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Adaptive Kinetic Model for the Ultrafast Laser Ablation Propulsion OLEG BATISHCHEV, MIT, Cambridge, MA 02139, ALLA BATISHCHEVA, DSL Inc, Cambridge, MA 02139, JEAN-LUC CAMBIER, AFRL/PRSA, Edwards AFB, CA 93524 — Modern ultrafast femtosecond Ti:Sa lasers are capable of delivering tera-watt powers to a 1-10μm size volumes at 1-10KHz repletion rates. Though the energy per single pulse is limited to 0.01-1J, due to the unparallel energy density, the material in a focal spot ablates with high energy, instantly forming T$\sim$0.01-1MeV plasma, which corresponds to the extremely high specific impulse Isp$\sim$0.01-1Msec. Amount of the ablated material is controlled by the focal spot size. Average thrust could be controlled in the broad range by varying the atomic weight of the irradiated material and the laser repetition rate, effectively varying average power in the 10W – 10kW interval. Various practical configurations are considered. One of the possibilities is ablating micro-droplets in the strong diverging magnetic field. In this way most of the 1.5kT random energy could be directed into a half-space, thus forming an exhaust plume. The efficiency of laser energy absorption, ablated plasmas energy spectra, plume divergence, net thrust production are difficult questions to be answered. For analysis we deploy an adaptive kinetic model that solves strongly couple sets of non-linear Boltzmann-Maxwell equations. Results of the numerical simulations for a range of physical parameters – laser pulse durations, flux densities, target dimensions – will be discussed.

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