Polarized Inelastic Neutron Scattering (PINS) Workshop And HYSPEC IDT Meeting

April 6-7, 2006
Brookhaven National Laboratory
Physics Department
Large Seminar Room

Thursday, April 6, 2006

8:30 – 8:45	Coffee
8:45 – 9:00	S.M. Shapiro (BNL) Welcome and workshop charge
	SCIENCE WITH POLARIZED NEUTRONS Chair: J. Tranquada
9:00 – 9:30	K. Kakurai (JAEA) To be announced
9:30 – 10:00	J.A. Fernandez-Baca (ORNL) Polarized inelastic neutron scattering in the CMR manganite $La_{0.70}Ca_{0.30}MnO_3$
10:00 – 10:30	L. P. Regnault (CEA-Grenoble) Polarized neutrons and high magnetic fields on TAS-IN22
10:30 - 10:45	BREAK
	POLARIZERS AND ANALYZERS - 1 Chair: R. McQueeney
10:45 – 11:15	T. Gentile (NIST) Polarized ^{3}He spin filter development in the U.S.
11:15 – 11:45	R. Erwin (NIST) To be announced.

11:45 – 12:15	W. T. Lee (SNS) Current development of using polarized ^{3}He spin filter at the SNS instruments
12:15 – 1:30	LUNCH
	POLARIZERS AND ANALYZERS - 2 Chair: J. Mesot
1:30 – 2:00	E. Lelievre-Berna (ILL) Update on ^{3}He spin filter developments in Europe
2:00 – 2:30	L.K.H. Andersen (ILL) Wide-angle polarization analysis using ^{3}He and supermirrors at the ILL
2:30 – 3:00	L. Passell (BNL) Options for ^{3}He polarization analysis on the HYSPEC ToF spectrometer
3:00 – 3:30	BREAK
	POLARIZERS AND ANALYZERS - 3 Chair: M. Hagen
3:30 – 4:00	I. Zaliznyak (BNL) Polarized beam operation of the Hybrid Spectrometer at the pulsed Spallation Neutron Source
4:00 – 4:30	P. Allenspach (PSI) Polarizers and Polarizing Benders for HYSPEC and FOCUS
4:30 – 5:00	Discussion led by S.M. Shapiro (BNL)
6:00	DINNER

Friday, April 7, 2006

NEW POLARIZATION ANALYSIS SPECTROMETERS
Chair: I. Zaliznyak

9:00 – 9:30	U. Filges (PSI) Instrument simulations and polarized neutrons
9:30 – 10:00	D. Yu (ANSTO) Polarized neutrons at ANSTO – from LONGPOL to Pelican, Taipan, Sika, Platypus and Quokka
10:00 – 10:30	J. Mesot (PSI) Status and foreseen upgrades of the hybrid ToF spectrometer FOCUS at SINQ.
10:30 – 11:00	BREAK

HYSPEC IDT MEETING
Chair: S. M. Shapiro

11:00 – 11:30	M. Hagen (SNS) The status of SNS and SING
11:30 – 12:15	W.J. Leonhardt (BNL/SNS) HYSPEC project and engineering status
12:15 – 1:15	LUNCH
1:15 – 1:45	M. Hagen (SNS) HYSPEC polarization issues
1:45 – 3:45	Discussion led by J.J. Rhyne (LANSCE)
3:45 – 4:00	BREAK
4:00 – 4:30	S.M. Shapiro (BNL) Closeout

SCIENCE WITH POLARIZED NEUTRONS

To be announced.
Kazuhisa Kakurai, Japan Atomic Energy Agency, Japan

Polarized inelastic neutron scattering in the CMR manganite $La_{0.70}Ca_{0.30}MnO_3$
Jaime. A. Fernandez-Baca*, Mark Hagen[+] and Jiri Kulda[++], *Center for Neutron Scattering, Oak Ridge National Laboratory, U.S.A, [+]Spallation Neutron Source, Oak Ridge National Laboratory, U.S.A and [++]Institut Laue Langevin, Grenoble, France

