Two-surface wave decay: Controlling power transfer in plasma-surface interactions
Yu. A. Akimov, K. Ostrikov, and N. A. Azarenkov

Citation: Physics of Plasmas (1994-present) 14, 082106 (2007); doi: 10.1063/1.2769966
View online: http://dx.doi.org/10.1063/1.2769966
View Table of Contents: http://scitation.aip.org/content/aip/journal/pop/14/8?ver=pdfcov
Published by the AIP Publishing

Articles you may be interested in
Nonlocal theory of electromagnetic wave decay into two electromagnetic waves in a rippled density plasma channel
Phys. Plasmas 19, 122113 (2012); 10.1063/1.4773029

Effect of beam premodulation on excitation of surface plasma waves in a magnetized plasma
Phys. Plasmas 17, 112701 (2010); 10.1063/1.3507293

Nonresonant power transfer in plasma-surface interactions via two-surface wave decay

Nonlinear interaction of a high-power electromagnetic beam in a dusty plasma: Two-dimensional effects
Phys. Plasmas 6, 762 (1999); 10.1063/1.873314

Production of uniform plasma with surface electromagnetic wave launched by a waveguide-surfatron
Two-surface wave decay: Controlling power transfer in plasma-surface interactions

Yu. A. Akimov
Complex Systems, School of Physics, The University of Sydney, Sydney NSW 2006, Australia and Institute of High Technologies, V. N. Karazin Kharkiv National University, 31 Kurchatov Avenue, Kharkiv 61108, Ukraine

K. Ostrikov
Complex Systems, School of Physics, The University of Sydney, Sydney NSW 2006, Australia

N. A. Azarenkov
V. N. Karazin Kharkiv National University, 4 Svobody sq., Kharkiv 61077, Ukraine

(Received 12 July 2007; accepted 19 July 2007; published online 27 August 2007)

Controlled interaction of high-power pulsed electromagnetic radiation with plasma-exposed solid surfaces is a major challenge in applications spanning from electron beam accelerators in microwave electronics to pulsed laser ablation-assisted synthesis of nanomaterials. It is shown that the efficiency of such interaction can be potentially improved via an additional channel of wave power dissipation due to nonlinear excitation of two counterpropagating surface waves, resonant excitations of the plasma-solid system. © 2007 American Institute of Physics. [DOI: 10.1063/1.2769966]

I. INTRODUCTION

The ability to control the efficiency and products of interaction of high-power pulsed electromagnetic radiation with solid surfaces exposed to a plasma still remains one of the major challenges in various applications ranging from more traditional inertial plasma confinement, plasma and electron/ion beam accelerators in microwave electronics, space propulsion and aeronautics to more recent uses of pulsed laser systems in individual micro- and nanoparticle manipulation in dusty plasma research, for generation of synchrotron radiation and also for diverse purposes of plasma-aided nanofabrication.1-11 Irrespective of the specific mechanism of the excitation of the electromagnetic pulses, some fraction of wave energy is transferred to the solid surface, whereas the remaining power stays in the plasma bulk.

Depending on the targeted application, this fraction needs to be controlled precisely. To maximize the amount of solid material released from the surface into the ionized gas phase, the wave energy transfer to the surface should generally be enhanced. However, the exact dose of the energy deposition should be optimized depending on other requirements such as structural/phase state and elemental composition of the material released and service lifespan of the irradiated target. On the other hand, if the electromagnetic radiation is merely used for surface diagnostic purposes (e.g., in situ real-time ellipsometry), or is primarily required in the ionized gas phase (e.g., for electron beam acceleration), the surface exposure should certainly be minimized. These issues have become even more important with the development of femtosecond, high-power laser systems; these stimulated extensive and in-depth theoretical and experimental studies of electromagnetic power absorption mechanisms and high-energy electron generation involve overdense plasmas.12

One of the most effective power absorption mechanisms in such systems is related to parametric excitation of electron surface waves (SWs),13-21 accompanied by energy dissipation of bulk plasma waves. Particle-in-cell simulations have found this in remarkable correlation with surface rippling and fast electron jets in the plasma bulk reported earlier.22 Likewise, the maximum rate of energy dissipation attributed to the excitation of two surface waves is achieved in the case of normal incidence of a laser beam with the frequency \(\omega\). In this case the second harmonic of the laser pulse can nonlinearly couple and excite two counterpropagating surface waves through the mechanism common as a two-surface wave decay \(2\omega \rightarrow \omega + \omega\).23 More importantly, the efficiency of the power transfer turns out to be the highest when the frequency of the incident laser beam is approximately half the electron plasma frequency \(\omega_{pe}\).23

