International and Interdisciplinary Workshop on Novel Phenomena in Integrated Complex Sciences : from Non-living to Living Systems

Date : 11th - 14th October, 2010
Place : Coop-Inn Kyoto, Kyoto city, Japan

Welcome to Kyoto and International and Interdisciplinary Workshop on Novel Phenomena in Integrated Complex Sciences: from Non-living to Living Systems.

In this workshop the recent advancement of experiments and theories will be discussed on superconductivity, emergent phenomena in biological material, chemical properties and economic problems of nonliving and living systems. The aim of this workshop is to discuss such old but still new problems from multidisciplinary perspective and to understand the general features behind diversity in condensed matter physics, experimental chemistry, physical basis in biology and economic science. The workshop will be broadly based, and is titled "International & Interdisciplinary Workshop on Novel Phenomena in Integrated Complex Sciences: from Non-living to Living Systems." However, the primary focus will be on superconductivity and NMR research into strongly correlated electrons. Contingent upon official approval in January 2010, the meeting will be held as an ICAM workshop. The proceedings will be published in the "Journal of Physics: Conference Series" (UK). We also plan to invite young scientists as well as graduate students. We hope that such young scientists have chance to talk with invited speakers and organizers on their own interests. We do not want to have a tight schedule, but instead to have a relatively enough time for discussion.

We join you in looking forward to an enjoyable and stimulating workshop.

Kazuyoshi Yoshimura
Conference chairman

Invited Speakers

Janice Chang (Irvine)
Nicholas Curro (Davis)
Minghu Fang (Zhejiang)
Satoshi Fujimoto (Kyoto)
Kenji Ishida (Kyoto)
Masami Ishido (Tsukuba)
Takashi Imai (Ontario)
Masayuki Itoh (Nagoya)
Shinsaku Kambe (Tohkai)
Itsuki Kunita (Hakodate)
Peter Lemmens (Braunschweig)
Herwig Michior (Wien)
Hidetake Miyata (Sendai)
Takamasa Momose (Vancouver)
Hiroyuki Nakamura (Kyoto)
Kelly Reavis (Irvine)
Toru Sakai (Hyogo)
Shigeru Sakurazawa (Hakodate)
Yuichi Shimakawa (Kyoto)
Raivo Stern (Tallinn)
Hiroshi Sugiyama (Kyoto)
Yoshinori Takahashi (Hyogo)
Masashi Takigawa (Kashiwa)
Hiroaki Ueda (Kashiwa)
Yoichi Yanase (Niigata)
Harukazu Kato (Kochi)
Masaki Kato (Kyoto)
Mitsuhiko Maesato (Kyoto)
Chishiro Michioka (Kyoto)
Hiroya Sakurai (Tsukuba)
Naohito Tsujii (Tsukuba)

International Advisory

Evgeny Antipov (Moscow)
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Raivo Stern (Tallinn)
Louis Taillefer (Sherbrooke)
Masashi Takigawa (Kashiwa)

Organizing Committee

M. Murase (Kyoto)
K. Nishimura (Kyoto)
K. Yoshimura (Kyoto)

Presentations

Posters are preferable if they are designed to fit in an area about 90 cm wide by 180 cm high. Please set up your poster before 18:00 on 12th October. Please keep your poster on the board until the end of the poster session on 13th October.
There are two types of oral presentations. One is 40 minutes (30 min. + 10 min.) and the other is 20 minutes (15 min. + 5 min.). Please respect your allotted time so that sessions can remain on schedule.

Proceedings

All registered participants are invited to submit a conference proceedings paper. Accepted manuscripts will be published in the Journal of Physics: Conference Series. The deadline for the manuscripts is 30th November. Submission of the manuscript is done through e-mail.
The e-mail address for submission is "**proc-com2010@yukawa.kyoto-u.ac.jp**".

Table of Contents

Program of the Workshop

Monday 11th Oct.

17:00 – Welcome reception

Tuesday 12th Oct.

8:30 – Registration

9:00 – 9:20 Opening address

Makoto YANO and **Kazuyoshi YOSHIMURA**

9:20 – 12:35 Oral session : Superconductivity in strongly correlated systems

chair **K. Yoshimura** (Kyoto University, Japan)

9:20 **Takashi IMAI** (McMaster University, Canada)
"NMR investigation of iron-based high T_c superconductors"

10:00 **Nicholas CURRO** (University of California at Davis, USA)
"Probing the Magnetism in Lightly Doped $Ba(Fe,Ni)_2As_2$ with NMR"

10:40 *break*

10:55 **Minghu FANG** (Zhejiang University, China)
"Magnetism and Superconductivity in Fe(Te,Se,S) system"

11:35 **Kenji ISHIDA** (Kyoto University, Japan)
"^{59}Co-NQR and NMR Studies on Ferromagnetic Superconductor UCoGe"

12:15 **Chishiro MICHIOKA** (Kyoto University, Japan)
"Microscopic Characterizations of $Fe_{1+\delta}Te_{1-x}Se_x$"

12:35 – 14:00 *lunch*

14:00 – 17:55 Oral session : Superconducting and related systems
:experiment and theory

chairs **T. Imai** (McMaster University, Canada)
M. Takigawa (University of Tokyo, Japan)

14:00 **Masashi TAKIGAWA** (ISSP, University of Tokyo, Japan)
"Microscopic insight into magnetism and superconductivity in FeAs-based materials"

14:40 **Raivo STERN** (NICPB, Estonia)
“Bose-Einstein Condensation in some Oxide Dimer Systems – a NMR Study”

15:20 **Harukazu KATO** (Kochi University, Japan)
"A NQR/NMR study of an A-site ordered perovskite system, $RCu_3Ru_4O_{12}$ (R = Ca, Sr, La, and Pr)"

15:40 *break*

15:55 **Herwig MICHIOR** (Vienna University of Technology, Austria)
"Evolution of quantum criticality in the system $CeNi_9Ge_4$"

16:35 **Yoichi YANASE** (Niigata University, Japan)
"Antiferromagnetic order and antiferromagnetic quantum criticality in Fulde-Ferrell-Larkin-Ovchinnikov state"

17:15 **Satoshi FUJIMOTO** (Kyoto University, Japan)
"Topological Phases and Majorana Fermions in Noncentrosymmetric Superconductors"

18:00 – 21:00 Poster session

19:00 – 21:00 Banquet

Wednesday 13th Oct.

9:00 – 12:35 Oral session : Magnetic and superconducting systems
chairs **N. Curro** (UC Davis, USA)
R. Stern (NICPB, Estonia)

9:00 **Peter LEMMENS** (TU Braunschweig, Germany)
"The interrelation of electronic and orbital fluctuations in a magnetic model system"

9:40 **Yoshinori TAKAHASHI** (University of Hyogo, Japan)
"Magnetic isotherm of itinerant electron magnets. - A new approach to itinerant electron metamagnetism"

10:20 **Shinsaku KAMBE** (ASRC, JAEA, Japan)
"NMR study of exotic magnetism and superconductivity in actinide compounds"

11:00 *break*

11:15 **Yuichi SHIMAKAWA** (Kyoto University, Japan)
“Magnetic and transport properties of new A-site ordered perovskites”

11:55 **Takamasa MOMOSE** (UBC, Canada)
"Cold and Ultracold Molecules: Current Status and Future Perspectives"

12:35 *lunch*

14:00 – 18:05 Oral session : Complex Phenomena from Molecules to Humans

chair **M. Murase** (Kyoto University, Japan)

14:00 **Kazuo NISHIMURA** (Kyoto University, Japan)
"Resting Mode of Brain in Relation to Individual Thinking Patterns"

14:40 **Hiroshi SUGIYAMA** (Kyoto University, Japan)
"DNA origami: Useful scaffold for observation of single molecular event"

15:20 *break*

15:35 **Masatoshi MURASE** (Kyoto University, Japan)
"Life as Compatible Contradiction
－Towards Integrated Studies of Complex Living Systems－"

15:55 **Itsuki KUNITA** (Riken Advanced Science Institute, Japan)
Shigeru SAKURAZAWA (Future University Hakodate, Japan)
"Movement Regulation of a Sliding Actin Filament in a Reconstruction Motility Assay System"

16:15 **Hidetake MIYATA** (Tohoku University, Japan)
"The effect of 50 Hz sinusoidal magnetic field on nitric oxide (NO) production by HUVEC"

16:35 *break*

16:45 **Masami ISHIDO** (National Institute for Environmental Studies, Japan)
"Biological Effects of Electromagnetic Fields on Human Breast Cancer MCF-7 cells"

17:05 **Ken NAITOH** (Waseda University, Japan)
"Spatiotemporal structure: common to subatomic system, biological process, and economic cycles"

17:25 **Janice CHANG** (University of California, Irvine, USA)
"ELECTRIC STIMULATION IN TINNITUS TREATMENT"

17:45 **Kelly REAVIS** (University of California, Irvine, USA)
"Temporally-Patterned Acoustic Sound Therapy for Tinnitus Suppression"

18:10 – 21:00 Poster session

Thursday 14th Oct.

9:00 – 12:55 Oral session : Frustrated and low dimensional systems

chairs **P. Lemmens** (TU Braunschweig, Germany)

H. Michior (Vienna UT, Austria)

9:00 **Hiroaki UEDA** (University of Tokyo, Japan)
"Novel field-induced magnetic transitions of 3*d* transition metal spinels and pyrochlores"

9:40 **Toru SAKAI** (JAEA, SPring-8, Japan)
"Topological Aspects of the Quantum Spin Nanotube"

10:00 **Mitsuhiko MAESATO** (Kyoto University, Japan)
“A two-dimensional conductor based on C_{60}”

10:20 **Masaki KATO** (Doshisha University, Japan)
"Synthesis and Physical Properties of Cu Oxides with Low-dimensional Tri-rutile and PbO_2 type structure"

10:40 **Masayuki ITOH** (Nagoya University, Japan)
"Metal-insulator transition in 3*d* transition metal oxides with double chains investigated by NMR"

11:20 *break*

11:35 **Hiroyuki NAKAMURA** (Kyoto University, Japan)
“Geometrical frustration in stella quadrangula lattice and quantum criticality in Fe_3Mo_3N”

12:15 **Naohito TSUJII** (NIMS, Japan)
“Superconducting properties of $YbGa_xSi_{2-x}$”

12:35 **Hiroya SAKURAI** (NIMS, Japan)
“Physical properties of AV_2O_4 and ACr_2O_4 (A = Ca and Na)”

12:55 – Closing address
Masatoshi MURASE (Kyoto University, Japan),
Kazuo NISHIMURA (Kyoto University, Japan),
and **Kazuyoshi YOSHIMURA** (Kyoto University, Japan)

List of poster presenters

PS-1 N. Hatayama (Mie)
PS-2 R. Konno (Mie)
PS-3 T. Waki (Kyoto)
PS-4 Y. Kotani (Hyogo)
PS-5 B. Chen (Kyoto)
PS-6 Y. Tabata (Kyoto)
PS-7 J. Yang (Kyoto)
PS-8 H. Sakurai (Tsukuba)
PS-9 M. Matsui (Kyoto)
PS-10 A. Shockley (Davis)
PS-11 M. Kawa (Kyoto)
PS-12 Y. Makino (Kyoto)
PS-13 A. Dioguardi (Davis)
PS-14 W. Ge (Kyoto)
PS-15 K. Nawa (Kyoto)
PS-16 A. Amano (Kyoto)
PS-17 S. Kobayashi (Kyoto)
PS-18 A. Tanizawa (Kyoto)
PS-19 H. Ohta (Kyoto)
PS-20 and PS-21 J. Sugiyama (Aichi)
PS-22 K. Nishiyama (Hyogo)
PS-23 Y. Osada (Kyoto)
PS-24 T. Hasegawa (Kanagawa)
PS-25 N. apRoberts-Warren (Davis)

Oral presenters and abstracts

Total 33 presentations

Tuesday 12th Oct. at 9:20

NMR investigation of iron-based high T_c superconductors

Takashi IMAI
Department of Physics and Astronomy, McMaster University
Canadian Institute for Advanced Research

We will discuss the electronic and superconducting properties of iron-based high temperature superconductors as investigated by NMR techniques [1,2]. Similarities and dissimilarities with cuprates will be pointed out.

