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A nonlinear 2-fluid study of the effect of pellet injection on ELM dynamics

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We report on nonlinear simulation studies of the dynamical behavior of ELMs under the influence of repetitive injection of pellets using the nonlinear 2-fluid code CUTIE. ELMs are excited by introducing a particle source in the confinement region and a particle sink in the edge region. High density pellets are injected repeatedly near the edge with different duty cycles, where a duty cycle refers to the ratio of on'time andoff' time of localized density perturbations. A combination of various duty cycles and different densities of the pellets have been used and comparative studies of the time series in
edge density and temperature perturbations both in the absence and presence of pellets have been made. We find that the pellets significantly influence both the frequency and amplitude of the ELMs and the results are sensitive to the duty cycle and the density of
the pellets. For pellets with density that are twice the normal edge density and injected with a duty cycle of 1:2, the ELMs are generated on an average at a faster rate (˜twice the rate of normal ELMs) and with reduced amplitudes (˜50% of the average height of ELMs without pellets). These changes lead to significant improvements in the plasma beta indicative of an improvement in the energy confinement due to pellet injection. Furthermore, advanced spectral analysis of the data shows that in the presence of pellets there is an inward shift in the radial location of the ELMs and a spectral shift of
the mode energy towards longer wavelengths. The shifts in the fluctuation spectrum with pellets are opposite to those of earlier RMP results in that pellets induce an inverse cascade while RMPs lead to a direct cascade of the energy. Both mechanisms however lead to an overall improvement in the plasma beta.

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