One possible interpretation of this observation is that a plasma wave (PW) is generated at \(2\omega\) and is strongly coupled with the surface waves being excited. Moreover, excitation of the plasma wave at the second harmonic of the laser pulse with \(\omega_{pe}/2\) can be an additional effective channel of power transfer even in the areas not exposed to the laser beam (e.g., other plasma boundaries such as additional electrodes, solid targets, or diagnostic tools). This interesting possibility (not highlighted in previous reports) and its relevance to experiments related to plasma-exposed surfaces subjected to high-power electromagnetic pulses is considered here. In particular, we discuss what can happen with the plasma wave when it reaches a dielectric surface, when the resonant power transfer can take place, how to achieve suitable conditions for the surface resonance excitation, and also address some other relevant practical issues.

\(^{a}\)Author to whom all correspondence should be addressed. Electronic mail: K.Ostrikov@physics.usyd.edu.au
To resolve these deceptively simple issues, we have developed an advanced model for the two-surface wave decay of a plasma wave normally incident onto a dielectric surface. A cold nonrelativistic plasma fluid approximation is used to describe the interaction of a pair of counterpropagating SWs. Using this model, the effects of the dielectric surface, plasma wave parameters, as well as topology of the surface wave fields on spatiotemporal dynamics of the two-surface wave decay process are studied and control strategies of the plasma-surface interactions are discussed.

**II. FORMULATION AND BASIC EQUATIONS**

Let us consider a flat interface between a cold nonrelativistic electron plasma occupying the semispace \(x>0\) and a dielectric in the region \(x<0\) (Fig. 1). Such an interface is well known to sustain counterpropagating SWs\(^\text{17}\) which travel along it (in the \(z\)-axis direction). These waves have opposite wavenumbers \(\pm k\) related to a wave frequency \(\omega\) by the linear dispersion relation

\[
k^2 = k^2 \frac{\varepsilon_p \varepsilon_d}{\varepsilon_p + \varepsilon_d},
\]

where \(k = \frac{\omega}{c}\) is the vacuum wavenumber, \(c\) is the speed of light in a vacuum, \(\varepsilon_p = 1 - \frac{\omega_p^2}{\omega^2}\) is the dielectric permittivity of the plasma with \(\omega_p\) being the electron plasma frequency, and \(\varepsilon_d\) is the permittivity of the dielectric.

The reciprocity of the surface waves enables their interaction with a plasma wave propagating perpendicularly to the plasma-dielectric interface (Fig. 2). It is provided by the spatial synchronism of the three waves along the \(z\)-direction, \(0 = k_x + (-k_x)\). Their temporal synchronism, \(\omega_{pe} = \omega + \omega_x\), which, in fact, characterizes the efficiency of this interaction is possible since the maximum frequency of the SWs,

\[
\omega_{\text{max}} = \frac{\omega_{pe}}{\sqrt{1 + \varepsilon_d}},
\]

may exceed the half-frequency of the PW, \(\omega_{\text{max}} \geq \omega_{pe}/2\), if the dielectric permittivity satisfies \(\varepsilon_d \leq 3\). In the opposite case, when the plasma is bounded by a dielectric with \(\varepsilon_d > 3\), the resonant interaction of the waves cannot be realized and only nonresonant decay is possible. In what follows, we will assume that \(\varepsilon_d \leq 3\) holds and the condition of resonant interaction is satisfied.

In the framework of the plasma fluid approach\(^1\text{7}\), the decay of PWs can be described by the following set of Maxwellian equations and the equation of motion of the plasma electrons in the wave fields,

\[
\nabla \times \mathbf{E} + \frac{1}{c} \frac{\partial \mathbf{H}}{\partial t} = 0,
\]

\[
\nabla \times \mathbf{H} - \frac{1}{c} \frac{\partial \mathbf{E}}{\partial t} + 4\pi \varepsilon_0 \mathbf{V} = - \frac{4\pi}{c} e n \mathbf{V},
\]

\[
\frac{\partial \mathbf{V}}{\partial t} + \nabla \cdot (n_0 \mathbf{V}) = - \nabla \cdot (n \mathbf{V}),
\]

