Parametric-Down Conversion of X-rays into the Optical Regime

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Nonlinear interactions of x-rays and optical radiation can provide insight into the microscopic structure of chemical bonds and valence electrons in solids, and into light-matter interactions at the atomic-scale resolution [1-3]. The high resolution is the result of the use the x-rays, whereas the optical fields interact with the valence electrons. This probe has a great potential to be used for testing and improving the understanding of condensed matter physics.

We present the first measurements of extreme non-degenerate parametric down-conversion (PDC) of x-rays into the optical regime [4]. The experimental setup is shown in Fig. 1. We measured PDC at energies that correspond to various optical wavelengths in the range of 280-650 nm. A measurement of the PDC x-ray signal for an analyzer scan is shown in Fig. 2(a). A measurement of the PDC x-ray signal as a function of crystal angle is shown in Fig. 2(b). The PDC signal is well above the background and the separation from the elastic is pronounced.

Fig. 1: Experimental setup

Fig. 2: (a) X-ray signal count rate as a function of the detuning from the photon energy of the input beam. (b) X-ray signal count rate as a function of the pump deviation angle from the phase matching angle. The blue dots are experimental data and the red curve is calculated from theory.