[1] F.L. Ning et al., Phys. Rev. Lett. 104 (2010) 037001.
[2] T. Imai et al., Phys. Rev. Lett. 102 (2009) 177005.

Tuesday 12th Oct. at 10:00

Probing the Magnetism in Lightly Doped $Ba(Fe,Ni)_2As_2$ with NMR

Nicholas CURRO

University of California at Davis, USA

We report ^{75}As NMR measurements in $BaFe_2As_2$ doped with Ni. Like Co, Ni doping suppresses the antiferromagnetic and structural phase transitions and gives rise to superconductivity for sufficiently large Ni doping. The spin lattice relaxation rate diverges at T_N, with a critical exponent consistent with 3D ordering of local moments. In the ordered state the spectra quickly broaden inhomogeneously with doping. We extract the average size of the ordered moment as a function of doping, and show that a model in which the order remains commensurate but with local amplitude variations in the vicinity of the dopant fully explains our observations.

Tuesday 12th Oct. at 10:55

Magnetism and Superconductivity in Fe(Te,Se,S) system

Mingfu FANG
Department of Physics, Zhejiang University, China

The discovery of high temperature superconductivity up to 55 K in the $ReO_{1-x}F_xFeAs$ (Re =rare earth) compounds has generated interesting in understanding the general interplay of quantum magnetism and superconductivity in iron-based compounds. The very recent observation of unusual superconductivity and magnetic order in the structurally simpler compounds such as FeSe and $Fe_{1+y}Te$ is highlight of current iron-based high-T_c research. Here, I shall review the recent development and show our recent experimental results of the magnetism and superconductivity in Fe(Te, Se, S) system. In July, 2008, we reported our study on superconductivity and phase diagram of the $Fe(Se_{1-x}Te_x)_{0.82}$ system. Recently, we found that the presence of excess Fe in Te(Se) layers suppresses bulk superconductivity and results in a complicated magnetic structure in both systems. I shall show the intrinsic phase diagram of $Fe_{1+y}Te_{1-x}Se_x$ after removing the excess Fe. In addition, it is found that the low-temperature upper critical field for $Fe_{1.11}Te_{0.6}Se_{0.4}$ with T_c=14 K, determined by the resistivity measurements in pulsed field of up to 60T, is rather isotropic, although the initial slope of $H_{C2}(T)$ near T_c does show some dependence on the field orientation. We believe that isotropic superconductivity is associated with the Fe-based superconductor's Fermi-surface topology with strong corrugations. Neutron scattering results reveal a unique complex incommensurate antiferromagnetic order in the parent compound $Fe_{1+y}Te$, which is different from that in the parent compounds of the other Fe-pnictide superconductors. These results suggest that superconductivity in Fe(Te, Se, S) system is associated with magnetic fluctuations and therefore may be unconventional in nature.

Tuesday 12th Oct. at 11:35

^{59}Co-NQR and NMR Studies on Ferromagnetic Superconductor UCoGe

Kenji ISHIDA*[1,2], Y. Ihara[1], T. Hattori[2], K. Karube, N. Tamura[3], K. Deguchi[3], N. K. Sato[3], and I. Satoh[4]

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[2] *Transformative Research Project on Iron Pnictides (TRIP), Japan Science and Technology Agency (JST), Tokyo 102-0075, Japan.*

[3] *Dept. of Physics, Graduate School of Science, Nagoya University, Nagoya 464-8602, Japan.*

[4] *Institute for Materials Research, Tohoku University, Sendai 980-8577 Japan.*

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We report ^{59}Co nuclear magnetic resonance (NMR) and nuclear quadrupole resonance (NQR) studies on the single crystalline ferromagnetic superconductor UCoGe[1], which exhibits ferromagnetic ordering at T_{Curie} =2.5 K and superconductivity below T_{Super} = 0.57 K [2]. The internal magnetic field at the Co site originating from the ferromagnetic moments is detected from the ^{59}Co-NQR measurements. Temperature variation of the ^{59}Co-NQR spectra indicates that the NQR signals arising from the paramagnetic (PM) and ferromagnetic (FM) regions coexist between 1 and 2.7 K, and that the PM signal is not observed below 0.9 K. These results suggest that the FM transition possesses a first-order-like character, and that single-crystal UCoGe is in the homogeneous FM state throughout the sample below 0.9 K.

The nuclear spin-lattice relaxation rate ($1/T_1$) measured at the FM NQR signal decreases below T_{Super} due to the opening of the superconducting (SC) gap, as shown in Fig. 1, which gives unambiguous evidence for the microscopic coexistence of ferromagnetism and superconductivity in UCoGe. We also synthesized the reference compound YCoGe without 5*f* electrons, which possesses the same crystal

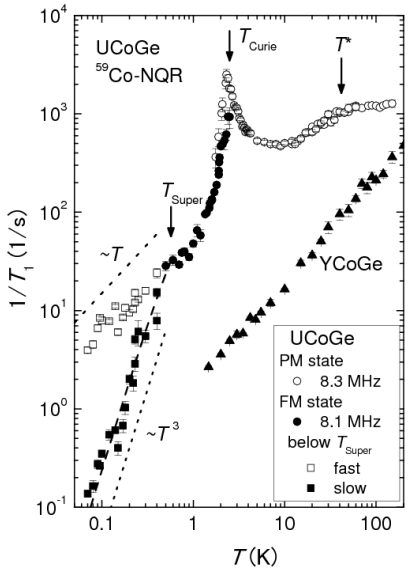

Fig. 1: Temperature dependence of $1/T_1$ in UCoGe and YCoGe.

structure as UCoGe, and investigated its physical properties. Since YCoGe shows neither ferromagnetism nor superconductivity down to 0.5 K, it is thus considered that ferromagnetism and superconductivity observed in UCoGe originate from the U 5*f* electrons.

In order to investigate the anisotropy of magnetic fluctuations and spin susceptibility from a microscopic view points, we have performed NMR measurements on the single crystalline UCoGe. From the analysis of angular dependence of the NMR spectra, we have succeeded in determine the principal axis of electric field gradient at the Co site. This has enabled us to measure $1/T_1$ and Knight shift for each axis. The experimental results indicate that both static and dynamic susceptibilities are ferromagnetic with strong Ising anisotropy along the *c* axis [3].

In addition, from the angle-resolved NMR measurements, we found that the magnetic field along the c axis (H//c) strongly suppresses both the FM Ising-type fluctuations and superconductivity in the same way. These results suggest that the characteristic FM fluctuations tuned by H//c induce the unique superconductivity in UCoGe, which is anticipated to be a spin-triplet superconductor. This is the first clear example of an intimate relationship between FM fluctuations and superconductivity.

References

[1] T. Ohta *et al*., J. Phys. Soc .Jpn. **79**, 023707 (2010).

[2] N. T. Huy *et al*., Phys. Rev. Lett. **100**, 077002 (2008).

[3] Y. Ihara *et al*, arXiv:10082837v1

Tuesday 12th Oct. at 12:15

Microscopic Characterizations of $Fe_{1+\delta}Te_{1-x}Se_x$

Chishiro MICHIOKA, H. Ohta, M. Matsui, J. Yang, K. Yoshimura and M. Fang[A]

Department of Chemistry, Graduate School of Science, Kyoto University,

Department of Physics, Zhejiang University[A]

Since recent discoveries of iron based superconductors with the superconducting transition temperature (T_c) being 55 K in the highest cases [1,2,3], many studies have been done to clarify the details of the electronic states. In the present work, we investigated the microscopic physical properties of $Fe_{1+\delta}Te_{1-x}Se_x$ by using ^{125}Te NMR method.

From the antiferromagnet FeTe, substitution by Se at Te site suppresses the antiferromagnetism and then $Fe_{1+\delta}Te_{1-x}Se_x$ with $x > 0.2$ exhibit the superconductivity with maximum T_c of 14 K [4]. In the superconducting $Fe_{1.04}Te_{0.67}Se_{0.33}$, the nuclear spin-lattice relaxation ratio divided by temperature ($1/^{125}T_1T$) which is proportional to the $\boldsymbol{q}$-summation of the imaginary part of the dynamical spin susceptibility enhances with decreasing temperature in the normal state. Taking into account that the spin part of the Knight shift also decreases with decreasing temperature, antiferromagnetic fluctuations are thought to develop at low temperatures. Such the behavior is similar to the case of stoichiometric FeSe [5]. With decreasing the Se substitution x, the growth of $1/^{125}T_1T$ at low temperatures is enhanced. Because the antiferromagnetic phase transition of FeTe occurs as that of first-order with the structural change, observed enhancement of $1/^{125}T_1T$ is not directly attributed to the antiferromagnetic transition. However, the systematical behavior of $1/^{125}T_1T$ of $Fe_{1+\delta}Te_{1-x}Se_x$ indicates that the superconductivity occurs in the vicinity of the antiferromagnetic phase and is possibly mediated by the growth of the antiferromagnetic spin fluctuations.

[1] Y. Kamihara, T. Watanabe, M. Hirano, and H. Hosono, J. Am. Chem. Soc. 130, 3296 (2008).

[2] Z. A. Ren, W. Lu, J. Yang, W. Yi, X. L. Shen, Z. C. Li, G. C. Che, X. L. Dong, L.L. Sun, F. Zhou and Z. X. Zhao, Chin. Phys. Lett. 25, 2215(2008).

[3] X. F. Chen, T. Wul, G. Wu, R. H. Liu, H. Chen, and D. F. Fang, Nature 453, 761 (2008).

