Session 22CP

Pressure effect on the resistivity of the filled skutterudite compounds **22CP1**

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Ternary intermetallic compounds RT_4X_{12} with the filled skutterudite structure have attracted much attention, since the large number of novel phenomena have been discovered in these compounds. Among them, $PrFe_4P_{12}$ have received special attentions because of their quite uncommon properties,such as the anomalous heavy electron state with quadrupole ordering at low temperature. $CeOs_4Sb_{12}$ shows semiconducting behavior with a very small energy gap. These unique properties might be attributed to the large $c-f$ hybridization strength, which originated in the unique structure. In order to clarify the electronic structure in these compounds, we have measured the transport properties under high pressure.

Low temperature properties of Sm-based filled skutterudite phosphides **22CP3**

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Filled skutterudite compounds SmT_4P_{12}(T=Fe,Ru,Os) have been prepared at high temperature and high pressure. The low temperature properties of these materials have been studied by means of electrical resistivity, magnetic susceptibility and specific heat measurements. $SmFe_4P_{12}$ and $SmOs_4P_{12}$ behave as a metalic below room temperature. On the other hand, $SmRu_4P_{12}$ shows metal-insulater transition near 16K. $SmOs_4P_{12}$ shows an antiferromagnetic ordering at 5K and transition temperature shifts to lower temperature, while applying high magnetic field. $SmFe_4P_{12}$ is paramagnetic down to 2K.

22CP4 Ferromagnetic Heavy Fermion System $SmFe_4P_{12}$

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We present the magnetic properties of a filled skutterudite compound $SmFe_4P_{12}$. The magnetic susceptibility and specific heat measurements reveal a ferromagnetic phase transition at 1.5 K. The temperature dependence of the electrical resistivity exhibits a Kondo effect and the electronic specific heat coefficient atains as large as 370 mJ/mole$\cdot$ K^2. This compound is the first Sm-based heavy fermion system with a ferromagnetic ground state.

22CP5 Anisotropy of the heavy fermion state in $PrFe_4P_{12}$

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Recently it has been confirmed that $PrFe_4P_{12}$ has a rare $4f^2$-based heavy fermion (HF) state in high fields where a non-magnetic ordered state is suppressed. We have studied the anisotropy of the HF state by applying magnetic fields (H) along different crystalline directions. For $H//\langle 100\rangle$ and $H//\langle 110\rangle$, the electronic part of specific heat (C_{el}/T) shows Fermi-liquid like behaviors at low temperatures, while C_{el}/T shows a $\ln T$-like divergence below 2 K for $H//\langle 111\rangle$. Correspondingly, electrical resistivity $\rho(T)$ shows an almost linear-in-T behavior below 1 K for $H//\langle 111\rangle$, while T^2 dependence is dominating for the other two directions. A fact that the observed non-Fermi-liquid (NFL) behaviors for $H//\langle 111\rangle$ are insensitive to the magnetic field may reflect the NFL nature of the ground state that is concealed by the non-magnetic ordered state in low fields.

22CP6 FLAPW Electronic Band Structure of the Filled Skutterudite $ThFe_4P_{12}$

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The $LaFe_4P_{12}$ compound has been known to be the metal with one hole per formula unit. Thus the $ThFe_4P_{12}$ compound is expected to be semiconducting, since thorium ion is believed to be tetravalent. However, the electric resistivity and infrared reflectance spectroscopy measurements have suggested that the $ThFe_4P_{12}$ compound behaves like metal.[1]
The electronic band structure is calculated for $ThFe_4P_{12}$ by using an FLAPW method. The result reveals that, between the filled valence bands and empty conduction bands, there is a direct band gap at the Γ point with gap width of 0.0331 Ry (0.45 eV), contrary to experimental results.

[1] S. V. Dordevic *et al.*: Phys. Rev. B **60** (1999) 11321.

Resonant X-ray Scattering Study on the filled skutterudite $PrFe_4P_{12}$ 22CP7

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One of the filled skutterudites, $PrFe_4P_{12}$, attracts interest because of a non-magnetic ordered ground state and a heavy fermion state under high magnetic field. Theoretically, antiquadrupolar ordering is proposed as the ordered state. We have performed resonant x-ray scattering study at the Pr-L_{III} absorption edge, and found that two Pr ions in a body-centered cubic unit cell certainly have a different electronic state.

^{57}Fe Mössbauer spectroscopic Study of $PrFe_4P_{12}$ 22CP8

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$PrFe_4P_{12}$ has recently been the most interesting compounds in the filled-skutterddite compounds. This compound shows the phase transition at 6.5 K. The ^{57}Fe Mössbauer parameters obtained in the present work show no temperature dependence around this temperature. We have also performed the ^{57}Fe Mössbauer spectroscopy under the applied magnetic field.

Elastic properties of *R*e-Ru_4Sb_{12} (*R*e; La, Pr) 22CP9

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We have studied elastic properties of *R*e-Ru_4Sb_{12} (*R*e; La, Pr) by means of ultrasonic measurement. They both exhibit a superconducting transition at temperature of T_c = 3.2 K for $LaRu_4Sb_{12}$ and T_c = 1.0 K for $PrRu_4Sb_{12}$. No distinct anomaly was observed at T_c in the both compounds. Elastic softening towards low temperature, which is reflected a $4f$ ground state of Pr ion doesn't appear. It suggests the $4f$ ground state to be Γ_1 singlet in $PrRu_4Sb_{12}$.

