



REPORT OF THE
MOLECULAR & MATERIALS SCIENCE
EXPERIMENTS EVALUATION COMMITTEE MEETING
DECEMBER 4 & 5, 2008

**TRIUMF
MOLECULAR & MATERIALS SCIENCE
EXPERIMENTS EVALUATION COMMITTEE MEETING
DECEMBER 4 & 5, 2008
TABLE OF CONTENTS**

| Exp # | Exp. Title | Spokesperson(s) | Page |
|--------------|--|--|-------------|
| 1 | SUMMARY OF RECOMMENDATIONS | | 3 |
| 2 | SUMMARY OF ALLOCATIONS | | 4 |
| 3 | INTRODUCTION | | 6 |
| 4A. | RECOMMENDATIONS: Progress Reports | | |
| M998 | Muon Spin Relaxation and Dynamic Scaling in Novel Magnetic Materials | D.E. MacLaughlin R.H. Heffner | 7 |
| M1049 | Spin State Transition in $RECoO_3$ ($RE=La, Pr, Nd$ and Sm) | J. Sugiyama J.H. Brewer T. Goko, T. Takami | 7 |
| M1051 | Muonium and Muoniated Free Radical Formation and Reactivity in Ionic Liquids | K. Ghandi | 8 |
| M1088 | μ^+ SR Studies of Magnetic Semiconductors | J. Brewer V.G. Storchak | 8 |
| M1115 | Magnetism and Superconductivity of $Bi_2Sr_2CuO_{6+\delta}$ | R. Kadono | 8 |
| M1131 | Free Radical Dynamics, Reactions and Hfcs in Supercritical CO_2 | K. Ghandi | 9 |
| M1139 | μ SR Studies of Magnon Bose Condensation in $Pb_2V_3O_9$ | C.R. Wiebe | 9 |
| M1154 | Novel metallic phase induced by geometrical electronic correlation | R. Kadono | 10 |
| M1160 | Local Pairing Correlations Above the Superconducting Transition Temperature | J.E. Sonier | 10 |
| M1163 | Photoexcitation of muonium in Ge | I. Fan, K.H. Chow | 10 |
| M1168 | Magnetic Fluctuations in Geometrically Frustrated Itinerant Ferromagnets | S. Dunsiger | 11 |
| M1180 | μ SR studies of iron oxy-pnictide superconductors and parent systems | G.M. Luke, Y.J. Uemura | 11 |

| Exp # | Exp. Title | Spokesperson(s) | Page |
|--------------|--|-------------------------------------|-------------|
| 4B. | RECOMMENDATIONS: New Proposals | | |
| M1184 | Ground state of one-dimensional zig-zag chain compounds | J. Sugiyama J.H. Brewer, O. Ofer | 12 |
| M1197 | TF- μ SR (and ZF- μ SR) in the $\text{La}_3\text{Bi}_4\text{Pt}_3$ superconductor without inversion symmetry | A. Bianchi G.F.D. Seyfarth | 12 |
| M1198 | Reaction kinetics in supercritical water as probed with muonium | K. Ghandi P.W. Percival | 13 |
| M1199 | Electron Localization into Magnetic Polaron in Antiferromagnetic Materials | J.H. Brewer V.G. Storchak | 13 |
| M1205 | Superconductivity in electron-doped AFe_2As_2 single crystals | J.E. Sonier | 14 |
| M1206 | Shallow Muonium Acceptor States in Semiconductors | R.L. Lichti | 14 |
| M1208 | MuSR studies of Volborthite system and CuBr compounds with tri-perovskite layers | G.M. Luke Y.J. Uemura | 15 |
| 5 | AGENDA | | 16 |
| 6 | COMMITTEE MEMBERSHIP | | 18 |

1. SUMMARY OF RECOMMENDATIONS

| | |
|--------------------------------------|-----------|
| Progress Reports | 12 |
| New Proposals | 7 |
| Letters of Intent | |
| Number of Items for Committee Report | <u>19</u> |

RECOMMENDATIONS FOR NEW PROPOSALS

| | |
|--------------|---|
| High | 1139, 1160, 1180*, 1198*, 1205* |
| Medium-High | 1088, 1163, 1168, 1180*, 1184*, 1199, 1205*, 1206, 1208 |
| Medium | 998, 1049*, 1051, 1131, 1154, 1184*, 1197, 1198*, 1208 |
| Medium-Low | 1049*, 1115 |
| Deferred | |
| Not Approved | |

TOTAL NEW SHIFTS

| Priority | Shifts |
|-------------------------|------------|
| High | 85 |
| Medium-High | 168 |
| Medium | 168 |
| Medium-Low | 24 |
| TOTAL NEW SHIFTS | 445 |

* Beam time recommended at more than one priority.

