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Numerical studies of nonlinear Raman amplification of laser pulses in plasma R.M.G.M. TRINES, R. BINGHAM, P.A. NORREYS, STFC Rutherford Appleton Laboratory, UK, F. FIUZA, L.O. SILVA, Instituto Superior Tecnico, Lisbon, Portugal, R.A. CAIRNS, U. St Andrews, St Andrews, UK — Raman amplification of a short probe pulse off a long pump in plasma is an attractive alternative to amplification in solids, as plasma can tolerate much higher intensities. Most theoretical and experimental studies conducted to date have employed moderate probe intensities ($< 10^{16}$ W/cm^2) and widths (< 50 micron). However, truly competitive intensities can only be reached if the amplification process is carried out at much higher probe intensities ($10^{17} - 10^{18}$ W/cm^2) and widths ($1 - 10$ mm). In this regime, various nonlinear effects become important, such as Langmuir wave breaking, Raman forward scattering, self-focusing, filamentation, and gain narrowing. In addition, nonlinear saturation of various processes may limit the energy transfer efficiency from pump to probe. In this paper we present 1-D and 2-D numerical simulations of strongly nonlinear Raman and superradiant amplification. The influence of various nonlinear processes will be investigated and the consequence for these amplification schemes will be discussed. This work is supported by the STFC Accelerator Science and Technology Centre and the STFC Centre for Fundamental Physics.

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