22CP10 Structural Phase Transition in Trivalent Skutterudites

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The trivalent skutterudites $PrRu_4P_{12}$, $PrFe_4P_{12}$, $NdFe_4P_{12}$, $SmRu_4P_{12}$, $GdRu_4P_{12}$ and $TbRu_4P_{12}$ display resistivity upturns, attributable to a partial (or full) metal-insulator transition, and magnetisation anomalies indicative of an ordered ground state. The common feature of these materials may be nesting of the Fermi surface, which is unstable due to coupling between local f-electrons and lattice distortions. We examine symmetry allowed couplings in order to determine which types of distortions may lead to a structural phase transition, and the possible 4f-electron ground states with which they are compatible.

22CP11 NMR study of magnetic properties in $SmRu_4P_{12}$

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^{31}P-NMR spectra and nuclear spin-lattice relaxation time T_1 have been measured in the temperature range between 1.3 and 300 K. NMR spectrum becomes suddenly broad below metal-insulator transition temperature (T_{M-I}=16.5K), suggesting that $SmRu_4P_{12}$ shows magnetic phase transition just below T_{M-I}. Broadening of the NMR line indicates that the amplitude and direction of internal field distribute randomly at P sites , that is, antiferromagnetic order is complicated, such as SDW or incommensurate one. Relaxation rate $1/T_1$ obeys exponential relation (exp[-ΔE/k$_B T$]) below T_{M-I}. This seems to be because a gap is open in the spin excitation spectrum.

22CP12 Magnetic Field Effects on the Pressure-Induced Colossal Maximum in Electrical Resistivity of CeSb

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Pressure-induced sharp maximum in electrical resistivity $\rho(T)$ is observed near 35K at pressures above 1.5GPa. The peak value increases rapidly in proportion to the square of pressure up to 6GPa, and at 7GPa it reaches a vaule nearly 23 times as large as that at ambient pressure. We have measured $\rho(T)$ curves of CeSb at 4GPa under high magnetic fields up to 16T. The peak value of this colossal maximum exhibits a very rapid decrease with increasing magnetic field and disappears completely above 6T. This result strongly suggests that the cause of the colossal maximum is attribute to some magnetic origin.

Antiferromagnetism and magnetoleasticity of UNiAl **22CP13**

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Results of thermal-expansion (TE) and magnetostriction (MS) measurements will be presented for the antiferromagnet UNiAl ($T_N = 19.3$ K), which undergoes at $T < 7$ K metamagnetic transition (MT) with a critical field $B_C = 11.4$ T (applied along the c-axis of hexagonal structure). The anomalous TE contributions observed at T up to $3T_N$ can be removed by magnetic fields sufficiently high (> 16 T) to suppress the AF correlations (or short range AF order), which are believed to be responsible for TE anomalies in paramagnetic state. The MT at $T < 7$ K is accompanied by an abrupt MS step of the order of $10 - 4$; negative (positive) along the c-axis (a-axis) leaving the volume effect negligible.

Specific Heat of $CeMg_2Cu_9$ with a Two-dimensional Ce Arrangement **22CP14**

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We have carried out the specific heat measurements under pressures between 0 and 0.91 GPa on $CeMg_2Cu_9$, in which the Ce atoms are a two-dimensional arrangement. A large peak is observed at $T_{\rm N}$ = 2.5 K for 0 GPa. The position of $T_{\rm N}$ increases below 0.89 GPa, and changes into decrease with pressurization. The released magnetic entropy S_m below $T_{\rm N}$ is about 60% of that expected for the twofold spin degeneracy. This suggests the Kondo-compensated moments are formed in the low temperature range. These behaviors are similar to the pressure-induced superconductor $CeRhIn_5$ with a two-dimensional arrangement of Ce atoms.

Insulator-metal transition studied by heat capacity measurements on SmS **22CP15**

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We have measured the specific heat of SmS at pressures up to ∼7.5 kbar. We observed that the electronic specific heat coefficient γ shows a steep increase at around $P_{\rm c} \sim 3.5$ kbar, which corresponds to an insulator-metal phase transition. In the metal phase above P_c, we found that γ exceeds 100 mJ/mole K^2, indicating a strongly correlated metallic state. On the other hand, we observed an anomaly in the temperature dependence of the specific heat around 1 K; a sample exhibits a huge γ-value that amounts to ∼200 mJ/mole K^2. We will discuss this origin of the anomaly.

22CP16 Magnetic properties of URhSi single crystal

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URhSi which crystallizes in the orthorhombic TiNiSi-type structure, is an itinerant $5f-$ electron ferromagnet having $T_{\rm c} = 9.5K$ with tiny magnetic moment of uranium. Due to the existence of strong magnetocrystalline anisotropy in this compound, single crystalline studies are desired. In the present work, we have grown URhSi single crystal and carried on magnetization, $M(B)$, measurement at 2 K and magnetic field up to 9 T. It is found that the $M(B)$ of URhSi is highly anisotropic and easy-magnetization direction is the c-axis. $M(B)$ curves along $a-$ and $b-$ axis are similar and non-zero spontaneous moment are observed for all axes. Specific heat result will also be presented.