[4] M. H. Fang, H. M. Pham, B. Qian, T. J. Liu, E. K. Vehstedt, Y. Liu, L. Spinu, and Z. Q. Mao, Phys. Rev. B 78, 224503 (2008).
[5] T. Imai, K. Ahilan, F. L. Ning, T. M. McQueen, and R. J. Cava, Phys. Rev. Lett. 102, 177005 (2009).

Tuesday 12th Oct. at 14:00

Microscopic insight into magnetism and superconductivity in FeAs-based materials

Masashi TAKIGAWA

Institute for Solid State Physics, University of Tokyo, Japan

We present results of NMR investigations on static and dynamic aspects of magnetism and superconductivity in Fe-based high temperature superconductors. In particular, we discuss a novel form of coexistence of antiferromagnetic order and bulk superconductivity in undoped parent materials under high pressure.

Tuesday 12th Oct. at 14:40

Bose-Einstein Condensation in some Oxide Dimer Systems - a NMR Study

Raivo STERN[a,b], S. Krämer[b], M. Horvatić[b], C. Berthier[b], I. Heinmaa[a], E. Joon[a], K. Yoshimura[c], T. Kimura[d]

[a]National Institute of Chemical Physics and Biophysics, Tallinn, Estonia

[b]Laboratoire National des Champs Magnétiques Intenses, CNRS, Grenoble, France

[c]Department of Chemistry, Graduate School of Science, Kyoto University, Japan

[d]Graduate School of Engineering Science, Osaka University, Japan

We will present an NMR study of the two quasi-2D coupled spin-1/2 dimer compound, $BaCuSi_2O_6$, which is considered as the prototype of the magnetic field induced Bose-Einstein Condensation (BEC) of triplet excitations on a lattice [1]. For such a transition, T_{BEC} varies as $(H - H_{c1})^{2/d}$, where d is the dimensionality of the system, and H_{c1} the critical field which closes the gap between the singlet ground state and the minimum of the lowest band of triplet excitations. $BaCuSi_2O_6$ has been claimed to exhibit an unusual reduction of dimensionality from 3D to 2D when lowering the temperature, due to the frustration between adjacent planes [2]. However, due to a structural transformation at 90 K, different intradimer exchange couplings and different gaps ($\Delta_B/\Delta_A = 1.16$) exist in every second plane along the c axis [3]. In a first series of NMR experiments [3], we have shown that the population of bosons in the B planes n_B was much smaller than n_A, but finite in the field range $\Delta_A/g\mu_B < H < \Delta_B/g\mu_B$ where $n_B = 0$ is expected in a naive model of uncoupled planes. Recently, a new model has been presented [4] which takes into account both frustration and quantum fluctuations. This leads to a non-zero population n_B of uncondensed bosons in the B plane, increasing quadratically with $(H - H_{c1})$, as compared to the linear dependence of n_A. We compare our new NMR results on a ^{29}Si enriched single crystal to these predictions.
We also will advertise the low-T high resolution solid state NMR technique developed at NICPB in Tallinn, cryogenic magic angle spinning (cryo-MAS) [5], as applied to low-D quantum magnets like $BaCuSi_2O_6$, $Sr_2Cu(BO_3)_2$, and $Pb_2V_3O_9$.

References

[1] M. Jaime et al., Phys. Rev. Lett. 93, 087203 (2004).

[2] S. E. Sebastian et al., Nature 441, 617 (2006).
[3] S. Krämer et al., Phys. Rev. B 76, 100406(R) (2007).
[4] N. Laflorencie and F. Mila, Phys. Rev. Lett. 102, 060602 (2009).
[5] A. Samoson et al., Topics in Current Chemistry 246, 15 (2005).

Tuesday 12th Oct. at 15:20

A NQR/NMR study of an A-site ordered perovskite system, $RCu_3Ru_4O_{12}$ (R = Ca, Sr, La, and Pr)

Harukazu KATO

Faculty of Science, Kochi University, Japan

NQR/NMR measurements have been carried out on an A-site ordered perovskite system, $RCu_3Ru_4O_{12}$ (R = Ca, Sr, La, and Pr), which shows heavy-electron-like behavior at low temperatures although it has no f electron. The spin lattice relaxation rate $1/T_1$ of the Cu nuclei in the Ca-involved compound shows unusual temperature dependence marked with 20 K and 150K, while that in the other materials obeys a simple *T*-linear relation among all the temperature range. The characteristic feature found in the Ca compound is discussed in terms of temperature variation of the density of states (DOS). The relation between the DOS magnitude and the heavy electron behavior will be also discussed.

Tuesday 12th Oct. at 15:55

Evolution of quantum criticality in the system $CeNi_9Ge_4$

Herwig MICHIOR (Vienna University of Technology, Austria), D.T. Adroja, A.D. Hillier (ISIS Facility), M.M. Koza (ILL), L. Peyker, C. Gold, and E.-W. Scheidt (Augsburg University)

The non-Fermi liquid heavy fermion system $CeNi_9Ge_4$ exhibits remarkable features such as: a record value of the electronic specific heat coefficient in systems with a paramagnetic ground state, C/T = 5.5 J/mol K^2 at T = 80 mK, a temperature-dependent Wilson ratio, $R = \chi/\gamma$, below 1 K and an approximate single ion scaling of the 4*f*-magnetic specific heat and susceptibility. These features are caused mainly by a rather small Kondo energy scale of a few Kelvin in combination with a quasi-quartet crystal field ground state. As the significance of RKKY interactions remains unclear in pure $CeNi_9Ge_4$, we have explored Ni-site substitutions by Cu and Co, i.e. electron and hole doping. The aim to tune the system through a quantum phase transition towards long range magnetic order is in fact accomplished by replacing a few at.% Ni by Cu as well as by Co. Specific heat, susceptibility and resistivity studies reveal T_{Neel} = 0.2 K for $CeNi_8CuGe_4$ and T_{Neel} = 1 K for $CeNi_8CoGe_4$. In both cases the quasi-quartet ground state observed in $CeNi_9Ge_4$ reduces to a two-fold degenerated one. To gain insight whether the transition from the paramagnetic NFL state to the magnetically ordered ground state is connected with a heavy fermion quantum critical point we performed specific heat and ac susceptibility studies and utilized the muon spin relaxation technique and quasi-elastic neutron scattering for selected compositions $CeNi_9Ge_4$, $CeNi_{8.6}Cu_{0.4}Ge_4$ and $CeNi_8CuGe_4$. The quasi-elastic linewidth study indicates that Cu substitution reduces the Kondo energy scale by about 50% from $CeNi_9Ge_4$ to $CeNi_8CuGe_4$ and interestingly the response exhibits E/T scaling of the dynamical susceptibility for $CeNi_{8.6}Cu_{0.4}Ge_4$ which is on the verge of the magnetically ordered ground state.

Tuesday 12th Oct. at 16:35

Antiferromagnetic order and antiferromagnetic quantum criticality in Fulde-Ferrell-Larkin-Ovchinnikov state

Yoichi YANASE

Department of Physics, Niigata University, Japan

The Fulde-Ferrell-Larkin-Ovchinnikov (FFLO) state in the superconductors was predicted in 1960's. After nearly 40 years of fruitless experimental search for FFLO states recent experiments provide opportunities to study such a new quantum condensed state.

On the other hand, the relationship between the superconductivity and magnetism has been a central subject in the strongly correlated electron systems. In this talk we focus on the possible FFLO state in the heavy fermion superconductor $CeCoIn_5$ and shed light on the novel manifestations of the magnetism order and magnetic quantum criticality in the FFLO superconducting state.

Tuesday 12th Oct. at 17:15

Topological Phases and Majorana Fermions in Noncentrosymmetric Superconductors

Satoshi FUJIMOTO

Department of Physics, Kyoto Univeristy, Japan

For noncentrosymmetric (NCS) superconductors which lack inversion center in their crystal structures, various exotic superconducting properties raised by broken inversion symmetry have been investigated extensively from both theoretical and experimental sides; e.g. parity-mxing of Cooper pairs, magnetoelectric effect, the helical vortex state, and huge Pauli limiting fields [1]. In this presentation, we would like to discuss another interesting phenomenon expected for NCS superconductors; the possible realization of topological phases. Topological phases are novel quantum ground states characterized by topologically non-trivial structures of many-body Hilbert space, and are, recently, attracting much interest in connection with the topological insulator. In this talk, we discuss analogous states realized in NCS superconductors, which support novel transport properties such the quantum spin Hall effect, and the realization of Majorana fermions as the Bogoliubov quasiparticles. A remarkable feature of Majorana fermions realized in superconductors is that a particle is identical to its anti-particle, and that vortices with Majorana fermion modes behave as neither bosons nor fermions, but obeys a novel quantum statistics called the non-Abelian statistics for which the exchange of particles is noncommutative. This property has been currently attracting much interest in connection with the application to fault-tolerant quantum computation. We demonstrate that under certain but realistic conditions, topological phases and Majorana fermions can be realized in NCS superconductors in both the cases of a spin-triplet pairing state and a spin-singlet pairing state. We also discuss that possible candidates of our proposal in real materials are heavy fermion superconductors $CeRhSi_3$ and $CeIrSi_3$.

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Wednesday 13th Oct. at 9:00

The interrelation of electronic and orbital fluctuations in a magnetic model system

Peter LEMMENS

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The compound $KCuF_3$ is a well established model system with respect to the relation of lattice distortions and electronic correlation effects. It has a high symmetry with a single hole in an e_g state of Cu^{2+}, realizing a seemingly simple and clear electronic and structural situation. At high temperature, cooperative Jahn-Teller transition leads to an orbital ordering that forms chains of orbitals that are the basis of its spin $s = 1/2$ chain magnetism. The magnetic ordering for temperatures below 50K on the background of these fluctuations allows the observation of a longitudinal magnon. Recent investigations, however, question this picture. ESR line shape/width and frequency anomalies in the optical phonons give evidence for dynamic distortions that allow DM interactions and spin orbit coupling to play a crucial role. Our study using phonon and magnetic light scattering support the picture of dynamic distortions in the orbitally ordered state of $KCuF_3$ similar to other complex correlated electron systems that tend to complex structural distortions at low temperatures.

Work supported by DFG and ESF-HFM.

Wednesday 13th Oct. at 9:40

Magnetic isotherm of itinerant electron magnets - A new approach to itinerant electron metamagnetism

Yoshinori TAKAHASHI

Graduate School of Material Science, University of Hyogo, Japan

Theoretical development on the magnetic isotherm in itinerant electron ferromagnets is briefly reviewed in comparison with observed magnetization measurements. Itinerant electron metamagnetic transitions originate from the specific magnetization curve derived from the negative fourth expansion coefficient of the free energy in magnetization. In our view, however, it is difficult to expect the negative fourth coefficient of magnetic origin. We therefore propose a new mechanism of the metamagnetic transition, by taking an explicit account of volume dependence of the free energy, which is consistent with our spin fluctuation theory of magnetic isotherms.

