Inverse Compton X/γ Source Based on Laser Wake-Field Accelerator

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Electron–photon scattering, or Thomson scattering, is one of the most fundamental mechanisms in electrodynamics, underlying laboratory and astrophysical sources of high-energy X-rays. After a century of studies, it is only recently that sufficiently high electromagnetic field strengths have been available to experimentally study the nonlinear regime of Thomson scattering in the laboratory. Making use of a high-power laser and a laser-driven electron accelerator, we made the first measurements of high-order multiphoton scattering, in which more than 500 near-infrared laser photons were scattered by a single electron into a single X-ray photon. Both the electron motion and the scattered photons were found to depend nonlinearly on field strength. The observed angular distribution of scattered X-rays permits independent measurement of absolute intensity, in situ, during interactions of ultra-intense laser light with free electrons. Furthermore, the experiment's potential to generate attosecond-duration hard X-ray pulses can enable the study of ultrafast nuclear dynamics.

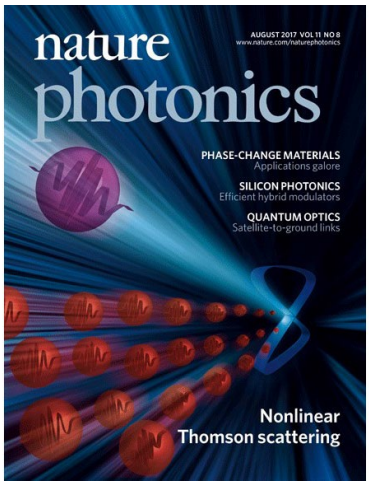

Figure 1: Cover art for [1]

This can act as a new generation of accelerator-based hard X/γ-ray sources driven exclusively by laser light. One ultrahigh intense CPA laser pulses will act as two means: first used to accelerate electrons by laser driven wake field (LWFA) to hundreds MeV, and second, from split beam or LWFA-leftover energy reflected by plasma mirror, to collide on the electron for the generation of X/γ-rays by inverse Compton scattering (ICS). Such all-laser-driven X/γ source have recently been demonstrated to be energetic, tunable, narrow/broad in bandwidth, short pulsed and well collimated. Simulation show highly intensive gamma energy harmonics can also generated these sources. Such characteristics, especially from a compact source, are highly advantageous for numerous advanced X-ray applications. Moreover, preliminary plan of laser wake-field accelerator and radiation source in high-power laser facility in SJTU and TDLI will be presented.

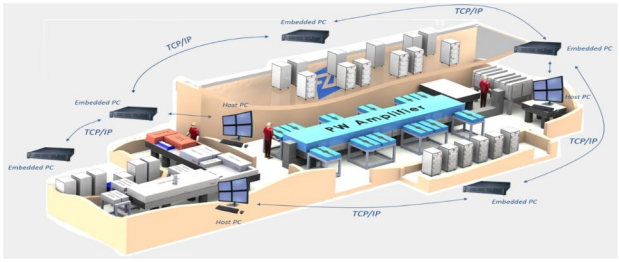

Figure 2: X/Gamma source in SJTU& TDLI

References

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[2] Y. Gu and Stefan Weber, Opt. Express 26, 19932-19939 (2018)

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