the oscillation amplitude is reduced from that given by Eq. (8) by a factor $\gamma/\omega_p$. For $\gamma = 3 \times 10^{11}\ \mathrm{s}^{-1}$ (one undamped plasma oscillation) the correct displacement of the plasma electron by the radiation pressure force $F_{\mathrm{RP}}$ is a factor of 6 smaller than claimed by CWM. Under no circumstances can the plasma oscillations with amplitude $\xi_0$ and lifetime $> \omega_p^{-1}$ be excited via collisional absorption force $F_{\mathrm{RP}}$ given by Eq. (7). CWM also overlooked the usual ponderomotive force $F_P = (e^2/2m\omega_L^2 v_g)\partial_t |E_L|^2$. When collisions are negligible, $F_P \gg F_{\mathrm{RP}}$ and $\xi_0^{\mathrm{P}} = (e^2/2m^2 c\omega_L^2) \int_{-\infty}^{+\infty} dt |E_L|^2$. CWM's claim that the ponderomotive force (which is proportional to the spatial intensity gradient) is too small for light strings of 100 $\mu$m diameter and the centimeter length is wrong: the relevant spatial gradient is inversely proportional to the short pulse length $ct_p \approx 3\ \mu$m.

(b) CWM incorrectly assumed that all plasma electrons oscillate in phase regardless of their position $z$, so that $\dot{\xi}(t, z) \equiv \dot{\xi}(t)$ is a function of time only, producing a uniform current $J_z$. This happens only if the plasma oscillations are excited instantaneously by the laser pulse propagating with an infinite speed. In fact, plasma oscillations are set up by the laser pulse at different times $t = z/v_g$, where $v_g < c$ is the group velocity of the pulse. Therefore, $\dot{\xi}(t, z) \equiv \dot{\xi}(t - z/v_g)$, and the longitudinal wave number of the current perturbation with frequency $\omega_{\mathrm{osc}}$ is $k_z = \omega_{\mathrm{osc}}/v_g$. For a $L = 1$ cm long plasma filament, this translates into the phase difference of $\Delta\phi = \omega_p L/c \approx 60$ for plasma oscillations excited along the light string. The destructive interference of these oscillations destroys radiation proposed by CWM.

(c) The idea of generating radiation using the setup of Ref. [1] is erroneous. First, it is impossible to produce any far-field radiation by an excitation which moves uniformly with a subluminal speed $v_g < c$. Indeed, for electromagnetic radiation in free space $k_\perp^2 = \omega_{\mathrm{osc}}^2/c^2 - k_z^2 < 0$, and radiation does not propagate out of the plasma channel. Second, even if the long-wavelength ($k_z \approx 0$) displacement $\xi_0$ of a plasma column could be set up somehow, it still would not emit narrow-band radiation at $\omega = \omega_p$. *Plasma waves can never emit radiation at* $\omega_{\mathrm{osc}} = \omega_p$ because the displacement current $(1/4\pi)\partial_t \vec{E}_p$ (where $\vec{E}_p$ is the electric field of a plasma wave) exactly compensates the plasma current $-en\vec{v}$ prohibiting radiation. While Cherenkov-like radiation is possible when the velocity of the laser pulse exceeds that of the emitted radiation [3], it is not narrow bandwidth.

The 2D oscillations of a narrow plasma column differ substantially [4,5] from the simplified 1D case considered by CWM. The far-field radiation was erroneously predicted because Eq. (11) contains a *prescribed* current $J_z$: the effect of $\vec{E}_{\mathrm{rad}}$ on the electron motion was neglected. By inserting the prescribed current $J_z$ into Eq. (11), CWM demonstrated that, not surprisingly, a *driven* electron current emits radiation. This is not the same as demonstrating that an initially perturbed plasma filament emits radiation while executing a *self-consistent* oscillation.

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