Spin-selective Neutron Optics for Neutron Fundamental Physics

H. M. Shimizu

KEK, 1-1 Oho, Tsukuba 305-0801, Japan

Techniques to optically control cold neutron beam have been intensively developed in the past decade and are being applied in neutron scattering experiments in material researches. Among currently applied neutron optics, the magnetic optics has enabled us to polarize the neutron spin beyond 99.9%, which would improve the accuracy of spin-related correlation terms in neutron beta decay by suppressing the systematic error in determination of neutron polarization. In addition, it introduces an accurate neutron beam transport to deliver neutrons to a remote fiducial volume which contributes to suppress the background gamma-rays. The well-defined beam also introduces a possibility to measure the neutron life time in flight by additionally developing a background-free high rate neutron imaging detector. One of the candidates is a micro-patterned imaging ^{3}He gas detector to distinguish gamma-rays and neutrons.

Neutron supermirrors having very large critical angles have become available recently. Such mirrors can deflect neutron beam strongly in a short distance to avoid the direct sight of neutron sources. A new type of neutron interferometer using multilayer mirrors also has become available. We discuss a possible installation of optical devices at neutron sources including the spallation neutron source at J-PARC to improve the accuracy of neutron decay parameters, scattering cross sections and quantum interference phenomena.

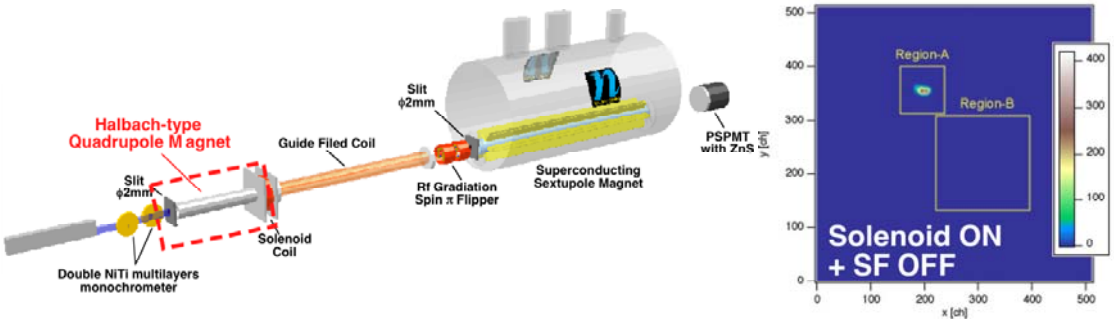

FIGURE 1. Experimental setup and the result of the measurement of the spin polarization of cold neutron beam after transmission of a permanent quadrupole magnet. The neutron polarization of exceeding 99.9% was observed by measuring the ratio of neutron numbers in the neutron distribution after transmission through a sextupole superconduting magnet.