Session 23CP

Resonant Two-Magnon Raman Scattering in Two-Dimensional Mott Insulators **23CP1**

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We investigate the resonant two-magnon Raman scattering in two-dimensional (2D) Mott insulators by using a hall-filled 2D Hubbard model. By performing numerical diagonalization calculation for a small cluster, we find that the model can reproduce the experimental features that the Raman intensity is enhanced when the incoming photon energy ω_i is not near the absorption edge but well above it. This is because the photoexcited states for the resonance are characterized the charge degree of freedom, while the absorption edge is by the spin degree of freedom.

Study of Phonon Anomalies in Stripe phase of High $T_{\rm c}$ Cuprates **23CP2**

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We theoretically investigate phonon anomalies in various high T_c cuprates in terms of stripe concept. The phonon anomalies are considered to be caused by coupling with charge translational modes of stripes. The collective stripe modes are taken into account by means of random phase approximation based on mean-field two dimensional Hubbard model, and the phonon self-energy correction was evaluated. In the result, it turns out that the coupling with stripes causes phonon dispersion gap. In this study we also investigate the oscillation modes of phonon at the gap, based on the linear response theory. The gapped branches of phonon are found to be in-phase and out-of-phase oscillations relative to the charge collective mode.

23CP3 Cu-NQR study for stripe ordering in La-based cuprate

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Cu-NQR spectra were measured in $La_{2-x-y}M_ySr_xCuO_4$, (M=Nd, Gd, Eu, Pr and Y), and $La_{2-x}Ba_xCuO_4$ with x=1/8. The low temperature tetragonal (LTT) structure is stabilized below T_{d2} in all the samples other than M=Pr. The usual NQR spectra observed in $T > T_{d2}$ in all the samples change to abnormally broad ones after a complete $wipeout$ of NQR signal below T_{d2} except for the cases of M=Nd, Gd and Pr. In the cases of M=Nd and Gd, the complete wipeout continues to 1.5 K probably due to the extrinsic nuclear relaxation path through the paramagnetic fluctuation of Nd and Gd moment. In the case of M=Pr, usual NQR spectrum continues to 1.5 K due to no structural transition to LTT phase. These results suggest a pinning in the LTT phase of stripe ordering inherently existing in the doped CuO_2 plane in La-based cuprate. The common broad spectra at 1.5 K were analyzed in terms of static stripe model.

23CP4 Dynamical Stripe Correlation in the d-p Model at $1/8$-filling

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We investigate the dynamical stripe correlation in the two-dimensional d-p model at $1/8$-filling on the basis of the dynamical cluster approximation combined with the unrestricted fluctuation exchange approximation. We calculate the one-particle spectral function, the charge correlation function, and the spin correlation function at finite temperature. We obtain the fully self-consistent solutions near $1/8$-filling. Our obtained solutions are completely metallic as far as in the one-particle picture. However, the charge and spin correlation functions reflect the existence of the quasi-one-dimensional fluctuation. This fluctuation tends to form the vertical stripe state.

23CP5 Extrinsic (Bi)Polaronic Metal-Insulator Transition in Doped High-T_c Oxides

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Unlike the Mott and Anderson transitions the new extrinsic (bi)polaronic metal-insulator transition (MIT) in doped oxide high-T_c superconductors (HTSC) is studied within the continuum model of extrinsic carrier self-trapping and the extrinsic (bi)polaronic band model using the variational method and tight-binding approximation. The proper criterions for extrinsic Mott transition and (bi)polaronic MIT are obtained. We show that the anisotropy of the dielectric or (bi)polaronic properties of HTSC is responsible for the smooth MIT, stripe formation and suppression of high-T_c superconductivity. We explain the observed in-gap states and MIT in doped oxide HTSC in terms of the large (bi)polaron model, the extrinsic Mott transition and the extrinsic (bi)polaronic MIT and find good agreement with various experiments.

Hall coefficient anomalies in Kondo-lattice $CeAl_2$ 23CP6

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Anomalous Hall effect in paramagnetic and modulated antiferromagnetic (AFM) phases of a Kondo-lattice $CeAl_2$ has been studied in a wide range of temperatures (1.8-300K) and magnetic fields (up to 80 kOe). It is shown that the large anomalous skew scattering component ${R_H}^a$ has a broad maximum around T≈4K depressing by a factor of 3 in H≈80 kOe. The non-monotonous behavior of magnetic components ${R_H}^{am}$ in magnetic field below 40 kOe and a narrow maximum of ${R_H}^{am}$(T) at T=T_N≈3.85K are likely to be attributed to the AFM-domains reorientation process at liquid helium temperatures. The problem of two magnetic phase transitions in $CeAl_2$ is discussed from the point of view of the data obtained.

Low-frequency noise in intermediate valent compound SmB_6 23CP7

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The study of the noise characteristics along different crystallographic directions in the intermediate valence compound SmB_6 revealed the strong anisotropic enhancement of the low-frequency resistance noise at T<15K. The noise voltage temperature dependencies in SmB_6 demonstrate a broad maximum at T≈11K which is very similar to the anomaly in the Hall mobility[1]. The anomalies observed are discussed in terms of a many-body states formation resulting from fast valence fluctuations on Sm-sites.

[1] N.E.Sluchanko et al., *Phys.Rev.* **B61**, 9906 (2000); *Physica B* **312-313C** 331 (2002).

Magnetotransport in $(Y_{1-x}Gd_x)Co_2$ alloys near to magnetic phase boundary 23CP9

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We present experimental results on magnetotransport in $(Y_{1-x}Gd_x)Co_2$ alloys, where the localized Gd-moments are coupled antiferromagnetically to the itinerant Co 3d electrons. The alloys are paramagnetic for $x < 0.15$. The transport properties of the paramagnetic alloys show Kondo like anomalies. On approaching to the magnetic phase boundary the resistivity reveals non-Fermi liquid behaviour, indicating a presence of apparently gap-less magnetic excitations. Large positive magnetoresistivity is observed in in the alloys with magnetic ground state at temperatures T $< T_c$.

23CP10 Gap formation in the semimetal U_2Ru_2Sn: ^{119} Sn NMR investigations

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We report measurements of the ^{119}Sn spin - lattice relaxation rate $1/T_1$ and the Knight shift K for U_2Ru_2Sn. The T dependence of $1/T_1$ is very similar to that of CeNiSn with the only difference that the T scale is increased roughly by a factor of 10. Therefore a first estimate gives a gap value of $\Delta/k_B \approx 140K$ (≈ 14 K for CeNiSn). At low temperatures a $T_1T = constant$ behaviour is observed similar to CeNiSn. Furthermore, measurements on the ^{119}Sn Knight shift, the susceptibility, the specific heat, the electrical resistivity and the Hall coefficient are discussed in the context of a gap formation due to correlations in this semimetal. Investigations on the non-magnetic reference compound Th_2Ru_2Sn are also presented.

23CP11 Photoemission study of CeTIn$_5$ (T=Rh, Ir)

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The electronic structures of CeTIn$_5$ (T=Rh, Ir) have been investigated by photoelectron spectroscopy.

23CP12 Thermal, magnetic, and transport properties of U_2Ru_2Sn

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U_2Ru_2Sn shares several properties with the strongly correlated semimetal CeNiSn. Here, we present measurements of thermal, magnetic, and transport properties of both poly- and single-crystalline samples. The specific heat provides evidence for the opening of an energy gap of approximately 160 K. Both the magnetic susceptibility and the electrical resistivity are anisotropic, suggesting that the energy gap opens primarily in the basal plane of the tetragonal compound U_2Ru_2Sn.

High Field Magnetoresistance in Heavy Fermion Superconductor $PrOs_4Sb_{12}$ 23CP13

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$PrOs_4Sb_{12}$ is recently found to show superconductivity below T_C=1.85 K, in which the large specific heat jump at T_C ($\Delta C/T_C \sim$ 500 mJ/K$^2\cdot$ mol) suggests the strong electronic correlation. We have succeeded in growing high quality single crystals of $PrOs_4Sb_{12}$ and measured the magnetoresistance (MR) upto 14 T. The field dependences of transverse MR are found to saturate for the whole field angular directions indicating that this compound is uncompensated metal with the closed Fermi surface. We have found the anomalous high field phase at 4$\sim$12 T below 1.25 K which is also found in the specific heat measurements under the magnetic fields.

Thermal Expansion of UCu_2Sn in the Basal Plane 23CP14

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We reported from the elastic moduli experiments that the hexagonal uranium compound UCu_2Sn undergoes a forroquadrupolar ordering of non-Kramers doublet Γ_5 at $T_Q = 16$ K. However, a macroscopic strain has not been measured by a X-ray diffraction experiment because the strain is expected to be smaller than the experimental resolution due to the weak coupling between the strain and order parameters [1]. To detect the spontaneous strain, we carried out a thermal expansion measurement by a capacitance method with higher resolution from 4.2 to 40 K. The thermal expansion in the basal plane shows a remarkable change below T_Q, suggesting the emergence of the ε_{Γ_5} strain which couples to Γ_5.