Wednesday 13th Oct. at 10:20

NMR study of exotic magnetism and superconductivity in actinide compounds

Shinsaku KAMBE

ASRC, JAEA, Japan

In 5*f*-electron systems, exotic magnetism and unconventional superconductivity appear at low temperatures owing to strong electron correlations and orbital degeneracy. For example, we have investigated the unconventional superconducting states of recently synthesized $NpPd_5Al_2$ (T_c = 5K) and $PuRhGa_5$ (T_c = 9K) in terms of both macroscopic (static susceptibility, specific heat, resistivity) and microscopic (NMR) probes. The relation between magnetic fluctuations and unconventional superconductivity in *f*-electron systems is also discussed. Another exciting topic concerns the series AnO_2 (An; U, Np, Pu, Am). Besides the importance of AnO_2 as a nuclear fuel, the magnetic properties of these compounds at low temperatures are particularly interesting. On the basis of ^{17}O-NMR studies, multipolar ordered states have been identified in UO_2 (dipolar+quadrupolar ordering) and NpO_2 (quadrupolar+octupolar ordering), in contrast with the non-magnetic ground state of PuO_2. 5*f*-electron systems constitute the last unexplored but fascinating field for the low temperature physics of superconductivity and magnetism. A perspective on research topics in this field will be given.

Wednesday 13th Oct. at 11:55

Cold and Ultracold Molecules: Current Status and Future Perspectives

Takamasa MOMOSE

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Cold and ultracold molecule research has grown rapidly in the last five years, as a natural extension of ultracold atom research. Technological breakthroughs in laser cooling made possible the study of ultracold atoms. Realization of Bose-Einstein condensation of quantum degenerated gases is one of the important outcomes of ultracold atom research, which contributed significantly to condensed matter physics. On the contrary, techniques to efficiently create quantities of cold molecules are still lacking. The importance of ultracold molecules in relation to ultracold atoms arises from the features of molecules which make them distinct from atoms. These features are that the particle-particle interactions can be much larger, have a richer spatial structure, and have a longer range than in atoms. Molecules also have additional internal degrees of freedom, including rotations and vibrations, absent in atoms. Ensembles of ultracold molecules are therefore a treasury of new frontiers in both chemistry and physics completely unavailable by any other means. In the last few years, our group has been working on the development of techniques to make cold and ultracold molecules from room temperature molecular ensembles. The lowest temperature we have obtained is still on the order of 10 mK, but techniques for further cooling are developing rapidly. In this talk, I will review the current status and future perspectives of cold and ultracold molecule research in the world, and discuss how the ultracold molecule would contribute to the understanding of condensed matter physics.

Wednesday 13th Oct. at 14:00

Resting Mode of Brain in Relation to Individual Thinking Patterns

Kazuo NISHIMURA

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We assigned subjects a task to "rest" in the experiment and we examined the brain activities by MEG in order to study about cognitive process of human beings. We found that there were individual differences in resting mode and those were related to the ways the subjects' make decision in everyday life.

Wednesday 13th Oct. at 14:40

DNA origami: Useful scaffold for observation of single molecular event

Hiroshi SUGIYAMA

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DNA is one of the most promising molecules for the creation of various self-assembled components and scaffolds to prepare complicated patterns, and for selective placement of functional molecules and nano-materials. The DNA origami method developed for the preparation of fully addressable two-dimensional (2-D) structures has been utilized for the selective positioning of the functional molecules and nano-particles and for the design of various 3-D architectures. Here we report the design of "DNA frame" using the DNA origami method to examine enzymatic reaction. We newly developed the tension-controlled double stranded DNA substrates in the DNA frame and demonstrated at the first time the importance of DNA strand relaxation in allowing DNA bending during enzymatic reaction. We introduced tensed and relaxed DNA bridges in DNA frame. The relaxed DNA bridge can accommodate the enzymes to bind and bend the target sequences. On the other hand, the tensed DNA bridge allows binding of these enzymes, while it is a poor substrate for the enzymes.

Wednesday 13th Oct. at 15:35

Life as Compatible Contradiction
—*Towards Integrated Studies of Complex Living Systems*—

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Although modern physicists are very familiar with Niels Bohr's complementarity principle concerning the wave-particle duality, most biologists and environmental scientists have often been challenged and confused by the emergence of conflicting results of a living system under the 'same' environmental constraints.

Ironically, Western science has been based on the dichotomy of subject and object, and thus we have been influenced by one of the most fundamental thoughts of 'positive' and 'negative', or the sharpness of 'yes' and 'no'. Even in a physical system just like the wave-particle duality, we can understand that there are seemingly incompatible aspects of the system, and that they are needed for its complete description.

In the case of a living system, when we are confronting with seemingly incompatible results, we have to think that there must appear some hidden variables such as clonal variability (i.e., variable characteristics of clone cells), temporal variability such as time-dependent adaptation (i.e., learning or evolution of a living system under the environmental stimuli), mind-body relationships (i.e., the change of mind affects the state of body and vice versa) and so on.

In the present paper, starting from the example of perception, biology of hypersensitivity will be discussed from a point of view of interdisciplinary studies.

Reverences

Masatoshi Murase: “Environmental pollution and health: an interdisciplinary study of the bioeffects of electromagnetic fields” *SANSAI: An Environmental Journal for the Global Community.Kyoto University No.3, 1-35 (2008).*

Masatoshi Murase: “Endo-exo circulation as a paradigm of life: towards a new synthesis of Eastern philosophy and Western science” In: *What is Life? The Next 100 Years of Yukawa’s Dream* (eds. Masatoshi Murase and Ichiro Tsuda), *Progress of Theoretical Physics Supplement No.173, 1-10 (2008).*

Physics of Non-equilibrium systems: Self-organized Structures and Dynamics far from Equilibrium (eds. Takao Ohta and and Masatoshi Murase), *Progress of Theoretical Physics Supplement No.165, 1-163 (2006)*

Masatoshi Murase: “Alzheimer's Disease as Subcellular 'Cancer' — The Scale-Invariant Principles Underlying the Mechanisms of Aging —”. *Progress of Theoretical Physics. 95(1). 1996. 1-36.*

2007 Nishinomiya-Yukawa Memorial International Symposium on “What is Life? The Next 100 Years of Yukawa's Dream”
http://www.yukawa.kyoto-u.ac.jp/contents/seminar/archive/2007/ny2007/

2008 International and Interdisciplinary workshop on “What is Creativity? Emergent Phenomena in Complex Adaptive Systems”
http://www.kier.kyoto-u.ac.jp/ICAM/complexity/conference08.html

2009 International and Interdisciplinary workshop on “What is Evolution? Bicentennial of Charles Darwin's Birth”
http://www.yukawa.kyoto-u.ac.jp/contents/seminar/archive/2009/yitp-w-09-14/ev2009/index.html

Wednesday 13th Oct. at 15:55

Movement Regulation of a Sliding Action Filament in a Reconstruction Motility Assay System

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The complex behaviors, such as periodic oscillation and bursting, are observed at various temporal-spatial levels in biology. A common mechanism of these behaviors is the systems self-organize due to connections between nonlinear subsystems. We assume that one of the factors of nonlinearity in subsystems is the characteristic of structure or time response of proteins. We have researched the biology motions, which are self-organized by the mechano-chemical system of proteins. Here, we discuss the mechanism, which regulated the action from myosin using actin filaments on the actomyosin system.

A sliding mechanism on the actomyosin system is generally explained as resulting from the actin filaments are moved by myosins. The filaments slide while changing shape in a reconstruction motility assay system. If the transformation of the filament has an effect on the sliding movement, the actin filaments are one of the factors to regulate the movement not a simple rail.

Therefore, we investigated the relationship between the transformation and the movement of actin filaments in the reconstruction motility assay system. As a result, the local windings of an actin filament propagated along the actin filament, and the propagation velocity was about twice the average sliding velocity of actin filament. The directions of winding propagation were from the tail-end to the head-end on the fast sliding filament, and from the head-end to tail-end on the slow sliding filament. Also the winding propagation found the complex behaviors or soliton like phenomena such as the repeat, dissipation, reflection, or fusion of a few winding waves. On the other hand, the not sliding actin filament did not find the winding propagation and those phenomena. These results suggest that the actin filament have a mechanism to regulate the windings, which occurs due to the action from myosins.

Here, if the winding propagation of the sliding actin filament is self-organized, the mechanism can be explained by a coupled model of actin monomers. Therefore, we

carried out the computer simulation experiment of a one-dimensional elastic body model. As a result, the similar local winding patterns in the sliding actin filament were found when the model meet the following three conditions. 1) The external actions to subsystem are intermittent. 2) The connections between the subsystems are nonlinear. 3) The connections between the subsystems are weak. This result corresponds to followings: the actions from myosins to the actin filaments are intermittent, the internal actin monomers have nonlinearity, and the actin filaments are flexible. These results suggest that the actin filaments have the regulation mechanism to propagate the local action from myosins to the neighbor region of actin filaments.

Wednesday 13th Oct. at 16:15

The effect of 50 Hz sinusoidal magnetic field on nitric oxide (NO) production by HUVEC

Hidetake MIYATA, Masami Ishido, Ken-ich Ishizawa and Tsuyoshi Hondou
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To investigate the effect of magnetic fields on living systems, we analyzed the effect of a 50-Hz, 1-mT sinusoidal magnetic field on nitric oxide (NO) production in human umbilical vein endothelial cells (HUVEC). Statistically significant differences in NO production were identified between groups of exposed and unexposed (sham) cells. However, in some cases NO production was higher for the exposed group than the sham group, while in other cases the reverse was true. This finding confirms previous studies that show magnetic fields can influence NO production, but unlike these studies, our results demonstrate two-way deviation of NO production under the influence of a magnetic field. Since the deviation did not seem to arise from the variation of physical parameters such as temperature, the two-way deviation is real and may have some biological implications that was not realized in previous studies.

Wednesday 13th Oct. at 16:45

Biological Effects of Electromagnetic Fields on Human Breast Cancer MCF-7 cells

Masami ISHIDO

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Epidemiological data by Drs. Wertheimer and Leeper stimulated the research area of biological effects of electromagnetic fields [1]. They first identified the association between child leukaemia and residential extremely low frequency magnetic fields. It was also reported a nearly threefold increase of breast cancer risk among women younger than 55 who lived near power lines, suggesting that MF exposure had accelerated development and growth of breast cancer. The subsequent epidemiological studies showed the association between child leukemia and residential electromagnetic fields. The International Agency for Research on Cancer classified power frequency magnetic fields as a possible human carcinogen.
Dr. Stevens hypothesized that magnetic fields (MF) can affect pineal gland melatonin secretion in vivo, which, in turn, can influence mammary (breast) carcinogenesis [2]. Since then, a number of experimental studies have been conducted in order to test this hypothesis. Liburdy originally demonstrated that 60 Hz MF at 1.2 T inhibit the antiproliferative effect of melatonin on the MCF-7 cells. In addition, three laboratories independently reported the results that are consistent with this finding concerning the effect of MF on melatonin, supporting the hypothesis proposed. We extended their findings to show the molecular mechanism of the biological effects of electromagnetic fields; exposure of electromagnetic fields causes the uncoupling of the melatonin signal transduction pathway [3]. Thus, electromagnetic fields certainly exert its effects on protein levels.
Alteration in transcription programs are a fundamental feature of cancer. Therefore, we further employed two kinds of human DNA arrays of Atlas glass Human 1.0 Microarray (Clontech Corp) and Agilent Whole Human Genome Oligo Microarray (4 x 44K; Agilent, Technology Inc.), containing 1,081 and 40,000 probe sets, respectively for transcriptional analyses of bioeffects of electromagnetic fields. The significant alteration of gene expression was found in both arrays.

