

X-ray optical wavemixing: Theory, challenges and prospects

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With the development of optical lasers, nonlinear wavemixing techniques were established that have since found their applications across a broad range of science and technologies. Today, the emergence of FELs allows to transfer such wavemixing concepts towards increasingly higher photon energies and thereby gain new probes of matter beyond the linear response. Of particular interest are processes of parametric x-ray optical wavemixing; these promise imaging capabilities similar to regular x-ray diffraction with additional spectroscopic selectivity tunable via the optical admixture. Intriguingly, this provides a method to specifically address valence electrons. In order to explore the potential of such processes, a theoretical description of parametric x-ray optical wavemixing is presented, which adopts a scattering perspective in non-relativistic QED. Applications in terms of sum- and difference-frequency generation will be discussed with a view to both present and future experiments.

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