[1] T.Suzuki *et al*., Phys. Rev. B **62**, 49 (2000).

Spin fluctuations in heavy-Fermion compounds $YbZnCu_4$ and $YbAuCu_4$, investigated by ^{63}Cu NMR/NQR 23CP15

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We have investigated spin fluctuations of the Yb 4f hole in heavy Fermion compounds close to localized spin regime: $YbZnCu_4$ ($T_K \simeq$ 30 K) and $YbAuCu_4$ ($T_K \simeq$ 1.6 K). The Curie-Weiss-type behavior of both isotropic and anisotropic Knight shifts for each of the compounds is indicative of Yb^{3+} ionic state. Correlation time τ_f of Yb spin fluctuations in $YbZnCu_4$ is found to be $\sim 10^{-13}$ sec and independent of the temperature for 1.4-100 K, due to an extremely small mixing between *f* electrons and conduction electron density. While in $YbAuCu_4$, the temperature-independent $\tau_f \sim 10^{-12}$ sec at high temperatures begins to decrease around $\sim$40 K, and approaches $\sim 10^{-11}$ sec which corresponds to k_BT_K in energy.

23CP16 Observation of cyclotron resonance in CeSb

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Cyclotron resonance measurements on a single-crystal of CeSb have been performed in the temperature range from 1.6 to 20 K in the frequency range from 50 to 110 GHz. We have successfully observed several absorption lines of cyclotron resonance. The estimated effective masses are in the range of 0.28-1.5m_0, and they are compared with the masses estimated from dHvA effect measurements. It is the first observation of cyclotron resonance on strongly correlated *f*-electron systems.

23CP17 Spin-glass Behavior in Ternary Uranium Compound U_2AuGa_3

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The magnetic properties of the intermetallic compound U_2AuGa_3 were investigated on well-annealed polycrystalline samples by DC magnetization, specific heat and magnetic relaxation measurements. The temperature dependence of magnetization shows irreversibility and the frozen-in magnetic moment was observed below a characteristic temperature T_f=23 K. The temperature dependence of specific heat does not show visible singularity indicating the absence of long-range magnetic order around T_f. Furthermore, more than 50% of the remnant magnetization is observed even after 3 hours due to long-time magnetic relaxation effect. These results clearly indicate that U_2AuGa_3 undergoes spin-glass transition at T_f.

23CP18 Non-Fermi-Liquid Behavior in Amorphous UPd_2Al_3

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These ten years, unusual behaviors in physical quantities different from Fermi liquid state have been reported in many heavy Fermion materials. Some experimental results have been explained from the disorder-induced non-Fermi-liquid theories. To investigate non-Fermi-liquid state further, a crystallographycally disordered amorphous UPd_2Al_3 has been prepared. Electrical resistivity and specific heat observed in an amorphous UPd_2Al_3 show anomalous behaviors at low temperatures, which are discussed by connecting with non-Fermi-liquid state and comparing with those observed in a crystalline UPd_2Al_3.

Transport properties of the dense Kondo system $Ce_{0.5}La_{0.5}B_6$ 23CP19

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$Ce_xLa_{1-x}B_6$ is well known as a cubic dense Kondo system. The ground crystal electric field state is a Γ_8 which carries both magnetic dipolar and electric quadrupolar moments. No long range ordering have been found in $Ce_{0.5}La_{0.5}B_6$ down to ~ 20 mK under low fields, and an antiferromagnetic or an antiferroquadrupole ordering is induced by applied magnetic fields. We present the transport properties of $Ce_{0.5}La_{0.5}B_6$ at low temperatures. The resistivity of $Ce_{0.5}La_{0.5}B_6$ follows the formula $AT^2 + const.$ in the low temperature region. This suggests the formation of a strongly correlated Fermi liquid.

Kondo Effect in Two-Dimensional Disordered Systems 23CP20

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We investigate the Kondo effect in two-dimensional disordered electron systems on the basis of the single-impurity Anderson model with on-site random potentials. Using a finite-temperature quantum Monte Carlo method, we calculate the susceptibility of a magnetic impurity. Depending on the position of a magnetic impurity, its local moment can be screened or unscreened by the spin of the conduction electron. In the former case, the susceptibility shows a local Fermi-liquid behavior, while in the latter case, the susceptibility shows a power-law or a logarithmic divergence. From the results, we show that the Kondo temperaturet T_K is distributed more widely and the weight at $T_K = 0$ becomes larger as randomness increases. The average susceptibility shows a weak power-law divergence at low temperature in strongly disordered systems, indicating a non-Fermi liquid behavior.

De Haas - van Alphen effect under pressure in URu_2Si_2 23CP21

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A tiny moment of $0.03\mu_B$/U in URu_2Si_2 is found to increase as a function of pressure and to have a small jump at 1.5 GPa, reaching $0.4\mu_B$/U. The recent NMR experiment claimed that this corresponds to an increase of the antiferromagnetic region with the moment of $0.4\mu_B$/U. We have done the de Haas-van Alphen (dHvA) effect under pressure up to 1.8 GPa. The present dHvA result is inconsistent with the NMR experiment because a new Fermi surface does not appear under the corresponding pressure, indicating a slight increase of the volume of the Fermi surface and a decrease of the cyclotron mass with increasing the pressure.

23CP22 Magnetic-Field Effects on the Pseudogap in CeRhAs

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The electrical resistivity and magnetization of single crystal CeRhAs, which is the so-called Kondo insulator, have been investigated in magnetic fields up to 55T. In the field region below 20T, anisotropic behaviors are observed in both transport and magnetic properties. Especially, the longitudinal magnetoresistance along the b and c axes show anomalous drops following with minima, while it decreases monotonically after a broad maximum in the a direction.These behaviors may be attributed to the existence of a narrow structure with an anisotropic nature inside the wide pseudogap.

23CP24 NMR Studies of YbB_6

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We have performed dc-magnetisation and ^{11}B-NMR measurements on single crystalline YbB_6. The magnetisation data at temperatures between 4 and 300 K reveal the presence of ferromagnetic order with a $T_C > 300K$ and involving very small ordered moments, $i.e.$, $0.002\mu_B/f.u.$ This value represents only a small fraction of the effective paramagnetic moment, per formula unit, that is evidenced in the results for the magnetic susceptiblity. The latter can be accounted for by assuming that only 2% of all the Yb atoms adopt the Yb^{+3} configuration. The ^{11}B spin-lattice relaxation rate has a substantial contribution of the form $T_1^{-1}(T) \propto T$ indicating that YbB_6 has a distinct metallic character, somewhat unexpected if it is considered that almost all the Yb ions adopt the divalent configuration.

23CP25 Kondo lattice behaviour of $CeNi_9Si_4$

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We have studied the phase formation, thermodynamic and transport properties of ternary compounds $R\mathrm{Ni_9Si_4}$ (R = La and Ce) with tetragonal crystal structure (space group $I4/mcm$). For $\mathrm{CeNi_9Si_4}$ resistivity, magnetic susceptibility and specific heat measurements reveal Kondo-lattice properties with a T^2 temperature dependence of the electrical resistivity, $A \sim 0.01\mu\Omega\mathrm{cm/K^2}$, an enhanced Sommerfeld value $\gamma = 160\,\mathrm{mJ/molK^2}$. The Kadowaki-Woods ratio $A/\gamma^2 \sim 0.4 \times 10^{-6}\mu\Omega\mathrm{cm(molK/mJ)^2}$ indicates weak RKKY coupling of the Ce-moments. The magnetic contribution to the specific heat and the magnetic susceptibility is analysed in terms of the Coqblin-Schrieffer model with a fully degenerate $J = 5/2$ ground state and a characteristic temperature $T_0 \simeq 180\,\mathrm{K}$.

Electronic structure and the Fermi surface of $UTGa_5$ (T=Fe, Co, Rh) 23CP26

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The relativistic augmented plane wave band calculations have been carried out for $\mathrm{UFeGa_5}$, $\mathrm{UCoGa_5}$ and $\mathrm{URhGa_5}$ under the assumption that $5f$-electrons are itinerant. The hole sheets of the Fermi surface in the 14th band are all small in size and closed in topology. The electron sheets of the Fermi surface in the 15th band are cylindrical and looks like a lattice-structure surface. The origins of the de Haas-van Alphen frequency branches in $\mathrm{UFeGa_5}$ have been clarified satisfactorily well.
The result for band calculations and the Fermi surface for $\mathrm{UCoGa_5}$ and $\mathrm{URhGa_5}$ is also presented.