\[
\frac{\partial n}{\partial t} + \nabla \cdot (n_0 \mathbf{V}) = - \nabla \cdot (n \mathbf{V}) - \frac{e}{m c} (\mathbf{V} \times \mathbf{H}),
\]

where \(\mathbf{V}, n_0, n, -e, \) and \(m\) are the fluid velocity, equilibrium density, perturbation of the density, charge, and mass of the plasma electrons, respectively. The fields of the SWs can be written in the following manner:

\[
\mathbf{W}_x = \frac{1}{2} \{ \mathbf{W}_x \exp(-i \omega t) + \mathbf{W}_x^* \exp(i \omega t) \},
\]

where \(\mathbf{W}_x = (E_{x,0}, E_{z,0}, H_{z,0})\) denotes the thee field components for both the waves, propagating in the positive and negative directions of the \(z\)-axis. In a model of cold plasma, the field of the PW is given by

\[
\mathbf{E}_0 = \frac{1}{2} \{ \mathbf{E}_0 \exp(-i \omega_{pe} t) + \mathbf{E}_0^* \exp(i \omega_{pe} t) \},
\]

where \(\mathbf{E}_0 = [E_0 \exp(-i k_0 x) - \exp(i k_0 x), 0, 0]\),

where \(k_0\) is the wavenumber of the PW. The first item in expression (9) describes the plasma wave incident onto the dielectric surface, while the second one accounts for the reflected part of the wave.

In the following, we will analyze only the linear stage of the parametric instability, when the nonlinear attenuation of
the plasma wave caused by the two-surface wave decay is small as compared to the linear damping of PW. It corresponds to the case when the amplitudes of the excited surface waves are small. In this case, the set of Eqs. (3)–(6) for the SW fields can be rewritten in terms of the nonlinear currents

\[ \nabla \times \mathbf{E}_z - i k \mathbf{H}_z = 0, \quad (10) \]

\[ \nabla \times \mathbf{H}_z + i k[(e_p - e_d)\Theta(x) + e_d]\mathbf{E}_z = \frac{4\pi}{c} \Theta(x)\mathbf{J}_z, \quad (11) \]

where \( \Theta(x) \) is the unit step function, equal to 0 for \( x < 0 \), and 1 for \( x \geq 0 \). The right-hand side of Eq. (11) is governed by the nonlinear current in the plasma,

\[ \mathbf{J}_z = \frac{ie}{2\pi\eta_{pe}} \left[ \nabla(\mathbf{E}_0 \cdot \mathbf{E}_z^\perp) + \frac{1}{2} \mathbf{E}_z^\perp(\nabla \cdot \mathbf{E}_0) - \mathbf{E}_0^\perp(\nabla \cdot \mathbf{E}_z^\perp) \right], \quad (12) \]

which includes terms up to the second order in magnitudes of the interacting waves.

It can easily be shown that, since the PW possesses only the perpendicular (with respect to the medium interface) electric field component, the second order surface current is equal to zero. Taking into account this fact, one can write the following boundary conditions:

\[ \mathbf{H}_z(x = -0) = \mathbf{H}_z(x = +0), \quad (13) \]

\[ \mathbf{E}_z(x = -0) = \mathbf{E}_z(x = +0), \quad (14) \]

which quantify the SW fields at the plasma-dielectric interface.

Solving Eqs. (10) and (11) using the method of successive approximations and applying boundary conditions (13) and (14) to the SW fields in the plasma and dielectric, one can derive the following dynamic equations for the amplitudes of the excited waves

\[ \left( \frac{\partial}{\partial t} + V_{gr} \frac{\partial}{\partial z} \right) E_z = -\alpha E_0 E_z^\perp, \quad (15) \]

where the coupling coefficient between the plasma and the surface waves

\[ \alpha = \frac{2e}{cm} \frac{e_p e_d^2 k_0}{e_d + e_p^2 (4e_p^2 k_0^2 - (e_d + e_p) k_0^2)} \quad (16) \]

characterize the efficiency of two-surface wave decay.\(^{24}\) These equations account for spatial perturbations of the SW amplitudes propagating with a group velocity \( V_{gr} = \left[ \partial \omega / \partial k_0 \right] \) in the positive direction of the \( z \)-axis for the wave with the amplitude \( E_z \) and in the opposite direction for the wave with \( E_z^\perp \).