2. SUMMARY OF ALLOCATIONS

| Exp # | Title | Priority | # Shifts |
|-----------------------------|---|----------|----------|
| 4A. PROGRESS REPORTS | | | |
| M998 | Muon Spin Relaxation and Dynamic Scaling in Novel Magnetic Materials | M | 24 |
| M1049 | Spin State Transition in $RECoO_3$ ($RE=La, Pr, Nd$ and Sm) | M-L & M | 12 & 24 |
| M1051 | Muonium and Muoniated Free Radical Formation and Reactivity in Ionic Liquids | M | 12 |
| M1088 | μ^+ SR Studies of Magnetic Semiconductors | M-H | 18 |
| M1115 | Magnetism and Superconductivity of $Bi_2Sr_2CuO_{6+\delta}$ | M-L | 12 |
| M1131 | Free Radical Dynamics, Reactions and Hfcs in Supercritical CO_2 | M | 24 |
| M1139 | μ SR Studies of Magnon Bose Condensation in $Pb_2V_3O_9$ | H | 13 |
| M1154 | Novel metallic phase induced by geometrical electronic correlation | M | 24 |
| M1160 | Local Pairing Correlations Above the Superconducting Transition Temperature | H | 24 |
| M1163 | Photoexcitation of muonium in Ge | M-H | 24 |
| M1168 | Magnetic Fluctuations in Geometrically Frustrated Itinerant Ferromagnets | M-H | 24 |
| M1180 | μ SR studies of iron oxy-pnictide superconductors and parent systems | M-H & H | 24 & 12 |
| 4B. NEW PROPOSALS | | | |
| M1184 | Ground state of one-dimensional zig-zag chain compounds | M & M-H | 12 & 12 |
| M1197 | TF- μ SR (and ZF- μ SR) in the $La_3Bi_4Pt_3$ superconductor without inversion symmetry | M | 12 |
| M1198 | Reaction kinetics in supercritical water as probed with muonium | M & H | 24 & 24 |
| M1199 | Electron Localization into Magnetic Polaron in Antiferromagnetic Materials | M-H | 18 |

| Exp # | Title | Priority | # Shifts |
|--------------|--|-----------------|-----------------|
| M1205 | Superconductivity in electron-doped AFe_2As_2 single crystals | M-H & H | 12 & 12 |
| M1206 | Shallow Muonium Acceptor States in Semiconductors | M-H | 24 |
| M1208 | MuSR studies of Volborthite system and CuBr compounds with tri-perovskite layers | M & M-H | 12 & 12 |

H = High; M-H = Medium-High; M = Medium; M-L = Medium-Low; L = Low;

3. INTRODUCTION

The Molecular and Materials Science Experiments Evaluation Committee reviewed 19 submissions at the December 2008 meeting: 7 new proposals and 12 progress reports on ongoing experiments requesting further beam time.

In the absence of Michel Gingras, the Chair was taken by Bob Cywinski. Bob Heffner was also unable to attend the meeting, but he provided valuable assistance as a reader for some reports. In addition, the Committee was strengthened with the addition of a new member: Prof. Karen Kavenagh of Simon Fraser University.

Recent news of TRIUMF was reported as usual by the Associate Director, Jean-Michel Poutissou. Of particular note was the recent external scientific review of TRIUMF's Five Year Plan, which requests \$325 million over the period 2010-2015. Also, the M9A surface muon beam line is under construction and its major elements will be installed during the shutdown period in early 2009. When M9A is finished it will be possible to start on the M20 replacement. Funds have just been received from CFI and BCKDF, so the tender process for major components can go ahead without delay. Other news of interest to μ SR users concerned the repairs of the HiTime superconducting magnet and the dilution refrigerator. Finally, the TRIUMF Centre for Molecular and Materials Science will be subject to a site visit by an NSERC committee on 17 January 2009 as part of the review of the Major Resources Support grant application.

The next meeting of the Molecular and Materials Science Experiments Evaluation Committee is provisionally scheduled for June 18 & 19, 2009.

