Final Report for DOE Grant DE-FG05-96ER45555
Scattering Studies of Ordering Processes and Quantum Excitations

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Section I

J. Subject Categories:

Neutron Scattering, X-ray Scattering, Magnetism, Phase Transitions

K. Description / Abstract

Small angle neutron scattering has been used to study ordering processes in phase-separating mixtures of solid ^3He - ^4He . Inelastic neutron scattering has been used to study excitations in low-dimensional quantum magnets.

We have no objection from a patent
standpoint to the publication or
dissemination of this material.

Mauli Dvorak 2/24/00
Office of Intellectual Date
Property Counsel
DOE Field Office, Chicago

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Abstract

This report summarizes the activities sponsored by the US DOE under award No. DE-FG05-96ER4555.

I. Research Activities

The research sponsored by this award utilized x-ray and neutron scattering techniques to investigate problems in condensed matter physics. The award supported two graduate research assistants (A.W. Garrett and J.P. Koster) enrolled at the University of Florida. The principal investigator, Dr. Stephen Nagler, is a former Professor of Physics at University of Florida. He is currently a senior research scientist and group leader at the Oak Ridge National Laboratory. The work supported included studies of phase separation in solid ^3He - ^4He mixtures. The bulk of the research involved inelastic neutron scattering studies of magnetic excitations in low dimensional magnetic materials.

The primary use of award money was to fund research assistantships and other expenses for research carried out by the graduate students Andrew Garrett and Jacobus (Sjaak) Koster. Some of the funds were used to procure isotopic (deuterated) chemicals for the preparation of single crystal samples for inelastic neutron scattering. This activity was carried out in collaboration with the groups of Professor D. Talham (Chemistry, University of Florida, sample preparation) and Professor M. Meisel (Physics, University of Florida, sample characterization).

As a result of research supported by this award, Andrew Garrett was awarded the Ph.D. Degree from the University of Florida in 1998. He is currently employed as a postdoctoral research fellow at the pulsed neutron laboratory, KEK, Japan. Sjaak Koster left the Ph.D. program before completion to pursue opportunities in the private sector. He is currently employed in a high technology company in silicon valley (San Jose, CA.)

II. Publications sponsored in whole or in part by this award:

A. Refereed Publications:

- P. Dai, H.A. Mook, C.L. Seaman, M.B. Maple, and J.P. Koster, *Neutron-Scattering Studies of $Y_{1-x}U_xPd_3$ Compounds*, Phys. Rev. Lett. **75**, 1202 (1995).
- A. Zheludev, S.E. Nagler, S.M. Shapiro, L.K. Chou, D.R. Talham and M.W. Meisel, *Spin Dynamics in the Linear-Chain $S=1$ Antiferromagnet $Ni(C_3H_{10}N_2)_2N_3(ClO_4)$* , Phys. Rev. **B53**, 15004 (1996).
- A.W. Garrett, S.E. Nagler, T. Barnes and B.C. Sales, *A Neutron Scattering Study of Magnetic Excitations in the Spin Ladder $(VO)_2P_2O_7$* , Phys. Rev. **B55**, 3631 (1997).
- A.W. Garrett, S.E. Nagler, T. Barnes and B.C. Sales, *Excitations in the Spin Ladder Material $(VO)_2P_2O_7$* , J. Appl. Phys. **81**, 3968 (1997).
- D.A. Tennant, S.E. Nagler, A.W. Garrett, T. Barnes and C.C. Torardi, *Excitation Spectrum and Superexchange Pathways in the Spin Dimer $VODPO_4 \cdot 1/2H_2O$* , Phys. Rev. Lett. **78**, 4998 (1997).
- A.W. Garrett, S.E. Nagler, D.A. Tennant, B.C. Sales and T. Barnes, *Magnetic Excitations in the $S=1/2$ Alternating Chain Compound $(VO)_2P_2O_7$* , Phys. Rev. Lett. **79**, 745 (1997).
- D. Vaknin, J.P. Koster, J.L. Zarestky, Z.R. Wang, J.A. Fernandez-Baca and D.C. Johnston, *Magnetic Neutron Diffraction from the Magnetic Clusters in Single Crystal $BaCuO_{2+x}$* , Phys. Rev. **B57**, 465 (1998).
- A.W. Garrett, S.E. Nagler, D.A. Tennant, T. Barnes and C.C. Torardi, *Magnetic Excitations in $(VO)HPO_4 \cdot 1/2H_2O$* , Physica **B241**, 552 (1998).

B. Contributed Abstracts of Conference Presentations:

- J.P. Koster, S.E. Nagler, E.D. Adams, and G.E. Wignall, *Small Angle Neutron Scattering Study of Phase Separation in Solid Helium Mixtures*, Proceedings of Physical Phenomena at High Magnetic Fields - II, Ed. Z. Fisk, L. Gor'kov, D. Meltzer and R. Schrieffer, page 427 (1996).
- S.E. Nagler, *Magnetic Excitations in $(VO)_2P_2O_7$* , Bull. Am. Phys. Soc. **42**, 286, (1997).
- D.A. Tennant, S.E. Nagler, A.W. Garrett, T. Barnes, and C. Torardi, *Inelastic Neutron Scattering Study of Magnetic Excitations in the Spin Dimer $(VO)DPO_4 \cdot 0.5D_2O$* Bull. Am. Phys. Soc. **42**, 621, (1997).

C. Ph.D. Thesis:

- Andrew W. Garrett, *Low Dimensional Magnetic Exchange in Vanadyl Pyrophosphate and Vanadyl Hydrogen Phosphate Hemihydrate*, University of Florida (Physics), (1998).

III. Personnel

- S.E. Nagler, PI (not directly supported by award).
- A.W. Garrett, Graduate Research Assistant
- J.P. Koster, Graduate Research Assistant

IV. Travel

The award supported some travel by A.W. Garrett and J.P. Koster between the University of Florida and the Oak Ridge National Laboratory, as well as to scientific meetings in Tallahassee, FL (*Physical Phenomena at High Magnetic Fields*), Kansas City MO (*APS March Meeting*), and Toronto, Canada (*International Conference on Neutron Scattering*).