Taking into account energy dissipation for both the surface and plasma waves, dynamic Eqs. (15) can be rewritten in the form\(^{25}\)

\[ \left( \frac{\partial}{\partial t} + V_{gr} \frac{\partial}{\partial z} \right) E_z = -\alpha E_0 E_z^\perp \exp(-\gamma_0 t) - \gamma E_z, \quad (17) \]

where the items \( -\gamma E_z \) describe the linear attenuation of the SWs,

\[ E_z \propto \exp(-\gamma t), \quad (18) \]

with the damping rate \( \gamma \). For example, collisional damping of surface waves is commonly known and is characterized by the rate

\[ \gamma_{col} = \frac{\nu (1 - e_p)}{2 (e_d + e_p^2)}, \quad (19) \]

where \( \nu \) is the effective frequency of electron collisions.\(^{17}\) Furthermore, the rate of resonant attenuation of the SW caused by the plasma nonuniformity in the transition layer near the solid surface is given by\(^{26}\)

\[ \gamma_{res} = -\pi \eta k \omega \sqrt{\frac{e_p^3}{e_d + e_p^2}} \frac{e_p^2 e_d^2}{(e_d + e_p)^2}, \quad (20) \]

where the parameter \( \eta = (d e_p/d x)_{\omega_0} \) describes the nonuniformity of the plasma density calculated at the point of the plasma resonance \( \omega_0 \), where \( e_p(\omega_0) = 0 \). Likewise, secondary electron emission from the dielectric surface\(^{26}\) may also significantly affect the surface wave damping

\[ \gamma_{sec} = -j_e F \sqrt{\frac{e_p}{e_d}} \frac{e_p-e_d^2 (1-e_p)}{e_d (e_d - e_p)(e_d + e_p^2)}, \quad (21) \]

especially in the low-frequency region, where the parameter \( F \) increases from 0.5 to 2.0 with decreasing SW frequency and characterizes the average energy taken by a secondary electron from the wave at a given secondary electron current density \( j_{se} \).

The factor \( \exp(-\gamma_0 t) \) in Eqs. (17) describes attenuation of the PW with the damping rate \( \gamma_0 \). Generally, it depends on the wavenumber \( k_0 \). However, for small wavenumbers when the cold plasma condition \( k_0^2 V_{Te}^2 / \omega^2 \ll 1 \) holds, the damping rate

\[ \gamma_0 = \nu / 2 \quad (22) \]

is primarily determined by electron collisions. Here, \( V_{Te} \) is the thermal velocity of the plasma electrons.

### III. RESULTS

The set of coupled dynamic equations (15) can be reduced to the following two independent equations:

\[ \left[ \frac{\partial}{\partial t} + \left( \frac{\partial}{\partial z} \right)^2 - V_{gr} \frac{\partial^2}{\partial z^2} \right] E_z = \alpha^2 |E_0|^2 E_z \exp(-2\gamma_0 t) - \gamma_0 \left( \frac{\partial}{\partial t} + \gamma + V_{gr} \frac{\partial}{\partial z} \right) E_z, \quad (23) \]

with the solutions

\[ E_z = \left[ C_{1z} f_m(\xi) + C_{2z} K_m(\xi) \right] \exp[-(\gamma_0 t/2) \pm i \kappa z], \quad (24) \]

where \( \xi = (\alpha |E_0| / \gamma_0) \exp(-\gamma_0 t), \) \( m = 1/2 - i(\kappa V_{gr} / \gamma_0), \) and \( \kappa \) is the wavenumber of spatial perturbations of the SW amplitudes. Here, \( f_m \) and \( K_m \) are the modified cylindrical Bessel and McDonald functions of the complex order \( m \). The con-
stants $C_{1k}$ and $C_{2k}$ are determined by the initial values of the SW amplitudes and their derivatives.