4A. RECOMMENDATIONS: PROGRESS REPORTS

| | | |
|-------------|---|--|
| M998 | Muon Spin Relaxation and Dynamic Scaling in Novel Magnetic Materials | D.E. MacLaughlin / R.H. Heffner |
|-------------|---|--|

The proposers ask for a significant amount of beam time (50 shifts) to complete a detailed and thorough study of three different frustrated magnets NiGa_2S_4 , $\text{Pr}_2\text{Ir}_2\text{O}_7$ and $\text{Eu}_2\text{Ir}_2\text{O}_7$. The Committee felt that while these materials are potentially interesting there is also an imminent need to prioritize experiments according to their urgency and potential impact on the broader field of frustrated magnetism. From this point of view the Committee recommends focusing on the spin-1/2 pyrochlore $\text{Eu}_2\text{Ir}_2\text{O}_7$, where there exists the best chance of observing the exotic spin-liquid behaviour at low temperatures. By contrast, although the Committee recognized the need for careful studies which help characterize the disordered states which may compete with or circumvent spin-liquid ordering, it was not clear to the Committee how big a potential impact studies of NiGa_2S_4 and $\text{Pr}_2\text{Ir}_2\text{O}_7$ might have on the field of frustrated magnetism.

RECOMMENDATION: 24 shifts at medium priority

| | | |
|--------------|---|--|
| M1049 | Spin State Transition in RECoO_3 ($\text{RE}=\text{La, Pr, Nd}$ and Sm) | J. Sugiyama / J.H. Brewer / T. Goko / T. Takami |
|--------------|---|--|

This is an interesting proposal to continue measurements of the spin-state transition temperatures of the Co ions in RECoO_3 compounds, which may prove useful for possible applications in fuel cells. The experimenters argue that characteristic changes in the muon hyperfine field with temperature signify changes from low spin (zero) to higher spin configurations as the Co electrons are thermally excited to higher crystal-field levels. They wish to complete their studies by using pressure to change the CEF levels and hence also induce changes in the spin configurations. They estimate that pressures less than 2 GPa are enough for these purposes. The Committee was particularly supportive of the pressure measurements suggested in the proposal and considered that such measurements were relatively “clean” compared to those associated with the application of “chemical pressure” through doping at the RE site. The measurements should provide a relatively direct confirmation of the relationship between the spin state transition temperature and cell size. The Committee also wondered whether the substitution of Y at the RE site might be an effective means of inducing chemical pressure without the added complications associated with complex rare earth magnetism. The Committee was a little concerned about the role of the muon in these studies. The proposers have not addressed the issue of whether the μ^+ alters the CEF configuration via its induced radial electric field gradient.

RECOMMENDATION: 12 shifts at medium-low priority (for the pressure measurements) and 24 shifts at medium priority (for the Sm-La compounds)

| | | |
|--------------|---|------------------|
| M1051 | Muonium and Muoniated Free Radical Formation and Reactivity in Ionic Liquids | K. Ghandi |
|--------------|---|------------------|

Ionic liquids have opened new perspectives for use as extraordinary solvents in some areas of chemistry. Free radical chemistry has rarely been explored in these environments. The present proposal addresses interesting aspects of this subject and suggests various measurements, but to a large extent it leaves open how the experimental results will be analysed in depth to reach well supported conclusions. The Committee would like to see a much more focused approach on a few subjects at a time and with sufficient statistics to reduce the error bars. This will allow for an adequate quantitative analysis and reliable interpretation. When corresponding reports are available the group may come back and ask for more beam time. For now, it is recommended that work should concentrate on points 1) and 2) of the experimental list: methyltrioctadecyl ammonium bromide (MT) magnetic field dependence of muon fractions, and fractional yields in mixtures of methanol with MT, 1-methyl-3-dodecyl imidazolium iodide and tetrabutyl phosphonium chloride).

RECOMMENDATION: 12 shifts at medium priority

| | | |
|--------------|--|------------------------------------|
| M1088 | μ^+SR Studies of Magnetic Semiconductors | J. Brewer V.G. Storchak |
|--------------|--|------------------------------------|

This is an interesting, ongoing project to study a bound state of muonium that is thought to be associated with some number of localized electrons called magnetic polarons (MPs). Having found convincing evidence for this state in EuS, EuO, CdCr₂Se₄, and GaMnAs, the group now proposes to study similar polaronic states in SmS. Preliminary results shows that MPs exist in SmS at temperatures as high as 900 K, consistent with this compound's weakly ferromagnetic properties. It is further proposed to separate the Coulomb and exchange contributions to the interactions by driving SmS metallic (presumably eliminating the Coulomb contribution via conduction electron screening). They propose to carry this out with applied pressure and by doping with Gd. They also wish to use a small amount of time for a first look at YbS. The Committee believes that this group is pursuing an interesting concept in itself. The connection to "spintronics" would help to increase the interest and impact of this work for the general community, but this needs more explanation to be convincing.