A polarized neutron experiment has been performed in order to separate the contributions of the phonons and the spin waves in a single crystal of the CMR manganite $La_{0.7}Ca_{0.3}MnO_3$. The experiment was performed at the IN20 instrument at the Institut Laue Langevin using the half-polarized setup of Holden and Stirling [1]. The combination of the horizontally and vertically focusing Heusler (111) monochromator, a horizontally focusing PG (002) analyzer, and the use of a 2T horizontal magnetic field parallel to the wave vector Q, allowed the efficient separation of the nuclear (phonon) scattering from the magnetic contributions to the excitation spectrum. Our polarized neutron measurements have revealed that most of the broadening reported from unpolarized neutron scattering experiments is due to the inability to separate the phonon scattering from the spin waves. Research sponsored by the Division of Materials Sciences and Engineering, Office of Basic Energy Sciences, U.S. Department of Energy, under contract DE-AC05-00OR22725 with Oak Ridge National Laboratory, managed and operated by UT-Battelle, LLC.
[1] T. M. Holden and W. G. Stirling, J. Phys. F7, 1901 (1977).

Polarized neutrons and high magnetic fields on TAS-IN22
Louis Pierre Regnault, CEA-Grenoble, DRFMC-SPSMS-MDN, Grenoble, France

IN22 is a "state-of-the-art" three-axis spectrometer installed at the end position of the H25 thermal supermirror (SM) guide at the ILL. It can be operated in the 5-120 meV incident-energy range in the unpolarized mode (thanks to vertically focusing PG-002 and Cu-111 monochromators) and in the 5-90 meV incident-energy range in the polarized mode (thanks to a vertically focusing Heusler-111 monochromator). The polarization analysis is performed through a horizontally focusing Heusler-111 analyser, which will be replaced soon by a double focusing Heusler-111 one. TAS-IN22 has been designed to have the best possible signal/background ratio, rather than to optimize the flux. A standard Helmholtz-based longitudinal-polarization-analysis (LPA) option is available since the beginning and, since year 2002, the spectrometer has been equipped with an efficient CRYOPAD-based spherical-neutron-polarimetry (SNP) option. Since last year, a "Neutron Resonance Spin Echo" (NRSE) option is under construction, especially designed for phonon- and magnon-life-time measurements for energy transfers in the 0-50 meV thermal range.

IN22 offers also the possibility of performing high-field inelastic neutron scattering experiments at very low temperatures (30 mK), both in the unpolarized mode (up to 15 T) and in the polarized mode (up to 12 T). In addition to the highly Heusler-based technology (which has been privileged on IN22), we have recently implemented a polarization analysis stage without energy analysis based on a ^{3}He neutron spin filter (NSF) solution, designed for performing accurate polarized-neutron determination of equal-time structure factors S(**q**) on TAS. In my talk, I will discuss the pros and the cons of the Heusler-based and ^{3}He-NSF-based technology on TAS (flux, polarization, easiness of use, etc). From recent results, I will show that an Heusler-based solution is likely the most flexible and easiest solution on thermal TAS.

POLARIZERS AND ANALYZERS

Polarized ^{3}He spin filter development in the U.S.
Tom Gentile, NCNR, NIST, Gaithersburg, Maryland, U.S.A.

We report U.S. progress in the development and application of neutron spin filters based on transmission through polarized ^{3}He gas. The results of current applications will be discussed, including polarization analysis for diffuse reflectometry, a polarizer-analyzer system for triple-axis spectrometry, and a continuously operating polarizer for single crystal diffractometry. Plans for future developments important for the Spallation Neutron Source will also be discussed. We are currently employing both spin-exchange (SEOP) and metastability-exchange optical pumping (MEOP) to polarize ^{3}He, but this presentation will focus on the scientific and technical issues in SEOP.

To be announced
Ross Erwin, NCNR, NIST, Gaithersburg, Maryland, U.S.A.

Current development of using polarized ^{3}He spin filter at the SNS instruments
W. T. Lee, Spallation Neutron Source, Oak Ridge National Laboratory, U.S.A

We report our current development work to use ^{3}He spin filters at pulsed neutron scattering instruments and the implementation work being undertaken at the SNS. For the former, we will discuss the latest results of an experiment at the Single Crystal Diffractometer at the Intense Pulsed Neutron Source, where we use a ^{3}He polarizer with continuous online optical pumping and adiabatic-fast-passage flipping of the ^{3}He polarization. For the latter, we will report the construction of a ^{3}He analyzer for use at the Magnetism Reflectometer. The analyzer is also equipped with online optical pumping and AFP ^{3}He polarization flipping capabilities. Finally, we will discuss the use of ^{3}He analyzer at HYSPEC with a focus on a plausible design that uses a polarized ^{3}He refill station at the instrument.