High-resolution, low-temperature photoemission spectroscopy of Kondo semiconductor CeRhAs and related compounds 23CP27

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We present and discuss the Ce 4f derived electronic states near the Fermi level of the Kondo semiconductor CeRhAs, the Kondo semimetal CeRhSb, and the Kondo metal CePtSn obtained by high-resolution (ΔE = 16-20 meV), low-temperature (10-12 K) resonant photoemission spectroscopy with a photon energy of hν = 122-126 eV.

Temperature Dependent Hyperfine Interactions in $CePdAl$ 23CP28

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Nuclear Magnetic Resonance have been performed to study hyperfine interactions in CePdAl. The temperature dependence of Knight shift(K) and susceptibility(χ) is highly anisotropic as expected from its crystal structure. Non-linearity of $K - \chi$ plot was observed only when the magnetic field was perpendicular to c-axis. Two dimensional short range correlations are discussed.

23CP29 Fermi surface of the periodic Anderson model by momentum-resolved charge compressibility

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We investigate a Fermi surface of the periodic Anderson model by the finite temperature quantum Monte calro method. Although the Luttinger sum rule predicts the system has a large Fermi surface (at $T = 0$) which contains both conduction and f electrons, the momentum distribution function $n(k)$ at a finite temperature shows large change at a small Fermi surface which contains only the conduction electrons without the f electrons and a clear signature of the large Fermi surface is not easily observed. On the other hand, the momentum-resolved compressibility $\frac{dn(k)}{d\mu}$ which reflects effects of an infinitesimal doping shows a peak structure at the large Fermi surface even at an easily accessible temperature.

23CP30 Neutron-Diffraction Study of the Unusual Ordered Phases of $Ce_{0.75}La_{0.25}B_6$

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$Ce_{0.75}La_{0.25}B_6$ shows paramagnetic phase (phase I), 4f-electron quadrupolar ordered phase (II), magnetically ordered phase (III), and unknown phase IV. In order to investigate order parameters in these phases, neutron diffraction experiments have been performed down to 74 mK. The order parameter in phase IV is not a magnetic dipole, and magnetic structure in phase III is different from that previously suggested for CeB_6 (Effantin *et al.*). These facts indicate an importance of 4f-electron multipole effect.

23CP31 The Coexistence of Magnetism and Superconductivity in $CeRhIn_5$

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The heavy fermion system $CeMIn_5$, where M is either Rh, Ir, or Co exhibits the coexistence of magnetism and superconductivity. $CeRhIn_5$ has an antiferromagnetic ground state giving way through a first order phase transition to a superconducting state with a critical temperature of 2.2 K under the application of 16 kbar of pressure. We have measured the evolution of the Fermi surface of $CeRhIn_5$ as a function of pressure. Experimental methods and results will be presented.

Metamagnetic transistions in the Heavy Fermion Superconductors $CeIrIn_5$ and $CeCoIn_5$ 23CP32

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The recently discovered heavy fermion materials $CeMIn_5$, where M is either Rh, Ir, or Co have proven to be an interesting class of materials with a rich phase diagram involving magnetism and superconductivity. In particular the superconductivity in $CeIrIn_5$ and $CeCoIn_5$ occurs at ambient pressure with transition temperatures of 0.4 K and 2.3 K respectively. We will present data taken at temperatures from 20 mK and DC magnetic fields up to 45 T on the metamagnetic transitions in these materials and the effects on the fermi surface determined by dHvA measurements both below and above the metamagnetic transitions.

Spin Fluctuations on $YbRh_2Si_2$ in the Vicinity of a Quantum-Critical Point Revealed by ^{29}Si NMR 23CP33

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We report a ^{29}Si NMR study on aligned single crystals of $YbRh_2Si_2$ shows behavior characteristic of the system of the vicinity of a quantum critical point (QCP: $T_{\rm N} \rightarrow 0$). K and $1/T_1T$ of Si show a strong dependence on the external field H, especially below 5 kOe. At the lowest field used in this measurement ($H \sim 1.5$ kOe), it was found that $1/T_1T$ continues to increase down to 50 mK, whereas K stays constant with a large magnitude below 200 mK. This result strongly suggests the development of antiferromagnetic fluctuations with finite $\boldsymbol{q}$ vectors that compete with $\boldsymbol{q} = 0$ spin fluctuations in the vicinity of the QCP near H =0.5 kOe. *Present address: Dept. of Phys. Kyoto Univ. Kyoto 606-8502, Japan.

Instability of RKKY-type long-range order in Kondo-lattice compound $Ce(Ru_{0.9}Rh_{0.1})_2(Si_{1-y}Ge_y)_2$ as studied by neutron diffraction 23CP34

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Neutron diffraction measurements have been made to study the response of the magnetic order of the heavy-fermion compound $Ce(Ru_{0.9}Rh_{0.1})_2(Si_{1-y}Ge_y)_2$ to hydrostatic pressure and to the chemical-pressure. With changing the Ge concentration, both of the magnitude of the magnetic moment and the value of the wave number show rapid change at around y=0.08. The 3rd harmonic component of the modulation of the y=0.2 compound clealy exhibits localized-electron nature at low temperature.

23CP35 Specific heat study of non-Fermi liquid behavior in $Ce_xLa_{1-x}Pd_2Al_3$

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We have measured specific heat of $Ce_xLa_{1-x}Pd_2Al_3$ ($0 \leq x \leq 1.0$) from 0.4 to 100 K. The magnetic specific heat normalized to a mole of Ce divided by temperature, C_m/T, for $x = 1.0$ shows a peak at 3.0 K which is attributed to the antiferromagnetic (AF) transition. With decreasing x, the peak shifts to lower temperatures. For $x = 0.7$, a logarithmic diverdence in C_m/T is observed below 7 K simultaneously with the disappearance of AF transition. This suggests that the non-Fermi liquid behavior appears due to the magnetic instability. With further decreasing x, C_m/T shows the same temperature dependence as that for $x = 0.7$ in the wide Ce concentration range down to $x = 0.3$.

23CP36 Magnetic Excitations in uranium based 5f systems

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We will review the results of our recent inelastic neutron scattering studies on uranium based intermetallic compounds. The high energy response is strongly dependent on the nature of $5f$ electrons. We observed clear cross over from localized to itinerant regime, namely distinct spin wave, crystalline electric field, and J-multiplet were observed in a localized system, while broad magnetic continuum with opening gap below $T_{\rm N}$ would be a signiture for the itinerant $5f$ character. The existence of a quasi-elastic response would be the evidence for the quasi-particles even in a localized system.

23CP37 de Haas-van Alphen Effect on $CeRh_3B_2$

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$CeRh_3B_2$ has the highest Curie temperature of 115 K in all the cerium compounds, although a saturation moment is only about $0.4\mu_{\rm B}$/Ce being much smaller than the moment based on the crystalline electric field. It is important to reveal whether the $4f$ electron has the itinerant charactor or not and the role of Rh d band in this compound.
We succeeded in growing high-quality single crystals of $CeRh_3B_2$, and in observing the de Haas-van Alphen (dHvA) effect. The dHvA frequencies are in the range from 400 $\sim$ 2000 T and some branches indicate the existence of closed Fermi surfaces.

^{11}B NMR Study in the Antiferromagnetic Phase III of $Ce_{0.75}La_{0.25}B_6$ 23CP38

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We have carried out the ^{11}B NMR experiments on a single crystalline sample of $Ce_{0.75}La_{0.25}B_6$ in order to elucidate the magnetic structure of the antiferromagnetic phase III and compare with the result of CeB_6. It is very important to investigate the magnetic property in phase III neighboring the unknown phase IV. In phase III, the spectrum is well reproduced by Sakai model, which reproduces the spectrum in phase III of CeB_6. It suggests that phase III of $Ce_{0.75}La_{0.25}B_6$ is similar to that of CeB_6. The more detailed experiments and analyses are now in progress. We will report those results at the presentation.

One-Loop Corrections to the Susceptibility and the Specific Heat in the Periodic Coqblin-Schrieffer Model 23CP39

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The periodic Coqblin-Schrieffer model with isotropic hybridization is investigated in the one-loop approximation for the half-filled case in terms of the functional integral formalism. We determine the order parameter corresponding to heavy fermion state and calculate the thermodynamic quantities such as susceptibility and specific heat. We discuss the fluctuation effects to the thermodynamic quantities comparing with the results obtained in the mean-field approximation.

μSR Study of Magnetism of $CeRh_2Si_2$ under High Pressure 23CP40

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$CeRh_2Si_2$ shows two antiferromagnetic transitions at ambient pressure (T_{N1}=36K and T_{N2}=27K). Application of pressure suppresses T_N to 0K at P_c $\sim$1GPa. We study the magnetism of the single crystalline sample of $CeRh_2Si_2$ by μSR method up to 0.4GPa. At $T < T_{N2}$, we observed both the spontaneous muon spin precession and the fast muon spin relaxation under a zero magnetic field. Although the transition temperature decreases with increasing the pressure, the precession frequency, which is proportional to the saturated sublattice magnetic moment, is nearly independent on the pressure.