CONCLUSIONS

Based on ‘Melatonin Hypothesis’, we demonstrated that electromagnetic fields exerted its effects on the protein levels in cultured MCF-7 cell, seen as a disruption of protein-protein interactions in a melatonin-signaling pathway. Furthermore, we examined the effects of electromagnetic fields on transcriptional levels, showing that the gene expression of some oncogenes was increased and that of others was decreased by exposure: the patters were similar in MF exposure of both 1.2 T and 100 T. The pathological roles of these alterations remain to be determined.

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Wednesday 13th Oct. at 17:05

Spatiotemporal structure: common to subatomic system, biological process, and economic cycles

Ken NAITOH
Waseda University, Japan

Our previous report on the spatial structure derived based on a quasi-stability concept applied to momentum conservation (Naitoh, JJIAM, 2001, Naitoh, Artificial Life Robotics, 2008, 2010) revealed the reason why several particles such as biological cells, nitrogenous bases, and liquid droplets have the bimodal size ratios of about 2:3 and 1:1. The present paper extended with stochastic mechanics and indeterminacy principle also reveals the reason why a neutron impacting uranium 235 leads to the fusion of asymmetric and symmetric size ratios. This paper also clarifies the other asymmetric ratios related to the halo structure in atoms. Moreover, we show the reason why the models based on energy conservation and variation principle did not explain the fusion. The present theory can be applied for several levels of parcels from baryons to stars in the cosmos: specifically, at the level of nuclear force, van der Waals force, surface tension, and force of gravity.
Next, let us examine the temporal structure. In this report, we also show that our theory on the morphogenetic process and the brain with a rhythm of about seven beats (Naitoh, JJIAM, 2011 in press) can explain several economic system cycles, because different types of economic cycles are about seven times the length of the fundamental production cycles or durable periods.

Wednesday 13th Oct. at 17:25

ELECTRIC STIMULATION IN TINNITUS TREATMENT

Janice CHANG and Fan-Gang Zeng
University of California, Irvine, USA

Imagine a world of silence. Then imagine, emerging from the blanket of silence, a tea kettle whistling. You hear it, but cannot turn it off. It's the first thing you hear each morning you wake up, and the last thing before you fall asleep – that is, if you can even sleep through it. This is the experience of an individual with tinnitus, a disorder commonly known as "ringing of the ears". Each person's tinnitus is highly individualized in terms of the types of sounds they hear, and the extent to which it impairs their daily living. This affects an estimated 600 million people worldwide who report tinnitus as a prolonged sensation. In the world we live in, where we are constantly exposed to high-levels of noise, and amongst the iPod generation, tinnitus is only becoming more of a problem. While researchers are making strides to better understand this disorder, the physiological changes that underlie this condition are not well-understood. There currently exists no cure, although management treatments and therapies are available.

Tinnitus has been compared to phantom limb syndrome, with the persistence of sensory perception when the peripheral system no longer exists or functions. Ten years ago, tinnitus was still thought to be a disorder of the peripheral auditory system, resulting from damage to the cochlea (hearing organ in the inner ear) and the cochlear (auditory) nerve. Individuals with debilitating tinnitus who had their auditory nerve surgically cut (cochlear neurectomy), experienced an abolishment of tinnitus in only 50-75% of cases (for review, see Tyler RS Tinnitus Handbook 2000, p.230). It is now currently accepted that while tinnitus can be triggered by damage to the peripheral system, there are changes that occur in the central nervous system that maintain the persistent percept of tinnitus, and mediate the emotional and attentional aspects of tinnitus as well.

Electric stimulation of the auditory system is one route that some researchers, including our group at UC Irvine, have explored as a means to suppressing

tinnitus. While specific pathophysiological mechanisms have not been completely worked out, tinnitus is believed to arise from abnormal biological electrical activity in the auditory system. Therefore electrical stimulation applied to the auditory system would seem a logical route of intervention for therapy.

Indeed, electric stimulation has been seen to be beneficial in suppressing tinnitus. The earliest reported work was in 1802, by a German physicist Grapengiesser, who connected deaf patients with tinnitus to a DC battery. He found that anodal current, where current flows with the positive terminal close to the ear, could suppress tinnitus. Reversing the current flow would cause sound perception and occasionally a worsening of the tinnitus (citation: Feldmann 1984). However, long-term DC stimulation can cause tissue damage, eliminating this as a viable treatment option. AC stimulation is still a feasible option, and can be applied anywhere along the auditory system: extracochlear, intracochlear, brainstem, and even cortical sites. Tinnitus in cochlear implant users had been anecdotally noted to improve for these deaf or hard-of-hearing individuals implanted with auditory prostheses, with efficacy rates ranging from 46-93% (review by Pan et al, 2009); our lab has explored different parameters of stimulation in cochlear implant users with tinnitus and found roughly 60% of our subjects to respond positively to tinnitus suppression.

In evaluating electrical stimulation for tinnitus suppression studies, the following factors should be taken into consideration: place of stimulation, parameters of stimulus (stimulation mode, rate and level, pulse type and duration), patient characteristics (age, gender, etiology, degree of hearing loss, tinnitus type, severity, other effects of tinnitus e.g. depression/anxiety/insomnia), and outcome measures (validated questionnaires, subjective loudness ratings, annoyance ratings, etc). Here we will evaluate various studies involving electric stimulation in suppressing tinnitus, discuss what we have learned and address questions to what remains to be explored.

Wednesday 13th Oct. at 17:45

Temporally-Patterned Acoustic Sound Therapy for Tinnitus Suppression

Kelly REAVIS and Fan-Gang Zeng
University of California, Irvine, USA

Tinnitus is defined as the perception of sound in the absence of any external stimuli. It affects approximately 10% of the population in industrialized nations (Hoffman & Reed 2004). For a percentage of people with tinnitus, it is so severely troublesome they seek continued medical treatment for the condition. Distressing tinnitus is associated with clinical complaints of insomnia, difficulty in concentrating, and depression (Dobie 2003; Tyler & Baker 1983). Noise-induced hearing loss is a primary risk factor associated with tinnitus (Hoffman & Reed 2004).

While over-exposure to sound can provoke tinnitus, if used appropriately it can also be used to alter its perception. Mainstream approaches to treat tinnitus routinely include sound. Sound introduced acoustically at safe levels can be used to treat tinnitus either by masking the phantom sound or by desensitizing the brain to the phantom sound (Davis et al 2007; Jastreboff et al 1994). These are psychophysical responses focused on diverting patient's attention away from his/her tinnitus.

Another approach to tinnitus treatment is by physiologically suppressing the sound. Suppression involves the use of sounds to completely eliminate the perception of tinnitus. Suppression is most frequently observed clinically following the cessation of a loud masking tone and is commonly referred to as residual inhibition (or post-masking suppression) in the literature. Residual inhibition is not a viable treatment option because the effect is short-lived and the external masker must be played at a loud level, making communication difficult for the tinnitus patient. However, the mere occurrence of residual inhibition suggests tinnitus suppression is an achievable goal.

Based on the neural model of tinnitus generation which assumes the auditory cortex to be in a chronic state of hyper-excitability (Eggermont & Roberts 2004), our

approach was to introduce cortically interesting sounds to positively alter the abnormal neural activities responsible for tinnitus. The brain is highly adapted to decoding complex natural sounds such as speech and music, both of which contain temporal modulations in both amplitude and frequency. It has been demonstrated in animals that temporally patterned sounds such as amplitude- and frequency-modulated signals produce highly synchronized and robust cortical responses (Liang et al 2002; Lu et al 2001). Therefore, we hypothesized temporally patterned sinusoids to be more effective than steady-state sounds for tinnitus suppression. Our results showed that low-rate modulated sinusoids near the tinnitus pitch matched frequency suppress tinnitus more often than steady-state tones.

Suppression is a physiologic process where sounds alter the activity of the auditory cortex and interrupt tinnitus generation. Some uncertainty remains regarding the optimal parameters which best evoke suppression. These parameters may be patient specific. Continued investigation into the efficacy and mechanisms of sound-based tinnitus suppression is warranted as it may direct future tinnitus treatment options.

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Thursday 14th Oct. at 9:00

Novel field-induced magnetic transitions of 3*d* transition metal spinels and pyrochlores

Hiroaki UEDA

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Magnetic properties of spinel oxides were studied from ancient days. In recent decades, geometrical frustration revived interests of this subject. One of the most famous examples of geometrical frustration is the so-called pyrochlore lattice in spinels and in pyrochlores. In spinel oxides and pyrochlore fluorides with 3*d* transition metal magnetic ions, we found novel field-induced magnetic transitions. I will present the details and discuss the role of frustration in these magnetic transitions.

Thursday 14th Oct. at 9:40

Topological Aspects of the Quantum Spin Nanotube

Toru SAKAI
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The spin nanotube has attracted a lot of interest as an intersection between the strongly correlated electronics and the nanoscience. Among spin nanotubes we focus on the $S = 1/2$ three-leg spin tube, because it has the largest quantum fluctuation and the strongest frustration. Our recent theoretical analyses on the system, using the numerical diagonalization and the density matrix renormalization group (DMRG) calculation indicated several interesting quatum phase transitions; (i) a transition from the spin-gap to gapless phases with respect to the lattice distortion[1], (ii) magnetic field induced chiral, dimer and N'eel orders[2]. Since the spin gap is realized only when the unit cell is a nearly regular triangle, it is supposed to be originated to a topological aspect, namely the chiral symmetry. In order to clarify this aspect, we calculated the quantized Berry phase of the present spin tube. As a result, the quantized Berry phase is revealed to well characterize the quantum phase transition between the gapped and gapless phases. We also propose a possible superconductivity in the carrier doped spin tube, based on the spin gap or the chirality mechanisms[2].

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Thursday 14th Oct. at 10:00

A two-dimensional conductor based on C_{60}

Mitsuhiko MAESATO

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We report the first two-dimensional organic metal based on fullerene[1]. The material is free of metal ions, containing only the elements, C, H and N. The fullerene anion has the two kinds of layer, A and B. The C_{60} anion in layer A is ordered, while that in layer B is rotationally disordered at room temperature. The order-disorder transition of C_{60} strongly alters the conducting and magnetic proterties at low temperature. We will discuss the electronic state of this unique two-dimensional system based on the crystal structure and physical properties.