RECOMMENDATION: 18 shifts at medium-high priority

| | | |
|--------------|---|------------------|
| M1115 | Magnetism and Superconductivity of Bi₂Sr₂CuO_{6+δ} | R. Kadono |
|--------------|---|------------------|

μ SR measurements on Bi2201Pb are proposed. This is a material which can be doped over a wide range, although the lowest doping achieved is 0.09, where superconductivity is suppressed but no static magnetism is observed. Past and proposed measurements focus on searches for static or quasistatic magnetism, gap anisotropy and pseudogap behaviour, where the latter is measured through the muon Knight shift. For the mature field of cuprate superconductivity, this work lacks sufficient focus and detail to have substantial impact. The gap anisotropy can be more

definitively studied by other probes, such as phase-sensitive probes or ARPES. Also, the search for static or quasistatic magnetism is somewhat hindered by the fact that one cannot obtain undoped or nearly undoped samples of this compound. Therefore, we recommend that this group focus on obtaining more detailed information about the pseudogap behaviour and attempt to connect with μ SR and other measurements of the pseudogap in other cuprate materials which propose various different pictures of what the pseudogap phase is.

RECOMMENDATION: 12 shifts at medium-low priority

| | | |
|--------------|--|------------------|
| M1131 | Free Radical Dynamics, Reactions and Hfcs in Supercritical CO₂ | K. Ghandi |
|--------------|--|------------------|

The variations of properties in fluids around their critical point are of fundamental interest and of major practical consequence for understanding the dynamics of elementary chemical reactions. Much of these effects may be due to significant density fluctuations in space and time. These inhomogeneities render proper averaging of diffusion constants or energy dissipation properties difficult. μ SR is a unique, and in many respects, the only method to address such questions in particular for free radical reactions. The Committee therefore welcomes the proposed kinetics experiments and recommends a cooperation with a theoretically oriented reaction kinetics specialist to aid a sound interpretation. However, it discourages scattering the resources by addressing diverse aspects and compounds at the same time, and recommends that the applicants concentrate on finishing the ethane kinetics and spectroscopy (in particular clarifying the inconsistency between the temperature dependencies of the muon and the β -proton hyperfine constants) and then to extend the study to comparable aspects of difluoroethene.

RECOMMENDATION: 24 shifts at medium priority

| | | |
|--------------|---|-------------------|
| M1139 | μSR Studies of Magnon Bose Condensation in Pb₂V₃O₉ | C.R. Wiebe |
|--------------|---|-------------------|

As explained in the introduction to this proposal the study of Bose-Einstein Condensation (BEC) is highly and historically interesting. The experimenters have identified an interesting system to study which also appears to be highly suitable for the μ SR technique. They can synthesize single crystals of the quasi-1D system Pb₂V₃O₉ large enough for good signal/background studies in the TRIUMF dilution-refrigerator spectrometer, which can reach 5-6 T in applied field. As such, this is a timely and interesting proposal which should be supported. Publications resulting from the experiments are likely to be of wide interest. The case for high-field, low-temperature measurements on the Pb₂V₃O₉ crystal was well made and the proposal was strongly supported. However, it was noted that the schematic transition levels discussed in the presentation were essentially isotropic, whilst Pb₂V₃O₉ is itself triclinic: the Committee wondered how the level scheme might be affected by the crystal symmetry.

RECOMMENDATION: 13 shifts at high priority

| | | |
|--------------|---|------------------|
| M1154 | Novel metallic phase induced by geometrical electronic correlation | R. Kadono |
|--------------|---|------------------|

This proposal is a continuation of a program in which the magnetic properties of the geometrically frustrated pyrochlores $A_2Ru_2O_7$ ($A = Cd, Hg$) are being investigated. The degree of itinerancy of the d-electrons is related to the cell size, and moving from Hg to Cd is qualitatively considered to be the effective application of chemical pressure to promote such itinerancy. Both the Hg and the Cd compounds undergo a transition to a magnetic state, but while the Hg compound also undergoes a structural transition, the metallic Cd compound does not, raising questions regarding the relationship between the onset of magnetism, frustration and crystal symmetry. In an attempt to resolve these issues the proposers now wish to study the insulating spinel compounds, ACr_2O_4 ($A = Hg, Cd$) and AV_2O_4 ($A = Zn, Al$) compounds, drawing analogies with the isomorphous heavy fermion-like LiV_2O_4 . The proposed experiments are a reasonably logical extension of the existing program, particularly with respect to the attempts to identify the role of electron itinerancy on the magnetic geometrical frustration. The Committee supports the proposal, but would like assurance that the new samples will be fully characterized, crystallographically and magnetically, in advance of the muon studies.