A. Initial stage

To investigate the dynamics of the instability, let us consider the initial stage, when $\gamma t \ll 1$. At this stage, the dynamics of the SWs is determined by the ratio of $\alpha |E_0|$ to $\gamma$. If the amplitude of the plasma wave is small enough ($\alpha |E_0| < \gamma_0$), the effect of the PW on surface waves can be ignored due to its significant attenuation. On the other hand, when the plasma wave is rather strong, and $\alpha |E_0| > \gamma_0$, holds, the amplitude of the plasma wave can reasonably be treated invariable during the initial stage. In that case, the solution is

$$E_\pm(t,z) = E_\pm(0) \exp(-\gamma t \pm i k z),$$  \hspace{1cm} (25)

where

$$\xi = \cosh(\beta) - \left( \frac{\alpha E_0 E_\pm(0)}{\beta} + i \frac{\kappa V_{SW}}{\beta} \right) \sinh(\beta)$$

and parameter $\beta = (\alpha^2 |E_0|^2 - \kappa^2 V_{SW}^2)^{1/2}$ characterizes an increase of the amplitudes of the surface waves initially modulated by the electric field

$$E_\pm(0,z) = E_\pm(0) \exp(\pm i k z),$$  \hspace{1cm} (26)

with the modulational wavenumber $k$.

The condition of SW excitation can be obtained from Eq. (25),

$$|E_\pm| > |E_{\theta\phi}| = \sqrt{\frac{\gamma^2 + \kappa^2 V_{SW}^2}{\alpha^2}},$$  \hspace{1cm} (27)

and taking into account that, at $t > 1/\beta$, the SW fields grow exponentially. This condition imposes a restriction on the minimum amplitude of the plasma wave, above which the SW excitation is possible. At smaller amplitudes of the PW, the damping of SWs dominates over the growth of their amplitudes caused by the development of the decay instability and results in a decrease in the amplitudes of both SWs with time. When the PW amplitude exceeds threshold value (27), the amplitudes of both SWs increase according to $E_\pm(t,z) \sim \exp(\gamma_{NL} t)$, where

$$\gamma_{NL} = \sqrt{\alpha^2 |E_\pm|^2 - \kappa^2 V_{SW}^2 - \gamma}$$  \hspace{1cm} (28)

is the nonlinear growth rate. Thus, an increase in the PW amplitude, as well as a decrease of the linear SW damping rate, leads to an increase in the nonlinear growth rate $\gamma_{NL}$.

The above results suggest that an increase in the absolute value of the modulational wavenumber, $k$, leads to an increase in the threshold, $|E_\pm|_{th}$, and to a decrease of the nonlinear growth rate, $\gamma_{NL}$. It means that perturbations of the surface wave amplitudes with shorter wavelengths may stabilize the decay process. Moreover, from Eq. (27) one can conclude that the global threshold for the decay is determined by the minimum of $|E_\pm|_{th}$.

It is worth noting that, in a cold plasma, the actual influence of the PW wavenumber $k_0$, on the values of the nonlinear growth rate $\gamma_{NL}$, and the threshold $|E_{\theta\phi}|_{th}$, is governed by the dependence $\alpha(k_0)$. It is easily be shown that the parameter $\alpha(k_0)$ is positive. Moreover, at

$$k_0_{max} = k \sqrt{-\frac{4\varepsilon_\epsilon^2}{\varepsilon_d + \varepsilon_\epsilon}},$$  \hspace{1cm} (29)

it reaches the maximum. Thus, at $k_0 = k_{0\max}$, threshold value (27) features the minimum, while nonlinear growth rate (28) reaches its maximum value.

We have also conducted a detailed numerical analysis which has shown that with an increase in the permittivity of the dielectric, the minimum of $|E_\pm|_{th}$ decreases and shifts towards larger wavenumbers $k_0$ (Fig. 3). In the limit of $\varepsilon_d = 3$, when the plasma wave decays into potential SWs, $k_{0\max}$ tends to infinity and the minimum of $|E_\pm|_{th}$ disappears.

B. Decay saturation and power transfer efficiency

Since the amplitude of the plasma wave decreases exponentially with time, the energy transferred to the surface waves also decreases. It leads to the saturation of the two-surface wave decay. After the plasma wave is attenuated completely, the surface wave damping is then characterized by the linear rate $\gamma$ entering

$$|E_\pm(t \rightarrow \infty) | \rightarrow \eta_{\pm}(t)|E_\pm(0)| \exp(-\gamma t),$$  \hspace{1cm} (30)

where the parameters

$$\eta_{\pm}(t) = \frac{|E_\pm(t)|}{|E_\pm(0)|} \exp(\gamma t)$$  \hspace{1cm} (31)

represent the ratios of the nonlinear SW amplitudes $|E_\pm(t)|$, to the amplitude values of the linear waves, $|E_\pm(0)| \exp(-\gamma t)$. Therefore, parameters $\eta_{\pm}$ can be used to quantify the power transfer efficiency of the three-wave interaction and in the limit $t \rightarrow \infty$ can be written as

\[ \eta_{\pm}(t) = 1 - \frac{1}{\alpha^2 |E_\pm|^2} \]
Two-surface wave decay: Controlling power transfer

