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Recently research progress on Thomson scattering X-ray source at Tsinghua University

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Tsinghua Thomson Scattering X-ray Source (TTX) is the first-of-its-kind dedicated hard X-ray source in China based on the Thomson scattering between a terawatt ultrashort laser and relativistic electron beams [1]. Many improvements have been performed at the facility during the last three years since 2013, including developing a new separated Ti:Sapphire laser system for collision, 100-fs timing system, photocathode RF gun to produce better electron beams and many beam diagnostic methods. The measured photon yield at ~50keV is 2× 〖10〗 ^7 per pulse, which is increased by an order compared with the previous report [1]. The angular intensity distribution and energy spectra of the scattered X-rays are measured by the silicon attenuators and Bragger diffraction in Highly Oriented Pyrolytic Graphite(HOPG) crystal. The results of the two methods are both agrees well with the theory predictions.
The scattered x-rays are partial coherent, due to the very small beam size(~5μm, theoretical value), which meets the requirement of phase contrast imaging(PCI). A series of samples like shrimp, fish, and peanut are imaged using TTX, and both absorption image and phase contrast images at different imaging distances of the same sample are taken. The interfaces between different materials in the samples are enhanced as the imaging distance increases. Because of this characteristic the testa of peanut, which can't be distinguished from cotyledon under its absorption image, can be seen clearly under its phase-contrast image, making interfaces diagnostic of low-Z materials possible. Besides, the tomography technique is also performed with the generated X-rays, and the 3-dimension structure of peanut are reconstructed.

[1] Yingchao Du, Lixin Yan, Jianfei Hua, Qiang Du, Zhen Zhang, Renkai Li, Houjun Qian, Wenhui Huang, Huaibi Chen, and Chuanxiang Tang. "Generation of first hard X-ray pulse at Tsinghua Thomson Scattering X-ray Source." Review of Scientific Instruments 84, no. 5 (2013): 053301.

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