Update on ^{3}He spin filter developments in Europe
Eddy Lelièvre-Berna, Institute Laue Langevin, Grenoble, France

Neutron spin filters are being actively developed by several neutron facilities within the framework of a Joint Research Activity funded by the European Commission. Both the spin-exchange (SEOP) and metastability-exchange (MEOP) optical pumping techniques are concerned. As of today, they reach similar effective ^{3}He polarizations while the MEOP technique remains faster and more reliable. We explain why both techniques are complementary and will certainly be necessary at neutron facilities. We also present new widgets that minimize the depolarization of the gas during the storage in low or large stray field environments, the transport and the spin-flip of polarized ^{3}He cells.

Wide-angle polarization analysis using ^{3}He and supermirrors at the ILL

Ken Andersen, Institut Laue Langevin, Grenoble, France

While polarization analysis (PA) is now a standard tool for many neutron scattering instruments, its extension to the coverage of large solid angles is not commonplace. At the ILL, there is only one instrument which currently employs wide-angle PA: the D7 diffuse-scattering spectrometer, which uses supermirrors. Design has started on a new instrument, named PASTIS, which will use polarized ^{3}He spin-filters to extend this technique to higher energies. Design considerations and current and expected performance are presented, together with a performance comparison between supermirrors and ^{3}He spin-filters.

Options for ^{3}He polarization analysis on the HYSPEC TOF spectrometer

L. Passell[1], L.D. Cooley[1], T. R. Gentile [3],V.J. Ghosh[1], M. Hagen [2], W.T. Lee[2], W.J. Leonhardt[1], S.M. Shapiro[1], I. Zaliznyak[1], [1]Department of Condensed Matter Physics and Material Science, Brookhaven National Laboratory, Upton, NY 11973-5000, USA, [2]Spallation Neutron Source, Oak Ridge National Laboratory, Oak Ridge, TN 37830, USA, [3]National Institute of Standards and Technology (NIST), Gaithersburg, Maryland 20899, USA

The HYSPEC TOF spectrometer will operate in a neutron energy regime in which it is anticipated that there will be a small but important sub-group of experiments in which it will be advantageous to analyze both the energy and polarization of neutrons scattered over a wide angular range with energies such that selective reflection from polarization-sensitive multilayers is no longer a viable option. For such applications, transmission through a cell filled with polarized ^{3}He gas is generally regarded as the most effective polarization analysis method currently available. We will address the requirements, practical problems and limitations involved in implementing ^{3}He polarization analysis on HYSPEC and, by inference, other TOF spectrometers with wide angular acceptance detector arrays. Three sample environments will be considered: (i) a compact low-field (<0.1T), low temperature environment employing either a closed-cycle refrigerator or ILL-type top-loading cryostat, (ii) a medium-field (1-3 T), low temperature environment utilizing either a resistive or a compensated, cryogen-free superconducting magnet and (iii) a high-field (10–15 T), low temperature environment in which the sample field is created by a compensated superconducting cryomagnet. In the first case an arrangement of coils generating a uniform field will be put forward as a convenient and practical way to supply both the combined guide and sample magnetic fields and the holding field for the ^{3}He cell. For case (ii) the fringe field of the sample magnet is expected to perturb the holding field at the ^{3}He cell enough to impact significantly on ^{3}He polarization lifetime and make it necessary to supply the cell holding field with a separate, magnetically-shielded solenoid. In case (iii) the fringe field of the sample magnet will become an even more serious problem and it is unlikely that ^{3}He polarization analysis will be possible unless the cell holding field solenoid is surrounded by a passive, persistent-mode superconducting magnetic shield. Constraints on the geometry of the ^{3}He cell and

possible ways to maintain the polarization of the gas by introducing continuous optical pumping will also be addressed.