...tudes continuously decrease due to pronounced damping. Corresponding SWs are not excited. On the contrary, their amplitudes increases with the initial phase $\Phi$. It means that at $\Phi=0$, the SW amplitudes reaches the maximum $\eta(\infty)=\cosh(\xi_0)-\sinh(\xi_0)\exp(i\Phi(0))$ when $\kappa=0$.

Due to the equivalence of the two excited surface waves, it is naturally to set $|E_+|_0=|E_-|_0$, then $\eta(\infty)=\eta(t)$ and we obtain

$$\eta(\infty)=\sqrt{\cosh(2\xi_0)-\sinh(2\xi_0)\cos(\Phi(0))}$$

This process may occur on dielectric surfaces characterized by $\epsilon_2\approx 3$ only, leading to the resonant excitation of a pair of subharmonic SWs with the half-plasma frequency. The results obtained have shown that dynamics of the two-surface wave decay is governed by the parameter $\alpha(k_0)E_0^3/\gamma_0$. Thus, the effects of different parameters of the plasma wave are the same for $\alpha(k_0)E_0^3/\gamma_0=\text{const}$. Therefore, the power transfer efficiency in the plasma wave decay (Fig. 5) increases, since the amplitude of the plasma wave, $|E_0|$, increases, whereas the PW wavenumber, $k_0$, tends to its maximum value, $k_{0\max}$.

We now estimate the threshold for the plasma wave decay for typical parameters of laser-generated plasmas with the density $n_0=3\times 10^{16}$ cm$^{-3}$ and the temperature $T=0.6$ eV used for pulsed laser ablation-based synthesis of Si nanoclusters. In this case, depending on the dielectric permittivity of a plasma-exposed surface, the two-surface wave decay of a PW with $k_0=600$ cm$^{-1}$ (corresponding to $k_0V_T/e\omega_p=0.002$) may occur, if the amplitude of the incident wave $|E_0|$ exceeds $0.2-0.5$ MV/cm for $\epsilon_2=1.0-2.9$, respectively. These values are well within the range of magnitudes of the electric field ($\sim 10^3-10^6$ V/cm) in laser beams used for pulsed laser deposition (PLD) of various nanomaterials.

The above estimates complemented by the results presented in Fig. 3 suggest that the two-surface wave decay of a plasma wave normally incident onto a plasma-exposed surface is characterized by relatively low thresholds which are comparable with or less (as the plasma temperature increases) than those of the modulational instability, $\epsilon|E_0|/mc\omega_p=V_T/e(\sqrt{3}c)$. Furthermore, in contrast to the modulational instability, the decay of PWs develops over time scales of electron motions. Therefore, it can be treated as an additional source of the SWs and serves as a powerful channel for plasma waves to dissipate their energy into the plasma periphery due to significant attenuation of the surface waves. In other words, this process leads to an additional heating of the plasma-exposed surface and plays an important role in redistribution of the input power.

Finally, we emphasize that the results of this study are valid for the weak nonrelativistic plasma nonlinearities only. Nevertheless, the two-surface wave decay of a plasma wave...
may appear under quite different conditions beyond the limits of the approximation used and may be of relevance to high-power regimes of interactions of pulsed lasers with solid targets.

V. CONCLUSION

This study has shown that the two-surface wave decay of a plasma wave incident normally onto a plasma interface may be a powerful channel for the excitation of electron surface waves in various processes that involve interactions of short laser pulses with overdense plasmas. This decay is based on the parametric excitation of a pair of counterpropagating SWs with frequencies close to the half-plasma frequency. We have studied the effect of the plasma wave parameters, as well as spatial perturbations of the SW fields, on spatiotemporal dynamics of the two-surface wave decay in the framework of the nonrelativistic, weakly nonlinear plasma fluid approximation. This process may play an important role in absorption of the input power in laser interactions with solid targets in diverse applications ranging from inertial plasma confinement to pulsed laser ablation of solid targets.

ACKNOWLEDGMENTS

This work was partially supported by the Australian Research Council and the University of Sydney.