RECOMMENDATION: 24 shifts at medium priority

| | | |
|--------------|--|--------------------|
| M1160 | Local Pairing Correlations Above the Superconducting Transition Temperature | J.E. Sonier |
|--------------|--|--------------------|

Sonier and co-workers have probed the local response of YBCO and LSCO to an applied field and interpret their results as evidence for pairing correlations above T_c . They compare their data to results from other techniques, including STM, Nernst and thermo-magnetic measurements, and propose that phase separation, with superconducting regions, plays a role in much of the cuprate phase diagram. This work addresses the nature of the pseudogap phase, believed to be at the heart of understanding high temperature superconductivity. Sonier and co-workers propose to extend their studies in the optimal and overdoped regime on samples of LSCO, YBCO and Ca-doped YBCO single crystals. This is a key part of the phase diagram as a crossover (or a quantum phase transition, at zero temperature) is thought to occur between the anomalous pseudogap behaviour and more conventional Fermi liquid behaviour. One can expect these measurements to yield further important, high-profile results.

RECOMMENDATION: 24 shifts at high priority

| | | |
|--------------|---|---------------------------|
| M1163 | Photoexcitation of muonium in Ge | I. Fan / K.H. Chow |
|--------------|---|---------------------------|

Studying muonium states in semiconductors has not only the tradition of being well-defined and detailed work but it has also had a significant impact on understanding the effect of atomic hydrogen on the passivation of defects based on the corresponding muon states. Longitudinal-

field studies allow only an indirect discrimination between the various muon states. Even in transverse fields it is often non-trivial to distinguish between the negative and the positive ions of μ , since they are both diamagnetic. The present proposal intends to use photoexcitation-induced relaxation to discriminate between the states and nail down the kinetic scheme of interconversion. The proposal is well-defined and sound. The Committee notes that muon semiconductor work tends to stop when the muon behaviour in these materials is understood. In the Committee's opinion the impact of the work in the non-muon community would benefit from a broader consideration of the results in the general context of semiconductor physics and applications.

RECOMMENDATION: 24 shifts at medium-high priority

| | | |
|--------------|---|--------------------|
| M1168 | Magnetic Fluctuations in Geometrically Frustrated Itinerant Ferromagnets | S. Dunsiger |
|--------------|---|--------------------|

Although the main goal of studies in frustrated magnetism — experimental identification of various exotic ground states such as the spin liquid or RVB liquid — remains elusive, much has been understood about these systems in cases when magnetic moments are localized. By contrast very little is known about the itinerant counterparts of these frustrated magnets. The presence of delocalized electrons leads to additional complexity associated with the interaction of localized moments with the delocalized moments in the sea of conduction electrons. This could lead to a host of novel phenomena, which will be studied under the present proposal. The Committee felt that systematic μ SR studies of metallic pyrochlores $\text{Nd}_2\text{Mo}_2\text{O}_7$ and $\text{Sm}_2\text{Mo}_2\text{O}_7$, focusing on changes in spin dynamics as a function of chemical substitution, introducing charge carriers and disorder, are worth pursuing and will lead to potentially important insights into a class of very interesting materials.

RECOMMENDATION: 24 shifts at medium-high priority

| | | |
|--------------|---|--------------------------------|
| M1180 | μSR studies of iron oxy-pnictide superconductors and parent systems | G.M. Luke / Y.J. Uemura |
|--------------|---|--------------------------------|

In 2008 superconductivity at temperatures up to 55 K was discovered in a class of iron oxy-pnictide materials. In many ways these materials are similar to cuprates (e.g. importance of 2d layered structure, proximity to magnetically ordered states) but there are also important differences. Historically, μ SR studies played an important role in deciphering the physics of cuprates and one expects that this will be true for oxy-pnictides. The Committee liked this proposal to study magnetic and superconducting properties of three families of oxy-pnictide materials. The Committee also felt that highest priority should be given to the studies of well-characterized single crystals of $\text{Ba}(\text{FeCo})_2\text{As}$. In cuprates it was not until single crystals became available that μ SR reached its full potential in illuminating the intrinsic properties of these materials.

