Radiative acceleration and transient, radiation-induced electric fields Zampieri et al.

abstract The radiative acceleration of particles and the electrostatic potential fields that arise in low density plasmas hit by radiation produced by a transient, compact source are investigated. We calculate the dynamical evolution and asymptotic energy of the charged particles accelerated by the photons and the radiation-induced electric double layer in the full relativistic, Klein-Nishina regime. For fluxes in excess of $10^{27}$ erg cm$^{-2}$ s$^{-1}$, the radiative force on a diluted plasma ($n10^{11}$ cm$^{-3}$) is so strong that electrons are accelerated rapidly to relativistic speeds while ions lag behind owing to their larger inertia. The ions are later effectively accelerated by the strong radiation-induced double layer electric field up to Lorentz factors $\approx 100$, attainable in the case of negligible Compton drag. The asymptotic energies achieved by both ions and electrons are larger by a factor 2–4 with respect to what one could naively expect assuming that the electron-ion assembly is a rigidly coupled system. The regime we investigate may be relevant within the framework of giant flares from soft gamma-repeaters.