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A novel parametric instability of propagating critical layer affecting the laser longitudinal envelope AAKASH SAHAI, Duke Univ — A parametric instability that affects the longitudinal envelope of a laser pulse interacting with a propagating critical layer is presented [Sahai,PoP 21,056707, 2014; Sahai, arXiv:1411.2401, 2014]. It is shown that non-linear mixing between the incident and reflected laser pulse from a propagating critical layer electron compression results in a beat-wave with a complete modulation of the incident wave envelope. This beat-wave modulates the velocity of the propagating critical layer, resulting in a new Doppler frequency which creates a second beat-wave, further modulating the laser envelope. The frequency spread of the laser envelope grows in time resulting in a large spectral spread of the laser pulse envelope. The velocity of the propagating critical layer acceleration structure is correspondingly modulated as is the space-charge potential. Thus, the ions that are accelerated off the potential have a large energy spread. Since, the growth rate of this instability depends upon the acceleration structure velocity, longer pulses are unfavorable for accelerating ions to higher energies with a narrow energy spread. This instability is also relevant to laser-driven fusion and laser hole-boring based fast-ignition but due to much smaller velocities, its effect is mitigated.

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