RECOMMENDATION: 24 shifts and medium-high priority and 12 shifts at high priority

4B. RECOMMENDATIONS: NEW PROPOSALS

| | | |
|-------|--|--|
| M1184 | Ground state of one-dimensional zig-zag chain compounds | J. Sugiyama / J.H. Brewer / O. Ofer |
|-------|--|--|

This is a new proposal which suggests the study of some interesting compounds with the CaF_2O_4 or hollandite structures in which the magnetic ions are located on essentially one dimensional zigzag chains, and where there is apparent competition between the near-neighbour and next-near-neighbour interactions. Samples of these materials (e.g. $\text{K}_2\text{V}_8\text{O}_{16}$) can only be prepared in small quantities (~ 0.2 g) by high pressure synthesis. The proposers argue that such quantities are insufficient for neutron measurements, and therefore wish to use μSR to study the magnetic transitions in these compounds. However the Committee notes that μSR cannot be used to solve magnetic structures, as suggested in the proposal, and the proposed measurements would certainly benefit from complementary neutron diffraction studies – such measurements could be carried out on less than a gram of material, and if the proposers have confidence in the repeatability of their sample preparation such quantities of homogeneous material should be achievable. The proposal is concerned with some interesting systems with interesting magnetic and transport properties, but as an experimental program it represents a rather unfocused “shot-gun” approach in which many compounds are suggested for study, without any real theoretical justification or attempt at prioritization. Nevertheless the proposal is supported by the panel.

RECOMMENDATION: 12 shifts at medium priority (for the $\text{K}_2\text{V}_8\text{O}_{16}$ compound) and 12 shifts at medium-high priority (for exploratory studies)

| | | |
|-------|--|---|
| M1197 | TF-μSR (and ZF-μSR) in the $\text{La}_3\text{Bi}_4\text{Pt}_3$ superconductor without inversion symmetry | A. Bianchi / G.F.D. Seyfarth |
|-------|--|---|

Bianchi and co-workers propose to study the temperature dependence of the penetration depth of the non-centrosymmetric superconductor, $\text{La}_2\text{Bi}_4\text{Pt}_3$, down to dilution-refrigerator temperatures. In principle, this measurement could provide key information about the superconducting order parameter symmetry. Due to the lack of inversion symmetry, even the electron-phonon mechanism can give rise to a nontrivial gap structure. However, this material will almost certainly have a complicated, multi-band Fermi surface (due to the large unit cell) severely complicating the analysis. The principal investigators are not μSR experts and the sample is not as thoroughly characterized as one might like before undertaking μSR studies. For example: What is the origin of the relatively wide resistivity transition (about 10% of T_c) in this material — is it sample or material dependent? Nevertheless the group has a strong research record and both the specific material and the general problem of non-centrosymmetric superconductors are potentially very interesting. Therefore, The Committee recommends beam time, but also recommend that the group work together with μSR experts in the analysis of the data, since extracting the penetration depth will almost certainly be complicated by the considerations mentioned above. In particular the Committee recommends that the experimental team carry out a careful experiment, rather than the cursory “first attempt” study suggested by the presentation, particularly as there is no doubt that μSR will indeed see the flux lines in this material. In this respect, measurements in only low transverse fields are expected to be unproductive: depending

upon the (unreported) pinning strength in these materials it is possible that low-field results will not shed light on single vortices, but upon a distorted flux-line lattice pinned close to the surface of the sample.

RECOMMENDATION: 12 shifts at medium priority

| | | |
|--------------|--|--------------------------------------|
| M1198 | Reaction kinetics in supercritical water as probed with muonium | K. Ghandi / P.W. Percival |
|--------------|--|--------------------------------------|

This new proposal intends to simulate the reactions of hydrogen atoms in a supercritical-water-cooled nuclear reactor by studying analogous reactions of Mu. Earlier measurements gave clear evidence that the temperature dependence of the rate constants of some reactions does not show smooth behaviour around the critical point, so that conventional extrapolation laws used in the transition regime between diffusion controlled and activation controlled reactions fail. This behaviour, which originates most likely in the pronounced density modulation of the supercritical fluid in space and time, is of fundamental importance, and Mu kinetics is currently the only method to study radical reactions in this regime. It is to be expected that the nature and extent of the irregularities depend significantly on the type of reaction (addition or abstraction) and on the size of the molecules involved. The results from the proposed Mu experiments will be valuable in their own right and may guide the extrapolation of H kinetic data from lower temperature. However, the Committee feels that cooperation with a theoretician in the field of reaction kinetics would help a quantitative understanding of the effects and further enhance the impact of the data. Because of the context of the GIF international collaboration for the development of advanced nuclear power systems, the proposal is not only of high scientific impact but also of strategic importance to TRIUMF. The Committee expresses its strong support.

