17a-F7-3

Source Structure of High-Order Harmonics from Relativistic Electron Spikes

JAEA [1], P. N. Lebedev Physical Institute [2], Rutherford Appleton Laboratory [3],

The Graduate School for the Creation of New Photonics Industries [4]

°A. S. Pirozhkov[1], M. Kando[1], T. Zh. Esirkepov[1], T. A. Pikuz[1], A. Ya. Faenov[1], K. Ogura[1], Y. Hayashi[1], H. Kotaki[1], E. N. Ragozin[2], D. Neely[3], H. Kiriyama[1], T. Shimomura[1], M. Tanoue[1], Y. Nakai[1], M. Okamoto[1], K. Torimoto[1], T. Sato[1], S. Kondo[1], S. Kanazawa[1], J. K. Koga[1], Y. Fukuda[1], M. Nishikino[1], T. Imazono[1], N. Hasegawa[1], T. Kawachi[1], H. Daido[1], Y. Kato[4], P. R. Bolton[1], S. V. Bulanov[1], and K. Kondo[1]

E-mail: pirozhkov.alexander@jaea.go.jp

We have recently discovered a new regime of relativistic high-order harmonic generation from gas jet targets driven by multi-terawatt relativistic-irradiance (>10^{18} W/cm^2) femtosecond lasers (~30-50 fs) [1] and suggested a new model of high harmonics generation by plasma flow catastrophes created by the laser pulse. The resulting extremely sharp, structurally stable, oscillating electron spikes coherently emit bright x-ray radiation.

In recent experiments with the J-KAREN laser [2] we imaged the source of harmonics with photon energies from 60 to 100 eV onto a LiF crystal detector [3], which provides sub-μm resolution. The images reveal that the harmonics are emitted from two point-like regions with size smaller than a micron, in accordance with the prediction of our relativistic electron spikes model.

1. A. S. Pirozhkov, *et al.*, "Soft-X-Ray Harmonic Comb from Relativistic Electron Spikes," *Phys. Rev. Lett.* **108** (13), 135004-5 (2012).
2. H. Kiriyama, *et al.*, "High temporal and spatial quality petawatt-class Ti:sapphire chirped-pulse amplification laser system," *Opt. Lett.* **35** (10), 1497-1499 (2010).
3. T. Pikuz, *et al.*, "Optical features of a soft X-ray imaging detector based on photoluminescence point defects in LiF crystals irradiated by Free Electron Laser pulses," *Optics Express* **20** (4), 3424 (2012).