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Thursday 14th Oct. at 10:20

Synthesis and Physical Properties of Cu Oxides with Low-dimensional Tri-rutile and PbO_2 type structure

Masaki KATO

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We report the synthesis and magnetic properties of Cu oxides with low-dimensional tri-rutile and PbO_2 type structure. For $CuSb_{2-x}Ti_xO_6$ compounds with tri-rutile type structure, magnetic susceptibility χ showed that a characteristic temperature, J / k_B, where a broad maximum of χ appears due to the short-range antiferromagnetic order, decreases with increase of x. Thus, it is considered that hole carriers doped by Ti substitution result in the decrease of J / k_B. Furthermore, it was found that the antiferromagnetic long-range order at the transition temperature (T_N), around 8.5 K for $x = 0.0$, still remains in the substituted compounds for $x = 0.3$, which indicates the one-dimensional interaction along the diagonal direction is dominant. $CuNb_{2-x}Ti_xO_6$ compounds have zig-zag chain structure in the edge-sharing CuO_6 octahedra. Temperature dependences of χ were found to be well analyzed by the alternating 1DHAF model. Hole doping into this material is realized by substituting Ti^{4+} ions for Sb^{5+} ions.

Thursday 14th Oct. at 10:40

Metal-insulator transition in 3*d* transition metal oxides with double chains investigated by NMR

Masayuki ITOH

Department of Physics, Graduate School of Science, Nagoya University, Japan

In the strongly correlated electron systems, interplay between the spin, charge, and orbital degrees of freedom plays an important role for physical properties. Although the metal-insulator (MI) transition in 3*d* transition metal oxides such as VO_2 and V_2O_3 has been extensively investigated, the MI transition and the magnetic ground state in the presence of the orbital degree of freedom have not fully understood particularly under strong quantum fluctuations due to frustration and orbital degeneracy. Recently mixed-valence oxides with double chains, $A_2M_6O_{18}$ with the Hollandite structure and AM_2O_4 with the calcium ferrite structure, have attracted attention as one of such oxides. Based on our NMR results of $K_2V_6O_{18}$, $K_2Cr_6O_{18}$, and NaV_2O_4, we will discuss the MI transition and the magnetic ground states which are governed by the orbital state, the quasi-one-dimensionality, and the frustration.

Thursday 14th Oct. at 11:35

Geometrical frustration in stella quadrangula lattice and quantum criticality in Fe_3Mo_3N

Hiroyuki NAKAMURA

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In the eta-carbide-type correlated-electron metal Fe_3Mo_3N, ferromagnetism is abruptly induced from a nonmagnetic non-Fermi-liquid ground state either when a magnetic field (~ 14 T) applied to it or when it is doped with a slight amount of impurity (~ 5% Co). We observed a peak in the paramagnetic neutron scattering intensity at finite wave vectors, revealing the presence of the antiferromagnetic (AF) correlation hidden in the magnetic measurements. It causes a new type of geometrical frustration in the stellla quadrangula lattice of the Fe sublattice. We propose that the frustrated AF correlation suppresses the F correlation to its marginal point and is therefore responsible for the origin of the ferromagnetic (F) quantum critical behavior in pure Fe_3Mo_3N.

Thursday 14th Oct. at 12:15

Superconducting properties of $YbGa_xSi_{2-x}$

Naohito TSUJII

National Institute for Materials Science, Japan

We will report magnetic and transport properties of the solid solution $YbGa_xSi_{2-x}$ [1,2]. The AlB_2-type phase is found to exist in the composition range of $1.12 <= x <= 1.49$, and superconductivity was seen in almost whole the composition range. T_c decreases with the increase of x from 2.5 K for $x = 1.15$ to ~1.7 K for $x = 1.41$. A weakly mixed-valent state $Yb^{2.3+}$ has been demonstrated by the X-ray absorption spectroscopy, suggesting nearly nonmagnetic state of Yb. Thus the superconductivity in this compound is inferred to be explained by the BCS theory. A hump was observed at low temperature in the temperature dependent electrical resistivity on the cooling process, with a hysteresis behavior on the heating process. This implies the evolution of a structural deformation or a charge density wave (CDW) state.

[1] M. Imai et al., J. Am. Chem. Soc. 130, 1886 (2008).
[2] N. Tsujii et al., Chem. Mater. 22, 4690 (2010).

Thursday 14th Oct. at 12:35

Physical properties of AV_2O_4 and ACr_2O_4 (A = Ca and Na)

Hiroya SAKURAI

National Institute for Materials Science, Japan

The title compounds have $CaFe_2O_4$-type crystal structure, where low-dimensional electron correlation and geometrical frustration coexist because of the M_2O_4 double chain (M = V or Cr). We discovered temperature-induced metal-insulator transition and multiple magnetic phases for the V compound. On the other hand, the Cr compound, which is electrically insulating regardless of the A element, shows complex magnetic structure. For the compound with a higher Na content, spontaneous magnetization was observed and extremely large magnetoresistance effect appeared. In addition, we found strong coupling between magnetic and dielectric properties. These interesting properties come from the characteristic structure.

Poster presenters and Abstracts

Totally 24 persons / 25 presentations.

PS-1

Effect of dimensionality crossover on magnetovolume properties of quasi one-dimensional weakly antiferromagnetic metals

Nobukuni Hatayama
Kinki University Technical College, Japan

Thermal expansion and thermal expansion coefficient of quasi one-dimensional weakly antiferromagnetic metals above the N'eel temperature T_N and nearly antiferromagnetic metals at low temperatures are investigated. As the dependence of T_N on dimensionality, we found that T_N increases with increasing the effect of three-dimensionality. On the other hand, we also found that both the magnitude of thermal expansion and thermal expansion coefficient are suppressed by the reduction of the lower dimensionality.

PS-2

The reexamination of the temperature dependence of thermal expansion of coexistence of ferromagnetism and superconductivity and the pressure differential of its superconducting transition temperature

Rikio Konno
Kinki University Technical College, Japan

The temperature dependence of thermal expansion of coexistence of ferromagnetism and superconductivity is reexamined. In the previous study [J.Phys.Conf.Ser.200 012056 (2010)] the volume differential of the kinetic energy of conduction electrons is constant. However, in this study the volume differential of the kinetic energy of conduction electrons is not constant. The superconducting gaps used in this study are like those of the thin film of A2 phase in liquid ^{3}He. The pressure differential of its superconducting transition temperature is also investigated.

PS-3

Magnetic Properties of T_6M_6X

Takeshi Waki
Department of Materials Science and Engineering, Kyoto University, Japan

Recently, we have found a non-Fermi-liquid (NFL) behavior in an eta-carbide type compound Fe_3Mo_3N. This NFL behavior could originate with the characteristic structure of the eta-carbide; in the structure, 3d magnetic atoms forms the stella quadrangle lattice which is composed of capped tetrahedrons. Although several compounds with the eta-carbide type structure have been known, few physical properties have been reported so far.
In our presentation, we will report syntheses and magnetic properties of eta-carbides T_6M_6X with the stella quadrangla lattice.

PS-4

Phase-Shift Analysis of Electric Conductance of Nanostructure bridge with Friedel Sum Rule

Yusuke Kotani
Graduate School of Material Science, University of Hyogo, Japan

We analyze the electric conductance through nanostructure bridges in terms of phase-shifts, which satisfy the Friedel sum rule. The phase-shifts are given by solving the eigenvalue equation obtained by extending the method applied to a single impurity problem in a metal. The charge neutrality condition is introduced through the Friedel sum rule. It is analytically shown that the electric conductance can increase as the two electrodes separate with the condition in which the phase-shifts satisfy the Friedel sum rule. The increment of the distance between two electrodes is obtained by gradually separating interatomic distance.

PS-5

^{119}Sn NMR study of superconductor $Ca_3Ir_4Sn_{13}$

Bin Chen
Department of Chemistry, Graduate School of Science, Kyoto University, Japan

$Ca_3Ir_4Sn_{13}$ is a superconductor with T_c = 7.0 K. The resistivity measurements show it is a superconductor near the quantum critical point. Here, we investigate the electronic properties of $Ca_3Ir_4Sn_{13}$ using ^{119}Sn NMR to search the key to the superconducting mechanism. We found that the good linear relationship between the $1/T_1T$ and bulk susceptibility χ, suggesting that the ferromagnetic spin fluctuation play an important role in the normal state of the superconductor. Our finding suggests it may be an unconventional superconductor with ferromagnetic spin fluctuations.

PS-6

Critical phenomena in long-range RKKY Ising spin glasses

Yoshikazu Tabata
Department of Materials Science and Engineering, Kyoto University, Japan

We have investigated critical phenomena in spin glasses $R_xY_{1-x}Ru_2Si_2$ (R = Dy, Tb, Gd), where the magnetic moments of rare-earth ions interact by the long-range RKKY interaction via conduction electrons with Ising anisotropy. Interestingly, the magnetic anisotropic energy is different in two orders of magnitude in these compounds, from 100 K to 1 K, however, the critical exponents are very similar. It strongly indicates the universality of the long-range RKKY Ising spin glasses.

PS-7

Coexistence of ferromagnetic spin fluctuations and a superconducting phase in $Ca_3Ir_4Sn_{13}$ single crystal

Jinhu Yang
Department of Chemistry, Kyoto University, Japan

$Ca_3Ir_4Sn_{13}$ crystallizes in Pm-3n space group (No. 223) and was synthesized almost 30 years ago. However, very few physical properties have been reported except for the superconducting transition temperature. In this poster, we present the results of magnetic susceptibility, specific heat and electric resistivity measurements on the single crystalline $Ca_3Ir_4Sn_{13}$. A superconducting transition is observed at T_c = 7 K, and strikingly, we observe a peak-like behavior in susceptibility and resistivity, which can be explained in terms of ferromagnetic correlations. Moreover, the resistivity shows a non Fermi-liquid behavior in normal state at low temperatures, and develops into a Fermi-liquid behavior by the suppression of the ferromagnetic spin fluctuation on increasing magnetic fields. The superconductivity disappears for field above 7 T as well as the diminution of the ferromagnetic spin fluctuations, strongly suggesting that the superconductivity coexists with the ferromagnetic spin fluctuations in this compound. The large values of Kadowaki-Woods and Wilson ratios indicate the electrons are highly correlated in this system.

PS-8

Physical properties of AV_2O_4 and ACr_2O_4 (A = Ca and Na)

Hiroya Sakurai
National Institute for Materials Science, Japan

The title compounds have $CaFe_2O_4$-type crystal structure, where low-dimensional electron correlation and geometrical frustration coexist because of the M_2O_4 double chain (M = V or Cr). We discovered temperature-induced metal-insulator transition and multiple magnetic phases for the V compound. On the other hand, the Cr compound, which is electrically insulating regardless of the A element, shows complex magnetic structure. For the compound with a higher Na content, spontaneous magnetization was observed and extremely large magnetoresistance effect appeared. In addition, we found strong coupling between magnetic and dielectric properties. These interesting properties come from the characteristic structure.