RECOMMENDATION: 24 shifts at medium priority and 24 shifts at high priority

| | | |
|--------------|---|--|
| M1199 | Electron Localization into Magnetic Polaron in Antiferromagnetic Materials | J.H. Brewer / V.G. Storchak |
|--------------|---|--|

This is a new proposal to study muon-induced spin polarons in single crystals of various antiferromagnetic materials distinguished by their dimensional structure, including: EuSe, EuTe (3D), LiCu₂O₂ (1D), and HTSC (2D). The proponents have results from LiCu₂O₂ interpreted as muon polaron formation and they wish to support this conclusion, and their hypothesis that muons may induce polarons more generally in antiferromagnets, by studying the dependence on dimensionality in new experiments. The Committee feels that the possibility of muon-induced polarons is an important issue and merits further investigation. However, the proposal and presentation did not connect sufficiently to other muon studies of antiferromagnets. A careful consideration of other possible explanations for a splitting into two muon frequencies has not been undertaken. The Committee recommends that a more in-depth study of a few materials be done, rather than the many proposed, and that the results be also interpreted in the context of other existing data.

RECOMMENDATION: 18 shifts at medium-high priority

| | | |
|--------------|---|--------------------|
| M1205 | Superconductivity in electron-doped AFe_2As_2 single crystals | J.E. Sonier |
|--------------|---|--------------------|

Research on the iron pnictides is moving very rapidly and this proposal has the advantage of proposing work that is unlikely to be done elsewhere or by others because of the specialized capabilities required. Sonier and co-workers propose detailed and extensive measurements of the internal field distribution in the vortex state of single-crystal BaFeCoAs. Their group has unique capabilities in analyzing such measurements for different pairing symmetries and band structures. These involve detailed analysis of the line shape in the vortex lattice and stem from a large body of work done previously by this group on cuprates and other unconventional superconductors. One would expect these measurements to be able to place clear restrictions on the superconducting order parameter symmetry, which is a key issue for addressing the mechanism for superconductivity in these new materials. Therefore, one can expect this work to have significant impact in this fast-moving, high-profile area.

RECOMMENDATION: 12 shifts at medium-high priority at 12 shifts at high priority

| | | |
|--------------|--|--------------------|
| M1206 | Shallow Muonium Acceptor States in Semiconductors | R.L. Lichti |
|--------------|--|--------------------|

This is a new proposal aiming to confirm the existence of a shallow acceptor state predicted for H in Ge and high Ge-content, GeSi alloys. Similar to results from theoretical calculations for H, the muonium experimental energy level for the change from + to - state is also very constant independent of the semiconductor matrix. Still, a question is why the experimental value is about 0.4 eV higher in energy compared to theory for H, which is only partially explained (50 meV) by isotope effects. Of particular interest is the proposal that neutral Mu disproportionates into a weak complex of highly localized Mu^- and a positive hole. Preliminary data from previous beam time indicates the slow formation of acceptor levels in GeSi as predicted. The group wishes to repeat measurements with higher sensitivity techniques to confirm the existence as well as to broaden the investigation to the measurement of charge-state transitions. Large (1 cm diameter) single crystals of the alloys as well as low-doped Ge crystals are available. This is a well conceived and focussed experiment that should succeed. To increase interest in μ SR studies by the general community, the Committee suggests that more emphasis in the proposal and reports is needed describing the potential impact of the results on, for example, solving problems with current SiGe device applications.

RECOMMENDATION: 24 shifts at medium-high priority

| | | |
|--------------|---|--------------------------------|
| M1208 | MuSR studies of Volborthite system and CuBr compounds with tri-perovskite layers | G.M. Luke / Y.J. Uemura |
|--------------|---|--------------------------------|

When interactions between localized magnetic moments in a lattice experience frustration, the ground state of a system often exhibits interesting properties. Some theories, specifically, predict that a spin-liquid ground state, i.e. state with no long-range spin order, can obtain. Although existence of such a spin liquid has not yet been convincingly demonstrated in any real system, the set of ideas continues to drive interest in the frustrated magnets and stimulates searches for new materials exhibiting frustration. The current proposal envisions μ SR investigation of two such recently discovered frustrated systems: the Volborthite with spins located on the vertices of the Kagome lattice and CuBr tri-perovskite which provides a realization of the J_1 - J_2 model on a square lattice. Both are prime candidates for the spin-liquid ground state. The existing experimental evidence indicates instead spin freezing in Volborthite below about 1 K, and a spin-gap behaviour in the tri-perovskite below about 2 K. The proposed μ SR measurements at sub-Kelvin temperatures will elucidate the nature of magnetism in these interesting compounds, and the Committee felt that they are well worth pursuing. The Volborthite study is considered to be more promising, and it is recommended that it be given higher priority than the CuBr investigation.

