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# Nonlinear X-Ray Wave-Mixing (+ Discussion)

*Tuesday, 19 May 2015 11:50 (45 minutes)*

I will describe recently performed experiments demonstrating nonlinear x-ray wave-mixing including x-ray and visible wave mixing [1], x-ray second harmonic generation [2], and x-ray parametric down-conversion [3]. I will present theoretical studies of difference-frequency generation of optical radiation from two-color x-ray pulses [4], and x-ray-pulse characterization by spectral shearing interferometry [5]. I will discuss future directions of exploring nonlinear and quantum effects in the x-ray regime. For example, x-ray parametric down-conversion may be developed into a very powerful method to study fundamental effects in quantum optics. X-ray and visible mixing may lead to atomic scale resolution techniques to study chemical bonds. Nonlinear techniques are expected to be useful in the inspection of sub-femtosecond temporal pulses.

[1] T. E. Glover et al., Nature 488, 603 (2012).
[2] S. Shwartz et al. Phy. Rev. Lett. 112, 163901 (2014).
[3] S. Shwartz et al. Phy. Rev. Lett. 109, 013602 (2012).
[4] E. Shwartz and S. Shwartz, Opt. Exp. 23, 7471 (2015)
[5] S. Yudovich and S. Shwartz, Phys. Rev. A 90, 033805 (2014).

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