PS-9

Synthesis of single crystal of superconductive FeTeSe

Mami Matsui, Jin Hu Yang, Hiroto Ohta, Chishiro Michioka and Kazuyoshi Yoshimura
Department of Chemistry, Graduate School of Science, Kyoto University, Japan

Novel superconductivity in oxy-pnictides with a transition temperature T_c = 26K was first discovered two years ago, and triggered numerous active studies on iron-based superconductors. Four types of iron-based superconductors have been discovered until now. The common feature of all is having a two-dimensional tetragonal crystal structure. We're studying on PbO-structure $FeTe_{1-x}Se_x$ ($0 \leqq x \leqq 0.5$), which has the simplest crystal structure. In this compound, the tetragonal Fe(Se or Te) layers stack continuously along the c-axis without any insertions of another layers. We regard this system as an important key compound to clarify the intrinsic properties of iron-based superconductors. The purpose of our study is to clarify the mechanism of iron-based superconductor.
Here, we synthesized single crystals of this system in order to measure physical properties. Up to now, we have succeeded in synthesizing the single crystals whose upper critical fields were very high, reaching to over 50T at very low temperatures. We report these results in detail in this presentation.

PS-11

Synthesis and physical property of PbO-type FeSe

Masatomo Kawa
Department of Chemistry, Graduate School of Science, Kyoto University, Japan

PbO-type FeSe is a member of the family of iron-pnictide and chalcogenide superconductors. It is expected that FeSe plays a key role to bring out the mechanism of iron-based superconductors since it has the simplest crystal structure with edge-sharing distorted FeSe4 tetrahedra.
We synthesized Fe_xSe ($0.98 < x < 1.17$) and measured physical properties focused on magnetism. In order to elucidate the normal state of FeSe, we investigated the magnetization above T_c. The magnetization increases gradually from room temperature to 120K and decreases suddenly at 120K. This anomaly of magnetization is originated in so called Verwey transition, i.e., electrical phase transition of Fe_3O_4 involved as an impurity. Therefore, we used Ti as reductant when we synthesized samples to remove impurity Fe_3O_4. As a result, we succeeded in synthesizing impurity-free samples and could measure intrinsic magnetism of FeSe. We also investigated the effect of acid treatments on FeSe. FeSe in acid changes to $FeSe_2$ at room temperature. This effect is not caused by any other iron selenides and PbO-type FeTe. In our poster, we will report in detail on synthesis and intrinsic magnetism of FeSe and the effect of acid treatments.

PS-12

Understanding of Superconductivity in Elemental Substances by Pseudopotentia Radii

Yukio Makino
Department of Chemistry, Faculty of Science, Kyoto University, Japan

Two dimensional map on superconductivity in elemental substances is constructed using pseudopotential radii and the derivative parameter, the root of (Z/r(s)), where r(s) and Z are the pseudopotential radius of s electron and valence. It is found that superconducting elements are well mapped by selecting the difference between pseudopotential radii and (Z/r(s))1/2 as the coordinates. It is suggested that transition temperature (T_c) of superconductivity is related to the root of (Z/r(s)) and the cube of r(s).

PS-13

Local Magnetic Inhomogeneities in Ni Doped $BaFe_2As_2$

Adam Dioguardi
University of California Davis, USA

We present ^{75}As nuclear magnetic resonance measurements in the paramagnetic and stripe-antiferromagnetic states of $Ba(Fe_{1-x}Ni_x)_2As_2$ in the lightly doped regime. Field swept spectra and spin-lattice relaxation measurements were obtained to probe the local hyperfine field and spin dynamics at the ^{75}As site. The spectra broaden inhomogeneously toward lower internal field with increased Nickel doping. The data agree well with simulations carried out within a model of commensurate stripe-antiferromagnetic modified in amplitude in the vicinity of a dopant atom. The spin-lattice relaxation data diverge at $T_N(x)$ with a critical exponent that indicates the presence of three-dimensional spin fluctuations.

PS-14

Synthesis and magnetic properties study of the novel layered triangular compounds $RE_3Ru_4Al_{12}$ (RE = La-Nd)

Wanyin Ge
Department of Chemistry, Graduate School of Science, Kyoto University, Kyoto University, Japan

Layered compounds possess very fascinating properties among the strong correlation electronic systems, just as the layered $YBa_2Cu_3O_{7-x}$ (YBCO) as well as FeAs based high-T_c superconductors. Recently, a kind of layered ternary rare earth transition metal aluminum compounds, $RE_3Ru_4Al_{12}$ (RE: rare earth element), gave rise to our extensive attentions. We synthesized a series of layered ternary rare earth compounds $RE_3Ru_4Al_{12}$ (RE = La-Nd) by an arc-melting technique. These layered compounds belonging to $P6_3/mmc$ space group are made up of two kinds of layers, “Ru-Al” and “RE-Al”. Both layers intergrowth along the c-axis like a sandwich structure.
We report the magnetic properties of $RE_3Ru_4Al_{12}$ (RE = La-Nd) in details. $La_3Ru_4Al_{12}$ shows the enhanced Pauli paramagnetism. Besides, in the case of $RE_3Ru_4Al_{12}$ (RE = Ce-Nd), the coupling between the localized moment of the rare earth element and the itinerant moment of the transition metal element exhibits the interesting magnetic behavior. The related study could stimulate the further study in this layered family as well as to explore the new layered compounds in condensed state physics field.

PS-15

The single crystal growths and the magnetic properties of the spin gap compounds $Pb_2V_3O_9$ and $NH_4CuPO_4 \cdot H_2O$

Kazuhiro Nawa, Chishiro Michioka, Kazuyoshi Yoshimura, Akira Matsuo[1] and Koichi Kindo[1]

Department of Chemistry, Graduate School of Science, Kyoto University, Japan
The Institute for Solid State Physics, University of Tokyo, Japan[1]

The spin gap system has been studied especially for the last decades owing to its experimental and theoretical interests. While an antiferromagnetically coupled spin dimer without interdimer interactions has the singlet ground state, the long range ordered state could be induced by external fields such as magnetic fields due to the interdimer interactions. The field-induced magnetic phase transition was regarded as the magnetic ordering of their transverse spin components based on the mean field theory [1]. On the other hand, the report in the compound $TlCuCl_3$ suggested that the ordered state is better described by Bose-Einstein condensation (BEC) of excited magnons [2]. In order to investigate the nature of the field-induced magnetic phase transition, we precisely determined the magnetic properties of $Pb_2V_3O_9$ and $NH_4CuPO_4 \cdot H_2O$, especially phase boundary topology.

$Pb_2V_3O_9$ consists of antiferromagnetic alternating chains of $S = 1/2$. The spin gap was estimated as 7 K from the magnetization curve [3]. The critical phase boundary showed the power-law behavior which was explained by the picture BEC of magnons [3]. We made further examination by growing single crystals by a floating-zone method and measuring the magnetic properties of the crystals. In terms of phase diagram topology, the system is found to be better described by the picture of magnon BEC in the low field region as well as quasi one-dimensional mean field in the high field region.

$NH_4CuPO_4 \cdot H_2O$ includes copper phosphate layers separated by NH^{4+} cations. The magnetic susceptibility was well reproduced by an isolated dimer model with the spin gap of 9.6 K [4]. In order to investigate the further properties under the magnetic fields, we synthesized the single crystals by a chemical reaction under aqueous solutions and measured the magnetic properties. An additional transition in the magnetic fields

was not observed and the experimental results were reproduced by an isolated dimer model.
From the examination of the spin gap compounds, we would like to suggest that the interdimer interactions are important for the occurrence of the field-induced phase transitions and the shape of the phase diagram.

[1] M. Tachiki and T. Yamada, J. Phys. Soc. Jpn., 28 (1970) 1413
[2] T. Nikuni, M. Oshikawa, A. Oosawa, and H. Tanaka, Phys. Rev. Lett. 19 (2000) 5868
[3] T. Waki, Y. Morimoto, C. Michioka, M. Kato, H. Kageyama, K. Yohimura, S. Nakatsuji, O. Sakai, Y. Maeno, H. Mitamura, and T. Goto, J. Phys. Soc. Jpn., 73 (2004) 3435
[4] A. Pujana, J. L. Pizarro, L. Lezama, A. Goni, M. I. Arriortua, and T. Rojo, J. Chem. Mater. 8 (1998) 1055

PS-16

Physical Properties of $Ca_3Co_2O_6$

Akifumi Amano, C. Michioka, K. Yoshimura
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Antiferromagnetic triangular lattice compounds exhibit various magnetic phases by spin frustration such as partially disordered antiferromagnetic (PDA), ferrimagnetic and possible spin-liquid states, and have potential multiferroic and thermoelectric applications. $Ca_3Co_2O_6$ is a typical compound of antiferromagnetic Ising spin triangular lattice with quasi-one dimensional ferromagnetic chains. These chains are made of the alternating face sharing CoO_6 trigonal prisms and CoO_6 octahedra. $Ca_3Co_2O_6$ has interesting properties [1-4], but their details have not been revealed sufficiently. Under the magnetic fields between 0 and 14 T, we measured the temperature dependence of the heat capacity of the polycrystalline sample. We also measured the temperature dependence of the magnetization of the oriented sample with the external field along the c-axis and the magnetization curves between 2.2 and 30 K. The heat capacity shows three peaks between 0 and 4 T at 2.2 K, and these peak fields are consistent with the three plateaus in the magnetization curve. The presence of such plateaus suggests that the multiple ferromagnetic phases are stabilized by the external fields. The heat capacity also shows a λ-type peak at about 25 K. The magnetic moments of $Ca_3Co_2O_6$ have a strong anisotropy: the magnetization under H//c is easily saturated by the external field above 10 T, while that under H$\perp$c does not, leading to the anisotropic H-T magnetic phase diagram in this compound. The ^{59}Co-NMR measurement at 5 K suggests the first-order transition from the ferrimagnetic to the ferromagnetic state at the efficient external magnetic field in the c-axis of 3.5 T [5]. The previous NMR results are consistent with an anisotropic phase diagram revealed in the present work.

[1] H. Kageyama et al., JPSJ 66, 3996 (1997).
[2] S. Niitaka et al., PRL 87, 177202 (2001).
[3] E. V. Sampathkumaran et al., PRB 70, 014437 (2004).
[4] V. Hardy et al., PRB 68, 014424 (2003).
[5] Y. Shimizu et al., PRB 82, 094430 (2010).