RECOMMENDATION: 12 shifts at medium priority and 12 shifts at medium-high priority

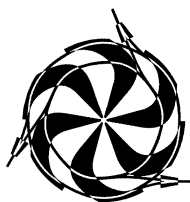


**TRIUMF
MOLECULAR AND MATERIALS SCIENCE
EVALUATION COMMITTEE MEETING
DECEMBER 4th & 5th, 2008
IN THE TRIUMF MOB CONFERENCE ROOM
AGENDA**

THURSDAY, DECEMBER 4th 2008

(New proposals are identified by the asterisk.)

| Time | Exp. # | Title | Spokesperson | Alt. Mode |
|--------------|--------|--|--------------|-------------|
| 08:30 | | Breakfast – Inside the MOB Conference Room | | |
| 09:00 | | CLOSED MEETING | | |
| 09:30 | M1180 | μ SR studies of iron oxy-pnictide superconductors and parent systems | T. Uemura | NY Tel. |
| 10:00 | M1208* | MuSR studies of volborthite system and CuBr compounds with tri-perovskite layers | T. Uemura | NY Tel. |
| 10:30 | | Coffee – Reception Area | | |
| 11:00 | M1206* | Shallow Muonium Acceptor States in Semiconductors | R. Lichti | Texas Video |
| 11:30 | M1049 | Spin State Transition in $RECoO_3$ ($RE=La, Pr, Nd$ and Sm) | J. Sugiyama | |
| 12:00 | M1184* | Ground state of one-dimensional zig-zag chain compounds | J. Sugiyama | |
| 12:30 | | Lunch – Inside the MOB Conference Room | | |
| 13:00 | | CLOSED MEETING | | |
| 13:30 | M1115 | Magnetism and Superconductivity of $Bi_2Sr_2CuO_{6+\delta}$ | R. Kadono | KEK Video |
| 14:00 | M1154 | Novel metallic phase induced by geometrical electronic correlation | R. Kadono | KEK Video |
| 14:30 | M1160 | Local Pairing Correlations Above the Superconducting Transition Temperature | J. Sonier | |
| 15:00 | | Coffee – Reception Area | | |
| 15:30 | M1205* | Superconductivity in electron-doped AFe_2As_2 single crystals | J. Sonier | |
| 16:00 | M1088 | μ^+ SR Studies of Magnetic Semiconductors | S. Storchak | |
| 16:30 | M1199* | Electron Localization into Magnetic Polaron in Antiferromagnetic Materials | S. Storchak | |
| 17:00 | | In-Camera Meeting – Inside the MOB Conference Room | | |



**TRIUMF
MOLECULAR AND MATERIALS SCIENCE
EVALUATION COMMITTEE MEETING
DECEMBER 4th & 5th, 2008
IN THE TRIUMF MOB CONFERENCE ROOM
AGENDA**

FRIDAY, DECEMBER 5th 2008

| Time | Exp. # | Title | Spokesperson | Alt. Mode |
|--------------|--------|--|-----------------|-------------|
| 08:30 | | Breakfast – Inside the MOB Conference Room | | |
| 09:00 | M1168 | Magnetic Fluctuations in Geometrically Frustrated Itinerant Ferromagnets | S. Dunsiger | Munich Tel. |
| 09:30 | M998 | Muon Spin Relaxation and Dynamic Scaling in Novel Magnetic Materials | D. MacLaughlin | CA Tel. |
| 10:00 | M1139 | μ SR Studies of Magnon Bose Condensation in $\text{Pb}_2\text{V}_3\text{O}_9$ | C. Wiebe | FL Tel. |
| 10:30 | | Coffee – Reception Area | | |
| 11:00 | M1197* | TF- μ SR (and ZF- μ SR) in the $\text{La}_3\text{Bi}_4\text{Pt}_3$ superconductor without inversion symmetry | A. Bianchi | MTL Video |
| 11:30 | M1051 | Muonium and Muoniated Free Radical Formation and Reactivity in Ionic Liquids | K. Ghandi | NB Video |
| 12:00 | M1131 | Free Radical Dynamics, Reactions and Hfcs in Supercritical CO_2 | K. Ghandi | NB Video |
| 12:30 | | Lunch – Inside the MOB Conference Room | | |
| 13:00 | | CLOSED MEETING | | |
| 13:30 | M1163 | Photoexcitation of muonium in Ge | K. Chow | |
| 14:00 | M1198* | Reaction kinetics in supercritical water as probed with muonium | J-C. Brodovitch | |
| 14:30 | | CLOSED MEETING | | |

