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Thermal effects in Raman amplification of laser pulses in plasma
R. TRINES, STFC Rutherford Appleton Laboratory, Didcot, UK, F. FIUZA, GoLP/Instituto de Plasmas e Fusao Nuclear, IST, Lisbon, Portugal, R. BINGHAM, P. NORREYS, STFC Rutherford Appleton Laboratory, Didcot, UK, R.A. FONSECA, L.O. SILVA, GoLP/Instituto de Plasmas e Fusao Nuclear, IST, Lisbon, Portugal, R.A. CAIRNS, University of St Andrews, St Andrews, UK — Recent numerical studies into Raman amplification in plasma at high laser intensities and powers showed that multi-petawatt pulses of fs-ps duration and energies of 0.1-1 kJ can be produced via this process [Trines et al., Nature Physics (2011), Phys. Rev. Lett. (2011)]. In these studies, it was assumed that the plasma was collisionless and initially cold. In practice, however, plasma will necessarily have a temperature of at least a few eV, and collisions will play an important role for higher plasma densities ($10^{19} - 10^{20}$ cm^{-3}) or longer pump pulse durations (> 100 ps). In this paper, we will investigate the influence of thermal and collisional effects such as Landau damping, collisional damping/absorption, thermal filamentation and Bohm-Gross frequency shifts, through one-and two-dimensional particle-in-cell simulations. We will show how the inclusion of thermal effects affects the parameter window for optimal Raman amplification, compared to the cold-plasma case. This work was supported by STFC's CLF and CfFP, by EPSRC through grant EP/G04239X/1 and by FCT (Portugal) through grants PTDC/FIS/66823/2006 and SFRH/BD/38952/2007.

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