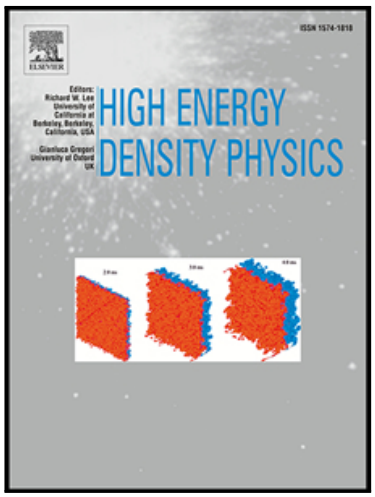

Transition from coherent to incoherent acceleration of nonthermal relativistic electron induced by an intense light pulse

Y.L. Liu, Y. Kuramitsu, T. Moritaka, S.H. Chen

PII: S1574-1818(17)30011-3
DOI: 10.1016/j.hedp.2017.02.006
Reference: HEDP 591

To appear in: *High Energy Density Physics*

Received date: 31 October 2016
Accepted date: 14 February 2017

Please cite this article as: Y.L. Liu, Y. Kuramitsu, T. Moritaka, S.H. Chen, Transition from coherent to incoherent acceleration of nonthermal relativistic electron induced by an intense light pulse, *High Energy Density Physics* (2017), doi: 10.1016/j.hedp.2017.02.006

Transition from coherent to incoherent acceleration of nonthermal relativistic electron induced by an intense light pulse

Y. L. Liu,[1] Y. Kuramitsu,[2] T. Moritaka,[3] and S. H. Chen[2]

[1)] *Institute of Atomic and Molecular Sciences, Academia Sinica, P. O. Box 23-166, Taipei, Taiwan*[a)]

[2)] *Department of Physics, National Central University, Jhongli 32001, Taiwan*[b)]

[3)] *Fundamental Physics Simulation Research Division, National Institute for Fusion Science, National Institutes of Natural Sciences, Toki 509-5292, Japan*

(Dated: 16 February 2017)

Nonthermal acceleration of relativistic electrons due to the wakefield induced by an intense light pulse is investigated. The spectra of the cosmic rays are well represented by power-law. Wakefield acceleration has been considered as a candidate for the origins of cosmic rays. The wakefield can be excited by an intense laser pulse as large-amplitude precursor waves in collisionless shocks in the universe. National Central University (NCU) 100-TW laser facility in Taiwan is able to provide high-repetition rate and short intense laser. To experimentally study the wakefield acceleration for the spectrum of the cosmic rays, particle-in-cell simulations are performed to calculate the energy distribution functions of electrons in fixed laser conditions with various plasma densities. The transitions of wakefields from coherent to inherent are observed as the plasma density increases. The distribution functions indicate that the smooth nonthermal power-law spectra with an index of -2 appear when the incoherent wakefields are excited. In contrast, the mono-peak appear in the spectra when the coherent wakefields are excited. The incoherent wakefields yielding the power-law spectra imply the stochastic accelerating of electrons. To explain the universal nonthermal power-law spectra with an index of -2, we described and extended the stochastic acceleration model based on Fokker-Planck equation by assuming the transition rate as an exponential function.

[a)] Electronic mail: nem2050@g.ncu.edu.tw

[b)] Electronic mail: yasuhiro.kuramitsu@gmail.com