23CP41 Effect of Pressure on $Yb_{1-x}Y_xInCu_4$ with First-order Valence Transition

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At transition temperature ($T_v \approx 42$ K) $YbInCu_4$ exhibts a first-order isostructural valence transition from Yb^{3+} free ion state at high temperature (HT) with Kondo temperture T_K^H= 25 K to intermediate valence state ($Yb^{2.9+}$) at low temperature (LT) with Kondo temperature T_K^L= 400 K. In LT phase this transition also can be induced by high magnetic field with transition magnetic field (H_v) $\approx$ 33 T or by pressure with transition pressure ($P_v \approx 20$ kbar). Although the $Yb_{1-x}Y_xInCu_4$ system make the lattice parameter of $YbInCu_4$ increase with the Y substitution, it shows a steep decrease of T_v and H_v, resulting in suppression of the valence transition around $x = 0.3$. The effect of pressure on $Yb_{1-x}Y_xInCu_4$ will be reported.

23CP42 Pressure effect on transport properties in heavy Fermion semimetal $CeRu_4Sb_{12}$

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$CeRu_4Sb_{12}$ has been reported to exhibit Non-Fermi-liquid (NFL) behavior at low temperatures [1]. The origin has not yet been clarified. Based on the transport and Shubnikov-de Haas (SdH) experiments, Fermi surface (FS) is large at high temperatures similar to $LaRu_4Sb_{12}$ [2], while at low temperatures it becomes a small semi-metallic one with highly enhanced effective mass. In order to understand such exotic behaviors, we have investigated the effect of pressure on the transport properties including the direct observation of FS using SdH effect. NFL behavior is easily destroyed both by magnetic field and pressure, though the pressure effect is minor at high temperatures. The SdH experiment under uniaxial pressure revealed that the nearly spherical FS is elongated along the pressure direction. [1] N. Takeda and M. Ishikawa: J. Phys. Soc. Japan **69** (2000) 868. [2] K. Abe et al.: to be published in Physica B.

23CP43 Anomalous Hall Effect in Heavy Fermion Compounds Ce_2TIn_8 (T = Rh or Ir)

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Ce_2RhIn_8 and Ce_2IrIn_8 are newly-found heavy fermion compounds. These materials are crystallized in the tetragonal Ho_2CoGa_8-type structure where the 2-layers of $CeIn_3$ and a layer of $RhIn_2$ or $IrIn_2$ are piled up alternately along the *c*-axis. We have grown a series of compounds R_2TIn_8 in single crystal form, where R = La, Ce or Pr, and T = Rh or Ir. The measurements of the magnetic susceptibility, the electrical resistivity and the Hall effect were performed in the temperature range between 2-300 K. In this contribution, we report the anomalous Hall effect in Ce_2TIn_8, compared with the data for the isostructural non-magnetic La_2TIn_8 and paramagnetic Pr_2TIn_8 which posses a singlet ground state.

Magnetic and Fermi Surface Properties of $UTGa_5$ (T : Fe , Co and Pt) 23CP44

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We succeeded in growing a high-quality single crystal of the $UTGa_5$ (T : Fe, Co and Pt) by the self-flux method, and measured the de Haas-van Alphen (dHvA) effect, together with the electrical resistivity, magnetoresistance, magnetic susceptibility and specific heat. Reflecting the unique tetragonal crystal structure, the Fermi surface in a paramagnet $UFeGa_5$ and an antiferromagnet $UPtGa_5$ consist of cylindrical Fermi surfaces and a lattice like Fermi surface. On the other hand, $UCoGa_5$ is the semimetal where Fermi surface consists of small closed Fermi surfaces.

Effect of Pressure on the Electrical Resistivity of Heavy Fermion Antiferromagnet Ce_2RhIn_8 23CP45

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The heavy fermion family Ce_nRhIn_{3n+2} have attracted much attention since the $CeIn_3$ (n=∞) and $CeRhIn_5$ (n=1) become superconductors under high pressure. Ce_2RhIn_8, which is the n=2 member of this family, is a heavy fermion antiferromagnet, T_N=2.8 K. We have grown a single crystal of Ce_2RhIn_8 and measured the electrical resistivity under high pressures up to 16 kbar in temperature range 1.5-300 K. At ambient pressure, the resistivity of Ce_2RhIn_8 increases logarithmically with decreasing temperature until it reaches a maximum at 5 K and show a shoulder at T_N. It is found that the resistive signature for T_N decreases with pressure. At 16 kbar, magnetic order is not observed down to 1.5 K.

Scanning SQUID microcopy of superconducting La2-xSrxCuO4 single crystals 23CP46

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The recent report on the existence of diamagnetic domains in La2-xSrxCuO4 (LSCO) thin films above Tc was stimulating, though the phenomena was not observed in successive measurements on bulky specimens. To clinch the controversy, we have measured local magnetic images of LSCO single crystals utilizing scanning SQUID microscope. For the LSCO single crystals with x=0.14-0.16, the vortex patterns were clearly observed at 3K. These patterns persisted up close to Tc, though they totally diminished at temperatures above 40K. Measurements on the underdoped and highly overdoped samples are in progress.

23CP47 Effect of orbital degeneracy on magnetic phases of electron-doped manganites

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The total energies for various magnetic structures of electron doped manganites are evaluated using energy bands E(**k**) accounting for the orbital degeneracy of e_g-band of manganese for the main A-, C- and G-types of antiferromagnetic ordering. To determine the magnetic configuration, minimization of the ground state energy with respect to the canting angle between the spins of Mn^{4+}-ions of the two magnetic sublattices has been performed. It appeared that in the case of complete degeneracy of e_g-orbital the calculated magnetic phase diagrams fail to explain the experimentally observed arrangement of magnetic phases. The account of rather small splitting of e_g-level drastically changes the phase diagrams retrieving their compatibility with experimental observations in the realistic region of parameters even in the collinear approximation.

23CP48 Scanning SQUID Microscopy on composition-spread NdSrMnO films under irradiation

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Local magnetic properties of composition-spread $Nd_{1-x}Sr_xMnO_3$ (NSMO; x=0.4-0.6) films were surveyed by a scanning SQUID microscope under irradiation. We have found that the spontaneous magnetization of the FM phase is drastically enhanced by the laser irradiation (λ=532nm), while that of the CO region is rather unchanged.

23CP49 Magnetic inhomogeneity effects in DC transport properties and microwave absorption of $La_{0.5}Sr_{0.5}CoO_{3-\delta}$ film

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Transport properties in a PLD $La_{0.5}Sr_{0.5}CoO_{3-\delta}$ film are studied by DC and microwave (41 GHz) technique. It is found that the microwave conductivity increases by the order of the magnitude at the transition to the ferromagnetic state. This is accompanied by only 10 % increase in the DC conductivity. This effect and the DC magnetoresistance data obtained are discussed considering the extrinsic and intrinsic sources of magnetic inhomogeneity in doped cobaltates, including the phase separation.

Structure and electromagnetic properties in thin films of $Pr_{0.65}Ca_{0.35}MnO_3$ 23CP50

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We have studied the ESR on the photo-induced phase transition of $Pr_{0.65}Ca_{0.35}MnO_3$ in the canted antiferromagnetic state [1]. Presently we report the magnetic property of the thin film of $Pr_{0.65}Ca_{0.35}MnO_3$ prepared with RF magnetron sputtering. Structurally, according to X-ray diffraction, high quality thin films were obtained on $LaAlO_3$ substrate at 850 °C with Ar/O_2 mixture gas atmosphere. They are ferrimagnet and the sample after long time deposition clearly shows the sign of charge-order formation. These properties are discussed comparatively with their bulk materials.

[1] O. Yanagisawa et al.: J. Superconductivity, 12, 311 (1999).

Fabrication of LBMO films and Magnetic Properties at Low Temperatures 23CP51

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Thin films of (La,Ba)MnO_3 were deposited by IBS at various substrate temperatures T_s and oxygen partial pressures P_o. Magnetic properties were investigated in terms of SQUID, magnetoresistance and ferromagnetic resonance (FMR). The various samples were characterized by FMR at 77 K. Effective magnetization M of the samples deposited at T_s=750°C is larger for P_o=1.5 than for 0.5 mTorr. Peak half width Γ is larger for 0.5 than for 1.5 mTorr, then the stronger magnetic and more homogenious film can be fabricated at 1.5 mTorr. $\Gamma\|$ is larger than $\Gamma\perp$. After annealing, M is increased, and the magnitudes of M$\perp$ and M$\|$ are converted to M$\perp$>M$\|$. The annealing affects seriously on in-plane and out-of-plane magnetization mproperties. The optimum annealing condition is 875°C → 800°C to increase M$\perp$. The magnetic homogeneity can be remarkably improved by the annealing both for H$\|$ and H$\perp$.

