fall-off time, $\tilde{P}(t)_{10\sim20ns}$ shows a speedy reduction, whereas $\tilde{P}(t)_{10\sim60ns}$ keeps a nearly fixed value. Fluctuation of the magnetic moment in the crystal is decreased by the time development of the magnetic relaxation.

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TIME AND ENERGY SPECTRA OF INTERNAL CONVERSION ELECTRONS FROM ^{57}Fe FOIL

Energy distribution and time spectra of internal conversion electrons from ^{57}Fe foil were measured at the **BL09XU** beamline. The emission signal of conversion electrons excited with incident X-ray photons was discriminated by electron energy analysis and intense prompt noise was excluded in the signal processing. The apparatus consists of an electrostatic electron energy analyzer and a sample manipulator contained in an ultrahigh vacuum chamber. The analyzer we developed was a planar electrostatic quadrupole type assembled on a 203 mm Conflat-type flange. The electrons incident through an entrance slit of the analyzer were deflected at an angle of 90˚ inside the hyperbolic electrostatic field. The acceptance angle and the energy resolution were 0.04 π and 4%, respectively.

An avalanche photodiode (APD) detector was attached at the exit of the analyzer. The APD detector proved high detection efficiency for high-energy electrons as well as excellent time response (< 1 ns) and noise characteristics (< 0.01 cps). The photons from an in-vacuum undulator are monochromatized to a band-width of 2 meV by a high-resolution nested channel-cut monochromator. The counting rate of APD detector for the prompt emission of photoelectrons was 1.4 x 10^6 cps. The energy spectrum of the electrons excited with a 14.413 keV X-ray is shown in Figure 1. To suppress the enormous counting rate of prompt emission of photoelectrons, the output pulse of the APD detector is discriminated in the time-domain between 10 and 190 ns after the incidence of synchrotron radiation. The peaks of K- and L-shell conversion electrons and KLL Auger electrons are clearly observed in the figure. The maximum counting rate at the peak energy of K-shell conversion electrons was 0.51 cps. The tail in the low energy side is due to the cascade inelastic scattering of electrons inside the sample. The energy resolution of 4% corresponds to the escape depth of 20 nm.

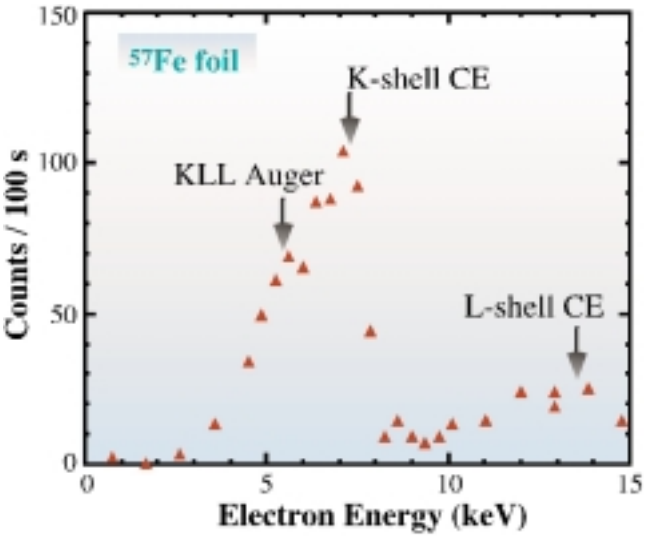

Fig.1: Energy distribution of electron emission from ^{57}Fe foil within a time-interval between 10 and 190 ns after incidence of primary photons.

The time spectrum of the K-shell conversion electrons is shown in Figure 2. The principal structure of the time spectrum is an exponential decay with the time constant of 131±17 ns, which coincides with the decay time of isolated ^{57}Fe nuclei, 141 ns. Compared with the time spectrum of the nuclear resonant photon emission for the same sample, neither the speed-up of decay process nor quantum beat structure is observed. The present results illustrate the incoherent nature and surface layer sensitivity of conversion electron emission.

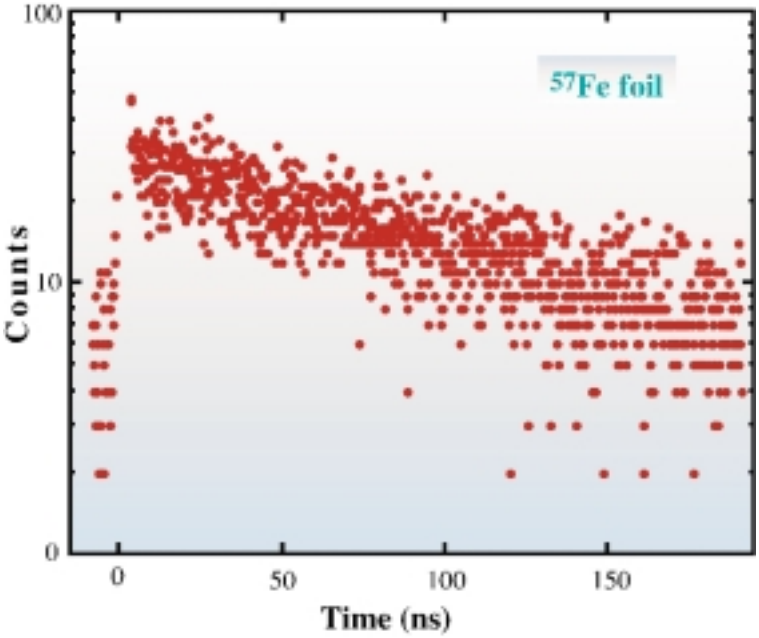

Fig. 2.: Time spectrum of K-shell conversion electrons from ^{57}Fe foil. Accumulation time of the spectrum was 7.8 hours.

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X-RAY PARAMETRIC DOWN CONVERSION AT THE BREWSTER ANGLE

X-ray parametric down conversion originating from the property of free electrons is one of the nonlinear phenomena in the X-ray region. The phenomenon that one X-ray photon is converted to two photons was observed by Eisenberger *et al.* using an X-ray tube [1] and by Yoda *et al.* using synchrotron radiation [2]. The polarization dependence in X-ray parametric down conversion is different not only from that in Thomson scattering but also from that in optical parametric conversion. In the latter case, the spatial symmetry of a nonlinear optical medium restricts the form of the nonlinear optical susceptibility. The X-ray parametric down conversion was observed in such a geometry that the π -polarized X-rays are incident on the crystal at the Brewster angle where Thomson scattering is prohibited.

The experiment was performed at the beamline **BL09XU**. The linear polarized X-rays in the horizontal plane can be obtained by the in-vacuum horizontal undulator. The storage ring was operated in multi-bunch mode with 2 nsec pulse intervals and its typical current was 17 mA. X-rays from a Si (111) inclined double-crystal monochromator were incident on a diamond single crystal as shown in Figure 1.

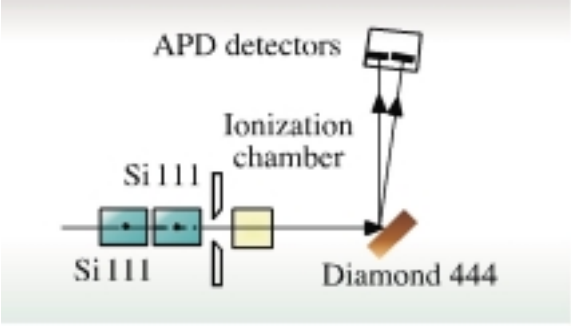

Fig.1: Experimental setup. Two APD detectors were arranged at scattering angles of nearly 90 degrees.