Self-modulation of a strong electromagnetic wave in a positron-electron plasma
induced by relativistic temperatures and phonon damping

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The modulational instability of a linearly polarized, strong, electromagnetic wave in a
(unmagnetized) positron-electron plasma is analyzed using relativistic two-fluid hydrodynamics to
properly account for physical regimes of very high temperatures. The effect of phonon damping is
also included in the treatment. The theory can be reduced to a pair of extended Zakharov equations.
The envelope modulation is then studied by deriving the corresponding nonlinear Schrödinger (NLS)
equation, using multiscale perturbation analysis. According to the intensity of the damping three
different types of NLS are obtained. The main results are (a) that relativistic temperatures modify the
stability result found in the literature for low temperature, zero damping, [formula presented]
-[formula presented] plasmas, and (b) that phonon damping also produces substantial changes in
the NLS, which then predict unstable envelopes. This work extends previous analyses, showing that
if the phonon damping is O([