

# Applications of Polarized $^3\text{He}$ Filters in Neutron scattering

H. Yan

Low Energy Neutron Source and Department of Physics  
Indiana University, Bloomington, IN-47408

## Abstract

Due to large spin dependent neutron absorption cross section, neutron spin filters using polarized  $^3\text{He}$  can work as both polarizers and analyzers in neutron scattering experiments. We outline the theory of neutron polarizers and analyzers based on spin-exchange optical pumping (SEOP) and describe a compact optical pumping system which can be used online at a neutron scattering instrument. This device can also implement Adiabatic Fast Passage (AFP) flipping of  $^3\text{He}$  polarization and thereby combines the functions of a polarizer and spin flipper. We describe two applications for this device. One was as a polarizer for the Single Crystal Diffractometer (SCD) of IPNS: we performed an experiment to measure the magnetic spin density of  $\text{Yb}_{14}\text{MnSb}_{11}$  using polarized neutron diffraction. Another is as a polarization analyzer for a Spin Echo Small Angle Measurement (SESAME) neutron spin echo instrument under construction at the Low Energy Neutron Source (LENS) at IUCF. We explain the SESAME spin echo principle and present the design for the analyzer and a theoretical analysis of the optimization of the statistical accuracy for a SESAME instrument using a polarized  $^3\text{He}$  analyzer.