PS-17

Syntheses and physical properties of $ThCr_2Si_2$ type ternary compounds RFe_2Ge_2 (R = rare-earth metal)

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The recent discovery of superconductivity in $LaFeAsO_{1-x}F_x$[1] attracted tremendous interest among the scientific communities around the world. The ternary iron-pnictide family $Ba_{1-x}K_xFe_2As_2$[2] with the tetragonal $ThCr_2Si_2$-type structure also shows a superconductivity on the FeAs layer as well as $LaFeAsO_{1-x}F_x$. RFe_2Ge_2 (R=rare-earth metal, e.g., non magnetic Y, Lu) also has the $ThCr_2Si_2$-type structure and FeGe layers should exhibit itinerant-electron magnetism. It was reported that $LuFe_2Ge_2$ shows a phase transition at 9 K probably due to SDW or CDW instabilities[3]. Although YFe_2Ge_2 and $LuFe_2Ge_2$ are expected to have similar physical properties because of structural and valence similarities, YFe_2Ge_2 doesn't show any phase transitions above 2 K. It is important to elucidate the origin of the difference in physical properties between them. In ref[3], both YFe_2Ge_2 and $LuFe_2Ge_2$ single crystals were synthesized by Sn-flux method. Therefore, Sn substitution for Ge has a possibility of changing physical properties. We synthesized YFe_2Ge_2 and $LuFe_2Ge_2$ pollycrystals by Ar arc-melting and single crystals by Sn-flux methods and measured their X-ray diffraction patterns, magnetizations and heat capacities. From these measurements, we will discuss the details of magnetic properties of YFe_2Ge_2 and $LuFe_2Ge_2$.

[1] Y. Kamihara et al., J. Am. Chem. Soc. 130 (2008) 3296.
[2] M. Rotter et al., Phys. Rev. Lett. 101 (2008) 107006.
[3] M.A. Avila et al., J. Magn. Magn. Mater. 270 (2004) 51.

PS-18

NMR studies of the A-site-ordered perovskites $ACu_3V_4O_{12}$

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Institute for Chemical Research, Kyoto University, Japan[A]

The A-site-ordered perovskites $AA'_3B_4O_{12}$, in which A and A' ions at the A site in cubic perovskites ABO_3 are ordered with A:A' = 1:3, show large varieties of physical properties, depending on the occupancies of A' and B ions. For example, $CaCu_3Ti_4O_{12}$, in which the non-magnetic Ti^{4+} ion occupies the B site, has an enormously large dielectric constant and also shows a behavior as an antiferromagnetic insulator. On the other hand, $CaCu_3Sn_4O_{12}$ and $CaCu_3Ge_4O_{12}$, in which non-magnetic Sn^{4+} and Ge^{4+} ions occupy the B site, behave as ferromagnetic insulators.

Recently, $ACu_3V_4O_{12}$ (A=Na^+, Ca^{2+} and Y^{3+}) was reported to show a Pauli paramagnetic behavior, which has a low resistivity of 1-35 mΩ cm at room temperature and temperature-independent magnetic susceptibility. In order to study the microscopic physical properties of these metallic compounds, we synthesized polycrystalline samples of $CaCu_3V_4O_{12}$ under high-pressure and high-temperature conditions, and performed NMR measurements for ^{51}V and ^{65}Cu nuclei in $CaCu_3V_4O_{12}$.

The NMR spectra of ^{51}V and ^{65}Cu are almost temperature-independent from 5K to 300K. These indicate no existence of magnetic ordering from 5K to 300K, which is consistent with the previous macroscopic measurements. Both $^{51}(1/T_1T)$ and $^{65}(1/T_1T)$, where $^{51}(1/T_1)$ and $^{65}(1/T_1)$ are the nuclear spin-lattice relaxation rates of ^{51}V and ^{65}Cu nuclei, have almost no temperature dependence in the ranges of 5 K to 300 K. This behavior is explained in terms of modified Korringa law (T_1T = const.) with ferromagnetic correlation, which is characteristic of the Fermi-liquid system. These results indicate that both 3*d* electrons of V and Cu contribute to the metallic conduction with ferromagnetic correlation.

PS-19

Physical properties of layered compound LnCoAsO with itinerant-electron ferromagnetism

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We synthesized layered compounds LnCoAsO (Ln = La - Gd) and studied physical properties of these compounds. From the results of magnetic measurements, all the compounds were found to show ferromagnetic transition. The Curie temperature T_C of LaCoAsO is 55 K while T_C of LnCoAsO (Ln = Ce - Gd) is about 70 K. From the analysis of magnetization based on the spin fluctuation theory, magnetism of LaCoAsO was found to be understood in the framework of ferromagnetic spin-fluctuation. LnCoAsO (Ln = Ce - Gd) were found to show various magnetic ordering at low temperature depending on Ln from magnetization, electric resistivity, and specific heat measurements. Especially in the cases of Ln = Nd, Sm and Gd, ferromagnetic-antiferromagnetic transition occurs below T_C. Due to the ferromagnetic-antiferromagnetic transition, NdCoAsO and SmCoAsO show large magnetoresistive effect around T_N.

PS-20

Successive magnetic transitions in RECoAsO studied by μSR

Jun Sugiyama
Toyota Central Research and Development Laboratories, Inc., Japan

For LaCoAsO, metallic resistivity and ferromagnetic (FM) order appears, but no SC. This is rather surprising since the electronic structure around the Fermi level is similar to that of $LaFe_{1-x}Co_xAsO$, consisting of Co-3d and As-3p hybridized orbitals. In context of competing orders and SC, details of the magnetic ground state of this compound are very interesting. LaCoAsO crystallizes with the ZeCuSiAs-type structure in tetragonal P4/nmm space group. No temperature dependent diffraction study is to be found on these samples, however, it has been shown that the related LaFeAsO undergoes a first-order structural phase transition to orthorhombic Cmma below 155 K. Further, at $T_C \sim 60$ K, an FM transition occurs with spontaneous and enhanced magnetic moments of 0.39 μ_B and 1.3 μ_B respectively. There have been speculative suggestions to the nature of this FM, but further investigations are evidently needed. We have, therefore, measured μSR spectra for LaCoAsO and related compounds to clarify their magnetic ground state.

PS-21

Magnetic and superconducting phases for water absorbed $Na_{0.35}CoO_2$ studied by muon-spin spectroscopy

Jun Sugiyama
Toyota Central Research and Development Laboratories, Inc., Japan

In order to clarify the carrier density dependence of the microscopic magnetic nature in $Na_xCoO_2 \cdot yH_2O$, we have performed a positive muon-spin rotation/relaxation (μ^+SR) study of H_2O and D_2O absorbed samples. Based on the zero field (ZF-) μ^+SR measurements, there was no clear difference between the two superconducting phases (SCI and SCII). This is also likely to exclude the exotic scenario for the superconductivity of the SCII phase, in which the superconducting state breaks the time-reversal symmetry of the Cooper pairs, resulting in the appearance of a weak internal magnetic field below T_c. Furthermore, the ZF-spectrum for the H_2O absorbed sample exhibits a clear oscillation in the whole T range measured (1.4-100~K), suggesting the formation of ``$[H_3O]^+$-like" $H_2\mu^+O$ ions in the sample. The absence of the oscillation in the D_2O absorbed sample also evidences the presence of the $H_2\mu^+O$ complex. Considering the fraction of the $H_2\mu^+O$ signal, we have demonstrated the coexistence of $[H_3O]^+$ ions and H_2O in this compound.

PS-22

^{77}Se-NMR study of quasi-one dimensional organic conductor $(TMTSF)_2X$

Kouhei Nishiyama
Graduate School of Material Science, University of Hyogo, Japan

The ground states of quasi-one dimensional organic conductor $(TMTSF)_2X$ (X = PF_6, AsF_6, SbF_6, etc) change from spin density wave (SDW) to superconducting states with increasing pressure, and therefore interplay between magnetism and superconductivity in this series have been an intriguing topic for more than three decades. However there still remain some unsolved problems even in the SDW state. One of them is the mechanism of subphases in this ordered phase mainly indicated by ^{1}H-NMR studies [1,2].

We have carried out systematic ^{77}Se-NMR studies on the compounds with X = PF_6, AsF_6, SbF_6. Because the conduction electrons are mainly contributed from the Se sites, one can expect to obtain more direct information about the SDW transition from the Se-NMR measurement. We observed a double-peaked NMR line in their SDW state. This line shape does not show significant changes at the subphase boundary T_x ~ 4K which is interestingly common to all three compounds at ambient pressure. On the other hand, spin relaxation rate $1/T_1$ shows clear anomaly at T_x, suggesting that this boundary is associated with rather dynamical magnetic properties. More detailed comparison between three compounds will be presented.

[1] Takahashi et al., Synth. Met. 41-43, 3985 (1995)
[2] Nomura et al., Synth.Met. 133-134, 1295 (1995)

PS-23

Physical properties of $CaFe_4As_3$ with three-dimensional FeAs network

Yoshiaki Osada, H. Ohta, C. Michioka and K. Yoshimura
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We synthesized single crystalline sample of $CaFe_4As_3$ and studied its physical properties, such as magnetism and electric resistivity. From magnetic measurements, we observed two magnetic phase transitions at about 90 K and 26 K. According to previous reports, incomensulate spin density wave (SDW) state realizes below 90 K and incomensulate to comensulate transition occurs at 26 K[1]. By using single crystalline sample, we found that magnetization in the paramagnetic state is isotropic and obeys the Curie-Weiss law. Such a behavior in magnetization is different from the behavior of mother compounds of FeAs-based superconductor, while it resembles magnetization of FeTe, which is the end compound of Fe(Te,Se) superconductor.

[1] P. Manuel et al., Phys. Rev. B 81, 184402 (2010).

PS-24

Carrier-Induced Ferrimagnetism in a frustrated system on a Kagome lattice

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Antiferromagnetic spin systems on a Kagome lattice are known to exhibit strong frustration phenomena. The ground state of such systems has macroscopic degeneracies, which in some case induce novel states through the residual entropies. Especially, when spin systems are coupled to other degree of freedom, stabilization of the total free energy might lead to peculiar ordered states which possibly cause novel phenomena. So far many experimental and theoretical researches have focused on such systems. However, due to limitations in both analytical an numerical methods, it is difficult to examine frustrated systems theoretically. Comprehensive understandings of frustrated systems are limited to some specific models.

In this paper, I study the extended double-exchange model on a Kagome lattice, where Ising spins with antiferromagnetic exchange couplings J and conduction electrons with hopping integrals t are interacting with each other through local Hund's couplings J_H. We perform finite-temperature Monte Carlo calculation to study thermodynamical properties. In this model, double-exchange ferromagnetic interactions compete with antiferromagnetic exchange interactions, which act to lift the macroscopic degeneracy of this frustrated spin system. In the strong coupling limit J, $J_H >> t$, carrier-induced ferrimagnetism is found at certain ranges of carrier densities. We discuss the clustering of spins as the origin of such carrier-induced ferrimagnetism.

PS-25

NQR Investigation of AFM order in Heavy Fermion Superconductor $CePt_2In_7$

Nicholas apRoberts-Warren
UC Davis, USA

Recently synthesized high-quality sample of $CePt_2In_7$ undergoes an anti-ferromagnetic phase transition at 5.2 K. The magnetic ordering wave-vector (*Q*) is investigated by Nuclear Quadrupole Resonance, and possible magnetic structures are considered.