

Study of Parity Mixing in ^{19}F

K. Kawase, H. Akimune¹, M. Fujiwara, H. Hashimoto, T. Hayakawa², M. Itoh, M. Itou³, T. Kudo³,
K. Nakanishi, H. Ohkuma³, S. Okumura, Y. Sakurai³, T. Shizuma², S. Suzuki³, K. Tamura³, H. Toyokawa³
and M. Uchida⁴

Research Center for Nuclear Physics (RCNP), Osaka University, Ibaraki, Osaka 567-0047, Japan

¹*Department of Physics, Konan University, Kobe, Hyogo 658-8501, Japan*

²*Advanced Photon Research Center (APR), Japan Atomic Energy Research Institute, Souraku,
Kyoto 619-0215, Japan*

³*Japan Synchrotron Radiation Research Institute (JASRI), Sayo, Hyogo 679-5198, Japan*

⁴*Department of Physics, Tokyo Institute of Technology, Meguro, Tokyo 152-8551, Japan*

The measurement of the nuclear parity non-conservation(PNC) is one of the best tools for studying the weak interactions in nuclei. The PNC in nuclei has been studied over three decades [1]. Among the various nuclear transitions, we aim to study the transition between the first excited state(109.89 keV $1/2^-$) and the ground state($1/2^+$) in ^{19}F for the PNC study. If the PNC force plays a role in mixing the two states in ^{19}F , this mixing causes the asymmetry in the scattering cross sections of nuclear resonance fluorescence(NRF) with left and right circular polarizations. The asymmetry A_γ is represented by

$$A_\gamma = \frac{\sigma_L - \sigma_R}{\sigma_L + \sigma_R} = 2 (1 + \cos \theta) \frac{\langle 1/2^- | H_{PNC} | 1/2^+ \rangle \langle M1 \rangle}{\Delta E \langle E1 \rangle},$$

where σ_L and σ_R are the NRF cross section with left and right circularly polarized photon beams, H_{PNC} is the weak PNC Hamiltonian, ΔE is the energy difference, $\langle M1 \rangle$, $\langle E1 \rangle$ is the amplitude of M1 and E1 transition, and θ is the scattering angle of photons [2].

We have carried out the experiment at the wiggler beamline (BL08W) in SPring-8 and measured the asymmetry of NRF scattering of the 108.89 keV monochromatic circularly polarized synchrotron radiation by the LiF(5 mm thick). The 100-pixel Ge solid state detector (SSD) owned by JASRI was used. The purpose is a high counting rate and high resolution measurement. The present status of the 100-pixel Ge SSD is that 89 pixels are available and the typical resolution is 0.5 keV at the typical resolution is 0.5 keV at 60 keV with an Am-241 source.

To perform the high counting detection experiment, we constructed a new high-speed data acquisition(DAQ) system. The main component of our DAQ system consists of the modules counting only the NRF peak by using single channel analyzers(SCA). We also counted the parity-conserved Compton scattering (caused by 2nd harmonics of the monochromator) by using CFD. For the monitor of the experiment, we measured the spectra for some pixels. The measurements were taken every 3 hours by changing the left and right polarities.

The preliminary result for the asymmetry from PNC shows

$$|A_\gamma| < 4.2 \times 10^{-3}.$$

Now the analyses are in progress to reduce the upper limit of the PNC asymmetry.

To get a high precision value, we plan to increase the NRF event-rate relatively by using a thin target (Teflon film : 10 μm) towards getting an important data for the PNC study.

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References

- [1] See, for example, E.G. Adelberger and W.C. Haxton, *Ann. Rev. Nucl. Part. Sci.* 35,501(1985), and references cited therein.
- [2] A.I. Titov, M. Fujiwara, K. Kawase, submitted to *Phys. Lett. B* in November(2004).