Temperature Dependence of FMR in La-Ba-Mn-O Thin Films 23CP52

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(La,Ba)MnO_3 thin films were fabricated by IBS. Ferromagnetic resonance (FMR) was measured on as-deposited and annealed samples at various temperatures (T). The resonance fields H_r, peak half widths Γ and magnetizations M were obtained for H$\|$plane and H$\perp$plane. The as-deposited film and the annealed film at 900 °C in O_2 showed FMR from 77 K to T_C=175 K and 185 K. In the annealed sample, $H_r\perp$ is larger than $H_r\|$ at 77 K due to demagnetization. $H_r\perp$ decreases while $H_r\|$ increases with increasing T, and finally they merge. M$\perp$ is larger than M$\|$, and they decrease with increasing T. $\Gamma\|$ is larger than $\Gamma\perp$, then spins are more distributed in H$\|$ than in H$\perp$. $\Gamma\|$ monotonically decreases with increasing T, then widely-distributed spins die out and only in-plane oriented spins are kept alive. While $\Gamma\perp$ once decreases then increases due to activated thermal fluctuation of remnant spins.

23CP53 Field Induced Magneticstructure Transisiton of $LaSrFeO_4$

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We report the magnetic transition studies on $LaSrFeO_4$. Single crystal of $LaSrFeO_4$ prepared by the floating-zone method and investigated by resistivity, magnetic susceptibility, and Mössbauer effect measurements. The crystal structure of $LaSrFeO_4$ is K_2NiF_4-type tetragonal (I4/mmm) symmetry. $LaSrFeO_4$ is a Mott-type antiferromagnetic semiconductor with multi phase transition. The Mössbauer spectra at room temperature consist of a single Fe^{3+} hyperfine sextets which are evidence for magnetically ordered phase. Furthermore we found the spin flop at 1.8 Tesla, T = 5 K in magnetization process, and make clear the magnetic ground state has [1 1 0] and [-1 1 0] direction spin order in the c plane.

23CP54 Non-linear conduction in the charge-disportionated phase of $La_{1/3}Sr_{2/3}FeO_3$

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In the perovskite $La_{1/3}Sr_{2/3}FeO_3$ charge disproportionation (CD) occurs at 200K: $3Fe^{\frac{11}{3}+} \rightarrow 2Fe^{3+}+Fe^{5+}$. Various studies indicate that in the CD phase there exist layered spin and charge order stacking along $[111]_{\rm cubic}$ direction, which can be regarded as a coupled spin density wave (SDW) and charge density wave (CDW). To investigate the nature of the CDW, we measured resistivity at pulsed high electric field up to 2000V/cm; special care was taken to eliminate the self-heating effect by choosing the thin film sample and by micro-fabrication with the focused ion beam technique. Current–voltage characteristics showed non-linear behavior (above 1000V/cm at 170K) only in CD phase and the threshold field E_{th} increases as temperature is reduced. Other phenomena for depinned CDW like negative differential resistivity and delay in pulse wave form were also observed. These suggest a collective motion in the present system.

23CP55 Specific Heat Studies on the Charge and Magnetic Ordering in Manganites

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Specific heat studies with a wide range of temperatures (T=30 - 300 K) on manganites $Pr_{0.65}Ca_{0.25}Sr_{0.1}MnO_3$ (PCSMO) and $Nd_{0.125}Sm_{0.375}Sr_{0.5}MnO_3$ (NSSMO) are reported. Both CO and AFM transitions in PCSMO and NSSMO can be clearly observed in specific heat data. However, the specific heat anomaly associated with the ferromagnetic (FM) ordering transition, which is usually corresponding to the MI transition, in both materials is not definitely determined. The possible explanations are discussed on the basis of whether the FM ordering is metastable or not.

Pressure induced ferromagnetic metal for a Mott insulator Ca_2RuO_4 23CP56

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We found a Mott insulator Ca_2RuO_4 features a metal-insulator transition at $P \sim 0.5$ GPa: at 300K from paramagnetic insulator to paramagnetic quasi-2D metal; at $T \leq$ 12K from AFM insulator to FM 3D metal. The P-phase diagram, especially the itinerant FM, is quite unique to our knowledge. We discuss the importance of structural distortions, which are expected to couple strongly to P. Moreover, our results suggest the induction of a FM quantum critical point at $P \leq$ 10GPa. We have strong interest in the connection between the p-wave superconductor Sr_2RuO_4, and the FM of metallic Ca_2RuO_4.

Crystal Structures and Magnetic Properties of the Double Perovskite $(Ca_{2-2x}Sr_{2x})FeMoO_6$ 23CP57

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Chemical size effect on structural and magnetic properties in $(Ca_{2-2x}Sr_{2x})FeMoO_6$ has been examined. The compounds crystallize in the monoclinic system for $0.0 \leq x < 0.2$, the orthorhombic for $0.2 \leq x < 0.4$ and the tetragonal for $0.4 \leq x$. The Curie temperature T_C increases with increasing x from 318 K (x=0.0) to 393 K (x=1.0). At 82 K, the saturation magnetization of all samples remains $M_S \leq 3.5 \mu_B$/formula unit compared to a theoretical spin-only moment $4 \mu_B$/formula unit for a perfectly ordered compound. This discrepancy is probably due to a slight disorder and valence-fluctuation between the Fe and Mo atoms.

Structure and magnetic properties of $BaFeO_{3-\delta}$ studied by neutron scattering measurements 23CP58

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It is reported that $BaFeO_{3-\delta}$ with an average oxidation state of +4 shows a decrease of Fe^{4+} concentration at low temperature, from a result of Mössbauer measurements. It implies that a charge disproportionation of Fe^{4+}, $2Fe^{4+} \rightarrow Fe^{3+} + Fe^{5+}$, occurs in this system. In this work, we have investigated the structure and the magnetic properties of $BaFeO_{3-\delta}$ using neutron scattering measurements. A drastic distortion of $[FeO_6]$ octahedra is observed around 180 K. The occurrence of the drastic distortion agrees well with the result of Mössbauer measurements.

23CP59 Charge and Orbital Ordered States in $Nd_{1-x}Sr_{1+x}MnO_4$ ($x = 0.67, 0.75$)

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The charge and orbital ordered states in the single-layered manganite crystals, $Nd_{1-x}Sr_{1+x}MnO_4$ ($x = 0.67, 0.75$), have been investigated. We have observed the superlattice spots of wave vector with $q = (\delta, \delta, 0)$, $\delta \sim \frac{1}{6}$ ($\frac{1}{8}$) in $x = 0.67$ ($x = 0.75$) by non-resonant x-ray scattering, which indicate atomic displacements induced by the charge-orbital ordering. To distinguish the charge-orbital states of Wigner-crystal and bi-stripe models, the resonant x-ray scattering technique were utilized at the q positions.

23CP60 μSR Study of Magnetic Order in $Sr_2Ru_{1-x}Ti_xO_4$

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Sr_2RuO_4 is an unconventional superconductor with $T_c = 1.5$ K which is extremely sensitive to even non-magnetic impurities. We have performed muon spin relaxation (μSR) measurements of $Sr_2Ru_{1-x}Ti_xO_4$. For $x = 0.01,\ 0.03$ we observe weak dilute spin freezing, similar to that seen in nominally pure but non-superconducting Sr_2RuO_4 while with $x = 0.09$ we observe spin glass freezing below $T_g \approx 15$ K.

23CP61 Electronic Transport of Bilayer Manganite $La_{1.2}Sr_{1.8}Mn_2O_7$ Single Crystal

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We report magnetoresistivity measurements on a $La_{1.2}Sr_{1.8}Mn_2O_7$ single crystal. The charge transport in the ferromagnetic phase is dominated by two-magnon scattering in the high T range and by weak localization effects at lower T, in the non-metallic regime. In the paramagnetic phase, $\rho_{ab}(T)$ obeys the adiabatic small polaron hopping mechanism, while $\rho_c(T)$ follows an Arrhenius behavior with the same activation energy. Considering the magnetic character of the polarons and the presence of ferromagnetic clusters in the paramagnetic state, we developed a model to determine $\rho_{ab,c}(H, T)$. The excellent agreement between calculated and measured $\rho_{ab,c}(H, T)$ indicates that small polarons play an essential role in the electrical transport of the paramagnetic phase of bilayer manganites.

EPR and magnetization study of the $Ni_2FeV_3O_{11}$ vanadate **23CP62**

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The novel nickel-iron vanadium oxide $Ni_2FeV_3O_{11}$ is investigated by EPR and dc magnetization measurements. Both measurements exhibit several singularities, indicative of diverse magnetic interactions.

