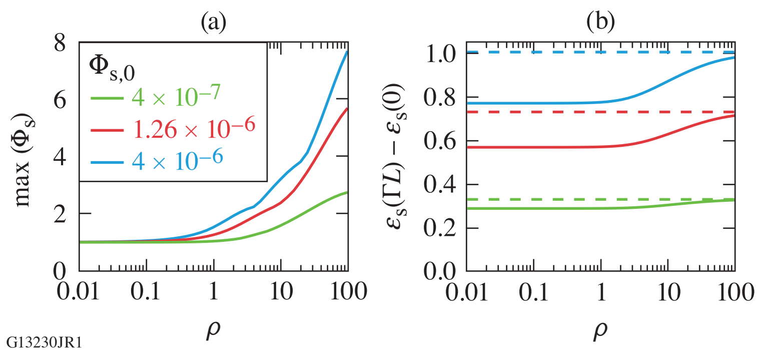
About the Cover:

Broadband spectrally incoherent pulses are promising to mitigate laser–plasma instabilities and beam imprint. Three-wave nonlinear mixing can amplify optical pulses over much larger bandwidth than laser amplification. The operation of optical parametric amplifiers (OPA's) with coherent pulses having smooth, slowly varying temporal profiles is well understood, but their operation with spectrally incoherent pulses having random high-frequency time-domain modulations has not previously been described in detail.

A framework based on normalized three-wave nonlinear mixing equations has been developed and used to analyze the operation of OPA's with spectrally incoherent pulses, showing that the temporal walk-off between signal, pump, and idler, as well as the relative photon flux of the pump and signal wave, play a critical role in the energy, bandwidth, and statistical properties of the amplified signal. The images on the cover show the evolution of the probability density function (pdf) of signal photon flux (Φ) as a function of the temporal walk-off between the signal and pump normalized to the signal's coherence time. In the absence of pump depletion (upper figure), the pdf remains a negative exponential function, as expected for an incoherent source. When the signal is sufficiently high to deplete the pump (lower figure), the pdf depends strongly on the pump-signal walk-off: the signal's photon flux is limited by the pump's photon flux at low temporal walk-off, but the signal can be amplified to much higher values if temporal walk-off allows it to deplete the pump over a range of times.

Parametric amplification leads to a clamping of the signal's temporal modulations for low pump-signal temporal walk-off, but the signal's intensity at certain times can be much larger than what can be obtained with coherent waves, particularly as the input signal intensity increases (a). The amplification efficiency for spectrally incoherent waves is lower than for coherent waves, but it converges to the same value for large pump-signal temporal walk-offs that allow for pump depletion in all time slots (b).



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