Polarized beam operation of the Hybrid Spectrometer at the pulsed Spallation Neutron Source

I. Zaliznyak*, V.J. Ghosh, S. M. Shapiro, L. Passell, Condensed Matter Physics and Material Science Department, Brookhaven National Laboratory, U.S.A

The concept of a neutron Hybrid Spectrometer (HYSPEC) combines the time-of-flight spectroscopy with the focusing Bragg optics and incorporates a polarized beam option. Here we describe the polarization analysis scheme proposed for HYSPEC and quantify its performance via the Monte-Carlo simulations. We find that the broadband supermirror-bender transmission polarizers provide reasonably good polarization analysis capability within a ~ 8-10 meV energy window for scattered neutron energies in the thermal range, up to ~ 25 meV. Transmission-mode operation extends a low-sensitivity polarization analysis capability to even larger range of scattered neutron energies. This can be used for distinguishing between the elastic and/or inelastic scattering peaks of structural and magnetic origin at large wavevector and/or energy transfers.

Polarizers and Polarizing Benders for HYSPEC and FOCUS

Peter Allenspach, Laboratory for Developments and Methods, Condensed Matter Research with Neutrons and Muons, Paul Scherrer Institute, CH-5232 Villigen-PSI, Switzerland.

PSI has a long tradition of producing multilayers, supermirrors and polarizers for neutron and synchrotron optics by DC magnetron sputtering. While for the former two the reflectivity is the primary quality parameter, for the latter the polarization/flipping ratio is of same importance. Fe/Si transmission polarizers on Si wafers are in operation in the primary flight path of the SANS-I instrument at PSI in one of the collimation drums, while FeCoV/Ti reflection polarizers on float glass or Si wafers are used on TASP, AMOR, MORPHEUS and FUNSPIN. These reflection polarizers are remanent with a coercive field of about 20 Oe and a flipping field of the order of 200 Oe. Hence, they can be used independently of the guide field direction and be flipped with a short magnetic pulse. The usable wave length range spans from large wave length down to typically 1.5 to 2 Å.

NEW POLARIZATION ANALYSIS SPECTROMETERS

Instrument simulations and polarized neutrons

Uwe Filges, Paul Scherrer Institute, CH-5232 Villigen-PSI, Switzerland.

To be announced.

Polarized neutrons at ANSTO – from LONGPOL to Pelican, Taipan, Sika, Platypus and Quokka

Dehong Yu and Shane Kennedy, Bragg Institute, ANSTO, NSW 2234, Australia

LONGPOL, the first polarization analysis neutron spectrometer, has served Australian scientific community for more than 30 years and it has officially retired recently, along with the transition of the old reactor HIFAR to the new OPAL reactor. Five new instruments with polarized neutrons are now under development at the OPAL reactor. A new instrument called Pelican using the combination of crystal monochromator and time of flight techniques with polarization analysis option will carry on and extend the capabilities of LONGPOL. In addition to that, the option of polarization analysis or polarized neutron beams has been incorporated into the Thermal neutron Triple Axis Spectrometer (Taipan), the Cold neutron Triple Axis Spectrometer (Sika), the Neutron reflectometer (Platypus) and the Small Angle Neutron Scattering instrument (Quokka). A general review and discussion about new capabilities and scientific opportunities with polarized neutrons in Australia will be given.

Status and foreseen upgrades of the hybrid ToF spectrometer FOCUS at SINQ.

Joel Mesot, Laboratory for Neutron Scattering, ETH Zurich and Paul Scherrer Institute, CH-5232 Villigen-PSI, Switzerland.

The cold time-of-flight (ToF) spectrometer FOCUS was one of the early instruments to be operational after the production of the first neutrons at SINQ in 1996. This instrument is a hybrid ToF that combines doubly focusing monochromators with a Fermi-chopper. The spectrometer can be operated both in time focusing and monochromatic modes, such that optimized configurations can be found for quasi-elastic and inelastic experiments. Two interchangeable monochromators (PG and MICA) enabling a continuous change of the incident energy between 0.25 and 20 meV. This year, a small angle detector chamber will be put into operation, which will allow inelastic measurements down to very small momentum transfers even with the use of the PG monochromator. Currently, we are investigating various options to perform polarization analysis of both incoming and outgoing beams on FOCUS.