Charge Disproportionation of A site in New Ni(II) Perovskite $BiNiO_3$ **23CP63**

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A new triclinic perovskite $BiNiO_3$ was synthesized at a high pressure of 6.5 GPa in an oxidizing atmosphere. Structure refinements based on synchrotron X-ray powder diffraction and bond valence calculation revealed a disproportionation of the Bi ions into Bi^{3+} and Bi^{5+}, both being located in distorted oxygen octahedra. Because of the presence of Bi^{5+}, the oxidation state of Ni was 2+, rather than 3+ as had been expected, and $BiNiO_3$ thus showed insulating behavior with localized spins of S=1. An antiferromagnetic ordering with spin canting took place at 300K.

MAGIC HOLE DOPED COMPOSITION OF $Sm_{1-x}Sr_xMnO_3$ MANGANITE: CRYSTAL STRUCTURE, AND UNUSUAL MAGNETIC AND TRANSPORT PROPERTIES AT x= 0.45 **23CP64**

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The manganite is established to exhibit a Pbnm space group and the net ferromagnetic (F)ground state, with Jahn-Teller distortions remaining in metallic F phase below T_c. A field hysteresis of the second harmonic of magnetization is observed above T_c. This behavior is explained by assuming a spontaneous magnetization to be associated with the AF domains possessing a weak F. The ordered regions destroy at T_c that indicates unusual character of the transition whose possible scenarios are discussed.

23CP65 NONLINEAR MAGNETIC PROPERTIES OF $Nd_{0.77}Ba_{0.23}MnO_3$ PSEUDOCUBIC SINGLE CRYSTAL IN CRITICAL PARAMAGNETIC REGION AND PHASE SEPARATION

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The second harmonic of magnetization is studied for $Nd_{0.77}Ba_{0.23}MnO_3$ that exhibits the insulating ferromagnetic ground state. The nonlinear response reveals the coexistence of the two magnetic phases in the paramagnetic region below T_p = 147K. Above T_p , critical behavior is described by dynamic scaling for the 3-D isotropic ferromagnets. The appearance a new magnetic phase is attributed to phase separation which can occur at orbital ordering in the cubic manganites.

23CP66 Elastic and structural properties of single crystalline $La_{0.95}Sr_{2.05}Mn_2O_7$

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It has been reported that CE-type Charge-ordered (CO) phase is observed at T_{CO} = 210 K [1] and the phase competition between this phase and A-type antiferromagnetic phase below T_{CO} in $LaSr_2Mn_2O_7$ [2], which is a half-doped bilayered manganaite $La_{2-2x}Sr_{1+2x}Mn_2O_7$ with x = 0.5. The competition becomes stronger in x =0.525 sample. We have grown single crystals of x = 0.525 by an optical floating-zone furnace to measure some physical and structual properties. We will discuss the results of ultrasonic measurement and the origin of the pase competition by comparing to the results for $LaSr_2Mn_2O_7$ [3].

[1] T. Kimura et al., PRB 58, 11081 (1998).
[2] D. N. Argyriou et al., PRB 61, 15269 (2000).
[3] A. Imaduddin et al., Physca B, in press.

23CP67 Magnetic phase diagram of $(La_{1-z}Pr_z)_{1.2}Sr_{1.8}Mn_2O_7$ for z = 0.6

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We have established a magnetic phase diagram of $(La_{1-z}Pr_z)_{1.2}Sr_{1.8}Mn_2O_7$ for z = 0.6 by means of elastic constants and magnetization measurements. A metamagnetic transition at H_m was observed both with a large hysteresis below the temperature of $T^* \sim 40$ K, and without a hysteresis above T^*. Two distinct elastic anomalies were observed in the field-dependence of elastic constants at the corresponding field H_m and another one below T^*. It was found that there were mainly three magnetic phases in the Field-Temperature ($H-T$) phase diagram. We will discuss the magnetic properties at low temperatures.

Electronic Properties of the Novel 4d Metallic Oxides $SrRhO_3$ and $Sr_3Rh_2O_7$ 23CP68

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The title metallic compounds (both have five 4d electrons per Rh) with perovskite- and Ruddlesden-Popper-type structures have been synthesized recently in our group by applying high-pressure and high-temperature techniques (6 GPa and 1500 °C), followed by measurements of the magnetic susceptibility, electrical resistivity, thermopower, and specific heat. Neutron and x-ray diffraction studies at room temperature revealed those structures. The DOS of $SrRhO_3$ was computed by LDA method with and without consideration of spin polarization. The electronic properties of these compounds will be reviewed, and compared with those of the analogous ruthenates, which have received the most attention.

The comparison of structure and magnetic properities between $La_{1-x}Pb_xMnO_3$ and $La_{1-x}Pb_xCoO_3$ system 23CP69

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The perovskite-like hole-doped $La_{1-x}Pb_xTO_3$ (x=0-0.5) oxides with T = Mn and Co are in the rhombhedral $R\bar{3}c$ structure. The similar physical phenomena, including the M-I transition, CMR, and related striking magnetostructural properties etc., have been observed in both the strongly correlation electron systems, however, the fundamental mechanisms actually are different. All our maganese samples exhibit long-range order ferromagnetism , and the cobalt compounds present spin-glass behavior, or even paramagnetism above 2 K.

Optical Study in the Charge-Ordered Phase of $(Nd_{1-x}Sr_x)MnO_3$ 23CP70

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We report the temperature and Sr concentration dependences of Raman and infrared reflection spectra in $(Nd_{1-x}Sr_x)MnO_3$. When x = 0.5, a phase transition from the paramagnetic insulator phase to the ferromagnetic metal one occurs at 250 K and a successive phase transition to the antiferromagnetic charge-ordered one at T_{CO} = 158 K. Above T_{CO}, we observe a broad Raman peak around 200 cm^{-1}, consistent with the $Ibmm$ symmetry with a small lattice distortion from the ideal perovskite structure. Below T_{CO}, we observe several new Raman peaks, coming from the folded phonons due to the formation of the superlattice. The infrared reflection spectra support the existence of the folded phonons below T_{CO}. A magnetic Raman peak from the single-ion-anisotropy gap is also observed below T_{CO}. These new peaks are not observed in the x = 0.48 sample which does not have the charge-ordered phase.

23CP71 High Field and Low Temperature X-ray Study on Phase Segregation for $Nd_{0.5}Sr_{0.5}MnO_3$ Powder and Single Crystal

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It has been found that the coexistence of the high temperature ferromagnetic (FM) and the low temperature antiferomagnetic (AF) phases was observed below the charge order transition temperature T_{co} for the $Nd_{0.5}Sr_{0.5}MnO_3$ powder sample. In order to investigate details of the phase segregation, the X-ray diffraction was carried out for the $Nd_{0.5}Sr_{0.5}MnO_3$ single crystal in magnetic fields up to 5 T. It was found that the phase segregation is strongly depends on the wave length of X-ray. These results suggest that the phase segregation of FM and AF mainly occurs near the surface within a few μm in depth .

23CP72 On the ferromagnetism of high-spin states

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The possibility of ferromagnetic ordering in a generalized Hubbard model and for infinite Hubbard energy is studied. The phase diagram of the ferromagnetism existence as a function of the degree of filling of d-shall is constructed. The calculation of the points of critical densities, between which ferromagnetic instability arises, was performed in a model of semielliptic primer density of state. On the bases of the deduced criterion, ferromagnetic instability was observed inside each integer interval of variation of the d-electron density. The appearance of separate regions of ferromagnetic instability is due to the possibility of change of sign of the scattering amplitude for Fermi excitations with opposite spin projections.

23CP73 Co K-edge Pre-edge XANES Studies on Intermediate Spin State of $RCoO_3$ (R = La, Eu)

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Room temperature Co K-edge x-ray absorption near-edge spectra (XANES) for the rhombohedral $RCoO_3$ (R = La, Eu) are reported. The small pre-edge peaks (P) observed near 7707-7715 eV are from the 1s-3d dipole transition, which is weakly allowed through the hybridization of Co 4p states with Co 3d states of neighboring atoms. The appearance of more than one pre-edge peak indicates an absorption transition to the majority e_g states as well as to minority e_g and t_{2g} state, which support a spin state transition from low spin state (LS: t_{2g}^6) to intermediate spin state (IS: $t_{2g}^5 e_g^1$) around 90 K for $LaCoO_3$. Similar pre-edge features are observed for $EuCoO_3$ indicates that Eu compound is also in the IS state with higher spin state transition temperature close to room temperature.

2D Ferromagnetic Fluctuation above T_N in Orbital-ordered $LaMnO_3$ A-type Antiferromagnet

23CP74

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Onset of two-dimensional (2D) ferromagnetic short range order with T_{2D} = 152 K was observed above A-type antiferromagnetic (AF) N*é*el temperature T_N = 139 K in orbital-ordered $LaMnO_3$ Mott insulator, using low field ($\leq$ 10 mT) field-cooled (FC) and zero-field-cooled (ZFC) magnetic susceptibility measurements. The A-type AF order with strong basal plane ferromagnetic coupling is due to orbital-ordered Mn^{3+} e_g electrons at $T_{oo} \simeq$ 780 K, and AF structure is stabilized through weak c-axis t_{2g} antiferromagnetic coupling. For applied field of 0.1 T, T_{2D} = 147 K and T_N = 137 K. Low temperature magnetization and Mn K-edge x-ray absorption near-edge spectrum (XANES) data on orthorhombic $LaMnO_3$ and rhombohedral $LaMnO_{3+\delta}$ ($\delta > 0$) will be discussed.

Transport Properties and Magnetic Phase Diagram in a Strongly Correlated $La_{0.7}(Ba_{1-x}Pb_x)_{0.3}MnO_{3+\delta}$ perovskites

23CP76

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The crystallographic data, transport properties and magnetic phase diagrams have been investigated for strongly electron correlated $La_{0.7}(Ba_{1-x}Pb_x)_{0.3}MnO_{3+\delta}$ ($0.0 \leq x \leq 1.0$) series. All our samples are in a rhombohedral structure of lattice parameters a $\simeq$ 5.50 Åand c $\simeq$ 13.38 Å. The enhanced disorder effect of addition of the Pb^{2+} ions doesn't apparently affect on both the metal-insulating and magnetic ordering temperatures as well as the magnetoresistance (MR) ratio. For the MR ratios of all samples linearly decrease with temperature from $\simeq$ 25 % at 5 K down to $\simeq$ 6 % at 300 K. The chemical disorder effect of the Pb substitution doesn't change the magnetic properties at low temperatures. It can be contributed to exhibit the same ratios of $[Ba^{2+}]+[Pb^{2+}]/[La^{3+}]$ and $[Mn^{4+}]/[Mn^{3+}]$ in the Pb doping manganese oxides.

Raman Scattering Study of $Y_{1-x}Ca_xTiO_3$ Single Crystals

23CP77

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We have systematically studied the Raman scattering spectra of single crystal $Y_{1-x}Ca_xTiO_3$ in the temperature region from 298K to 8K. The observed peaks below 600cm^{-1} have been assigned as phonons, and their observed number satisfies the symmetry of $Pbnm$ at room temperature. However, new additional peaks appear below 200K. This result shows that the crystal structure becomes monoclinic of $P2_1/n$. This structural phase transition from orthorhombic to monoclinic ones universally occurs for x$\leq$ 0.39 at around 200K.

23CP79 Dynamics of Phase Transitions in Cobalt Perovskites

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$La_{1-x}Sr_xCoO_3$ is distinct because of its unique spin transitions, subjecting the system to variable spin-lattice coupling. These occur with increasing temperature and doping from the low spin, to either a high-spin or an intermediate-spin (IS) configuration. The IS state is distinct because it is Jahn-Teller (JT) active. Such spin fluctuations would be accompanied by distortions in the local atomic structure corresponding to the type of transition. Pair density function analysis provided strong evidence for local lattice distortions associated with a Jahn-Teller active mode directly correlated to the change in the magnetic/conductive states of this system. Measurements of $S(Q,\omega)$ provided additional evidence that lattice modes indeed change with temperature and composition. The magnitude of their intensity is indicative of a collective excitation consistent with a phase transition not otherwise observed macroscopically.

23CP80 Pressure Effect on Transport and Magnetic Properties of A_2FeMoO_6 (A = Ba, Sr)

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For double perovskite oxides A_2FeMoO_6 (A = Ba, Sr), which show the colossal magnetoresistance up to room temperature, the resistivity and magnetization have been measured under pressure and magnetic fields. As pressure is applied to Ba_2FeMoO_6 (BFMO), the magnetic transition temperature T_C increases linearly, suggesting the enhancement of magnetic interactions between cations. The normalized resistivity $\rho(P)/\rho(P=0)$ at 5 K exhibits quite same pressure dependence in all magnetic fields up to 7 T, though the field dependence of magnetoresistance is extremely different in each magnetic field. This result indicates that the components contributing to the large filed-dependence of ρ hardly depends on pressure.

23CP81 Pressure-enhanced antiferromagnetism in Sr3Ru2O7

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The experimental picture of magnetism in a double-layered ruthenate Sr3Ru2O7 (with both the ferromagnetic and antiferromagnetic correlations present) could be consistent with a FM (itinerant) ordering of spins within bilayers, and AF (superexchange) coupling between bilayers. Since the effects of reduced dimensionality can be suppressed by pressure, we have conducted the systematic study of the effects of hydrostatic (helium-gas) pressure on magnetic susceptibility of single crystals of Sr3Ru2O7. Here we report that indeed the tendency to antiferromagnetism (and not ferromagnetism) is enhanced under hydrostatic pressure, as evidenced by an observed increase with pressure of a Neel-like transition temperature Tmax. We also report a pressure-induced first-order transition, presumably a structural one, which occurs at around 80K in response to the change of pressure at low temperature.

Study of low band width manganites with equal average ionic radii and manganese valence ratio

23CP82

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The reason for the interesting properties observed in CMR materials, other than average ionic radii ($< r_A >$) and Mn valence ratio (Mn^{3+}/Mn^{4+}), has been tried to find out by investigating the transport and magnetic properties of $Pr_{0.65}(Ca_{0.7}Sr_{0.3})_{0.35}MnO_3$, $Pr_{0.527}La_{0.123}(Ca_{0.8}Sr_{0.2})_{0.35}MnO_3$ and $Pr_{0.65}(Ca_{0.866}Ba_{0.134})_{0.35}MnO_3$. The $< r_A >$ and valence ratio of all three samples have been kept equal. The out come of the investigation indicates more intense role of the nature of individual A-site cation and the lattice mismatch.

ESR INVESTIGATION OF $Nd_{0.77}Ba_{0.23}MnO_3$ SINGLE CRYSTAL IN PARAMAGNETIC REGION: EVIDENCE FOR PHASE SEPARATION

23CP84

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We present an electron-spin-resonance (ESR) study in single crystal of $Nd_{0.77}Ba_{0.23}MnO_3$ above the Curie point T_c =124K. The temperature dependence of the ESR linewidth is established to agree well with critical behavior of that for a 3-D isotropic ferromagnet in paramagnetic region above T_p = 147K, when relaxation of an uniform magnetization is caused by the dipolar interactions and spin-phonon coupling. Below T_p a new regime is observed, the signal depending on a temperature treatment. The compound reveals the two signals at a slow cooling from the room temperature. This effect is assumed to be related to phase separation that can occur in the cubic manganites at orbital ordering.

Spectroscopic Evidence for Charge-Density-Wave Formation in Manganite

23CP85

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The typical charge ordered manganite, $Pr_{0.7}Ca_{0.3}MnO_3$ investigated here, shows the charge ordering (CO), which is characterized both by a single-particle excitation across the charge-gap 2Δ and by a collective excitation well below 2Δ. The former spectrum has been extensively investigated in recent years. However, a clear evidence for the presence of the collective excitation has not been reported so far. Here we used THz time-domain spectroscopy to directly probe the low-energy (0.5–5 meV) electrodynamics of $Pr_{0.7}Ca_{0.3}MnO_3$ and revealed the existence of a finite peak structure around 2–3 meV well below $2\Delta \sim 300$ meV. As compared to the optical properties of low-dimensional materials, we attributed this observed structure to the collective excitation mode arising from the charge-density-wave condensate.

23CP86 Successive Transitions of the Ordered *RE*$BaMn_2O_6$ *RE*=Tb, Dy , Ho and Y

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The ordered perovskites *RE*$BaMn_2O_6$ (*RE*=Tb, Dy, Ho and Y) consist of alternate stack of the RE^{3+} and Ba^{2+} ions along the *c*-axis. The $YBaMn_2O_6$ shows three successive transitions, a structural transition (T_{c1}=520 K), a M-I transition (T_{c2}=480 K) and an antiferromagnetic transition (T_{c3}=195 K). The $TbBaMn_2O_6$, the $DyBaMn_2O_6$ and the $HoBaMn_2O_6$ show the similar transitions as the $YBaMn_2O_6$. It should be noticed that the charge/orbital order in these compounds occurs at much higher temperature compared with the other disordered manganite perovskites. We will discuss these phase transitions from the crystal structure.

23CP87 Optical Reflectivity Study on Magnetoresistive Manganese Perovskites: Impurity Effect on the Ferromagnetic-Metallic and Charge-Ordered States

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Impurity effect on manganese perovskites are investigated by the optical reflectivity measured on cleaved surfaces of the single crystals. The Al impurity affects optical conductivity $\sigma(\omega)$ of ferromagnetic-metallic $La_{1-x}Sr_xMnO_3$ over a wide energy range up to 1 eV or higher, contrary to the simple-Drude picture. In particular, the Al impurity induces the unconventional localization state, which is characterized by the additional absorption at $\sim$3 eV in $\sigma(\omega)$ in addition to the infrared peak. The present study shows that the energy gap of the charge-ordered (CO) state in $Nd_{0.5}Sr_{0.5}MnO_3$ is about 0.5 eV, much larger than that suggested by the previous studies using polished surfaces. The CO state can be easily damaged by external disorder. We also discuss the different effect on the CO state between Cr and Al doping.

23CP88 Spin modulation of ^{57}Fe NMR frequency and relaxation in $BiFeO_3$

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NMR spectra were measured in ^{57}Fe enriched ferroelectric-antiferromagnet $BiFeO_3$ with space modulated magnetic structure of cycloidal type. This structure leads to space modulation of local field on ^{57}Fe nuclei as well as space periodic spin-spin relaxation and specific NMR line shape with frequency variable local width. Line shape temperature behavior is described using the model of nuclei in Bloch walls. This effect is based on indirect Sule-Nakamura spin-spin interaction which becomes effective at high concentration of magneto-active nuclei as a consequence of excitement of spin waves.

Phase Diagram and Magneto-Transport Properties in $Nd_{1-x}Sr_xMnO_3$ Crystals **23CP89**

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We have investigated electronic transport and magnetic properties of $Nd_{1-x}Sr_xMnO_3$ crystals with controlled band filling ($0 \leq x \leq 0.8$) grown by the floating zone method. The phase diagram of $Nd_{1-x}Sr_xMnO_3$ was obtained through magnetization, resistivity, and crystal structure measurements. We have found the phase separation near the phase boundary (x=0.62) between the A-type-antiferromagnetic (AF) metal with monoclinic symmetry and the C-type-AF insulator with tetragonal one. We have also studied magnetoresistance (MR), Hall resistivity, and Seebeck coefficient in the samples showing various electronic and magnetic structures. We have observed a large *positive* MR just below T_N in the A-type-AF sample (x=0.60), which is not the conventional negative CMR near T_C in manganites.

Studies of $La_{0.7-x}Pr_xCa_{0.3}MnO_3$(x=0.4 and 0.5) under pressure and magnetic field **23CP90**

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We investigated resistivity of $La_{0.7-x}Pr_xCa_{0.3}MnO_3$ (x=0.4 and 0.5) polycrystals under hydrostatic pressures and magnetic fields. With increasing pressures and fields, overall resistivity values drop sharply and at the same time MI transition increases monotonically. With increasing pressures and fields, however, our resistivity data show another anomaly developing at lower temperature than the MI transition. But, our susceptibility data do not show any anomalous behavior at the temperature of the resistivity anomaly, suggesting that this new feature seen in the resistivity data is unlikely to be connected to a change in the thermodynamic properties.

Inhomogeneous States and Isotope Substitution in Magnetic Oxides **23CP91**

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Inhomogeneous states and the phase separation originating from the competition between various types of charge, spin, and orbital ordering in complex magnetic oxides were experimentally studied. The oxygen isotope substitution was used both as the unique tool for investigating inhomogeneous state and as the method for modification of the ground state. At first, we demonstrate that the magnetic and transport measurements revealed a phase separation in $(La_{0.25}Pr_{0.75})_{0.7}Ca_{0.3}MnO_3$ compound with various concentrations of ^{18}O. Then we studied the isotope effect on transport and magnetic properties of $Sm_{0.55}Sr_{0.45}MnO_3$ manganite and showed that the $^{16}O \rightarrow {}^{18}O$ isotope substitution induces the phase separation in $Sm_{0.55}Sr_{0.45}MnO_3$ system causes the formation of antiferromagnetic clusters in the ferromagnetic matrix.

23CP92 Anomalies of magnetic and magnetoelastic properties in $Nd_{1-x}Ca_xMnO_3$

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Magnetic, anisotropic, and magnetoelastic properties have been investigated for $Nd_{1-x}Ca_xMnO_3$ monocrystals (x=0; 0.25; 0.05; 0.3) in pulsed magnetic fields up to 250 kOe in temperature range 10-100 K. Jumps of magnetization and magnetostriction induced by the strong magnetic field H along b have been observed at H$approx$100 kOe in the x=0, 0.25, 0.05 compounds. We attribute this phenomena to a reorientation of the weak ferromagnetic moment from c to b-axis. Corresponding H-T phase diagrams were obtained. This work supported by RFBR (00-02-16500 and 00-15-96695).

23CP93 Induced by magnetic field spin reorientation in YMn_2O_5

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In ferroelectric YMn_2O_5 weak ferromagnetism was found along a-axis of rhombic crystal. It was shown that the nature of ferromagnetic sublattices cant is determined by magnetoelectric ordering. Reorientation of magnetic moment was observed under strong magnetic field applied along b-axis of crystal, that was accompanied by sharp increase of magnetostriction and jumps of electric polarization. In $EuMn_2O_5$, as in YMn_2O_5, spontaneous and magnetic field induced phase transitions from incommensurate to commensurate phase were observed, accompanied by cardinal changing of magnetoelectrical properties.
This work supported by RFBR (01-02-16468 and 00-15-96695)

23CP94 Orbital Order in $La_{0.95}Sr_{0.05}MnO_3$ and $LaMn_{1-x}Cr_xMnO_3$ probed by ESR

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We present an analysis of Dzyaloshinsky-Moriya interaction and crystal-field parameters using the angular and T-dependence of the paramagnetic resonance shift and linewidth in single crystals of $La_{0.95}Sr_{0.05}MnO_3$ within the Jahn-Teller distorted phase. The DM interaction ($\sim$ 1 K) results from the tilting of the MnO_6 octahedra. The CF parameters D and E are found to be of comparable magnitude ($\sim$ 1 K) with $D \approx -E$. This indicates a mixing of the $|3z^2 - r^2\rangle$ and $|x^2 - y^2\rangle$ states for the real orbital order with an orbital parameter $\theta \approx -60^\circ$. Thus, the discrepancy between anisotropic optical spectra and the value $\theta \approx 108^\circ$ obtained from neutron scattering in $LaMnO_3$ can be explained. By substituting Mn with Cr, the JT-driven OO persists up to $x = 0.3$. The Cr^{3+} ions do not contribute to the ESR signal.

GW Study of Half-Metallic Electronic Structure of $La_{0.7}Ba_{0.3}MnO_3$ **23CP95**

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The half-metallic systems will be quite useful in future spin electronics. The LDA in the density functional theory bas been widely used first-principles method, but it is also known that the LDA underestimates band gaps in semiconductors and insulators. The GW approximation is employed to study $La_{0.7}Ba_{0.3}MnO_3$, which is one of candidates for the half-metallic ferromagnets, to show that the lowest energy of the unoccupied states for the minority spin is far above the Fermi energy compared to that in the LDA. As a bulk, this system is predicted to be a fully-polarized half-metallic ferromagnet.

Orbital Ordering in UGa_3: Direct Detection by ^{69}Ga NMR **23CP96**

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^{69}Ga NMR spectra are reported and analyzed for the paramagnetic and antiferromagnetically (AFM) ordered states of UGa_3($T_N = 67K$). Ordered-state splitting of the NMR lines indicates that the fourfold symmetry of the Ga-site hyperfine (HF) coupling is broken in the AFM state. A striking change in the Ga HF coupling constant also occurs at T_N. These effects are attributed to uranium (5f) orbital ordering, which appears to set in just below T_N. Orientation of the U moments has been determined as $[11\delta]$ ($0 < \delta < 1$) for $40K < T < T_N$ and $[\alpha, \beta, \gamma]$ ($\alpha, \beta, \gamma \neq$) for $T < 40K$. Electric field gradients and field-dependent HF effects are also discussed.

Specific Heat in Normal Conducting UPt_3 Revisited **23CP97**

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Using a high-quality single crystal with exceptional superconducting transition temperature we have measured specific heat of UPt_3 in the temperature range from 0.3 K to 16 K and in magnetic fields up to 8 T. The focus of this work lies on the normal state properties, where apart from the heavy Fermion behaviour, in neutron scattering experiments magnetic correlations have been found setting in at 6 K. However, this ordering has so far have not been confirmed in thermodynamic measurements. For the first time we observe a peak at 6.7 K that shifts to 3.2 K in 3 T, independent of field direction. We discuss its origin and possible explanations either in terms of the magnetic correlations or impurity contributions.

23CP98 New Energy Scale in Low Temperature of $YbAl_3$

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A new anomaly, which is seen in the specific heat and magnetic susceptibility measurements, is observed at lower temperature than Kondo peak temperature at 150 K in $YbAl_3$. The new peak could associate with a new temperature scale for the development of Fermi liquid coherence in $YbAl_3$. The susceptibility anomaly was suppressed by application of high magnetic fields abve 40T. The magnetization measurement suggests that the low temperature coherent peak disappears when the magnetic field reaches over 40 T. This behavior implies that new character of electronic states in $YbAl_3$ may appear in high magnetic field.