22CP18 Magnetic Properties of $CeRu_2Si_2$ at Ultra Low Temperatures

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We simultaneously measured the ac susceptibility and dc magnetization of the heavy fermion compound $CeRu_2Si_2$ in various small magnetic fields at temperatures down to 170μK. The susceptibility and magnetization increased below 100mK followed by Curie law with small magnetic moment 0.02μ_B/Ce. In fields higher than 0.20mT, the susceptibility showed the peak, the temperature (T_M) and height of which were higher and lower with increasing the field, respectively. In addition, approaching T_M, increase in the static magnetization became flat and showed a plateau in fields higher than 0.39mT. These results reflect the spin fluctuation of the itinerant 4*f* electron with the antiferromagnetic correlations.

22CP19 Bound states in the one-dimensional Kondo lattice model

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We apply recently developed high-order coupling expansion techniques to study zero-temperature properties of 2-hole excitations in the one-dimensional Kondo lattice model around half-filling. Starting from the insulating Kondo spin liquid phase which is the strong-coupling limit of isolated dimers we expand effective Hamiltonians in the subspaces of single-hole and two-hole excitations. This way we can expand the dispersion of a single hole excitation up to 10th order. With growing hopping amplitudes the effective mass of the holes is found to strongly increase. In the two-hole sector we find a continuum of scattering states and two distinct states which separate from the continuum around $k = \pi$ momentum. These 2-hole states can be identified as singlet and triplet combination of two hole excitations.

M^4 Scaling of Negative Magnetoresistance in CeSi **22CP20**

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CeSi crystallizes in the orthorhombic FeB type structure. Below 6 K it has a sinusoidally modulated magnetic structure, which is incommensurate with the crystal lattice. Magnetization for $H \parallel b$ shows a metamagnetic transition at 0.5 T and saturates with the moment of 1.7$\mu_{\rm B}$/Ce. In the compound, a large negative magnetoresistance for $H \parallel b$ was observed. It was found that the scaling between the magnetoresistance and the magnetization shows an interesting relation of $\Delta\rho/\rho_0 \propto -(M/M_s)^4$ in a wide field region up to 8 T. This may suggest that in the system an interatomic coupling of fluctuation is dominant as well as a single-site fluctuation with relation to the unique magnetic structure.

Specific Heat and Electrical Resistivity Measurements in $Pr_{0.03}La_{0.97}Pb_3$ **22CP21**

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We have measured specific heat C and electrical resistivity ρ for $Pr_{0.03}La_{0.97}Pb_3$ with the Γ_3 doublet in the crystalline-electric-field ground state to examine the Kondo effect arising from the correlation between the quadrupolar moments and the conduction electrons. It is found that C/T increases monotonically with lowering temperature below 1.5 K, which is clearly different from that in the Pr concentrated region. Moreover, ρ shows the clear drop below 3 K. The possible origin of these results is discussed.

Magnetic Susceptibility of $LaRu_3Si_2$ **22CP22**

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To study the mixed valence behavior in RRu_3Si_2 (R=rare earth elements), the magnetization M of $LaRu_3Si_2$ was measured in the normal state. The magnetization curve (M-H curve) was analyzed with assuming that it consists of an intrinsic paramagnetic part and a ferromagnetic impurity part. The obtained magnetic susceptibility is very dependent on temperature, which is considered to be due to a high density of states and narrow band. This result is also considered to be related to its considerably high superconducting transition temperature T_s=7 K.

22CP23 A Simple Tight-Binding Model Description of the Conduction Band of the Kondo Insulator YbB_{12}

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It is shown that the conduction band of typical Kondo insulator YbB_{12} can be expressed rather well by a simple tight-binding model of $5d_\epsilon$-orbitals on Yb. The $(dd\sigma)$ overlapping integral is considered to include the effect of B_{12}. Mixing of f-states with the conduction band can be described in terms of the extended Slater-Koster integrals with the spin-orbit interactions. Using this model, thermal, thermoelectric, transport and magnetic properties of YbB_{12} will be discussed. Effect of strong correlation on the thermal current will be also discussed

22CP24 Magnetism of $UCo_{1-x}T_xAl$ (T = Fe, Ni) single crystals

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The specific metamagnetic (M) behavior of UCoAl is easily modified to ferromagnetism (F) or conventional paramagnetism with doping UCoAl by suitable elements. We demonstrate these features in the magnetization study of single crystals of the $UCo_{1-x}T_xAl$ (T = Fe, Ni) at 1.5-40 K. The Ni substitution for Co yields an increase of the critical field and a gradual suppression of M, which disappears at x=0.10. The compounds $UCo_{0.95}Fe_{0.05}Al$ and $UFe_{0.50}Ni_{0.50}Al$ are F below 30 K and 52 K, respectively. For $UCo_{0.95}Fe_{0.05}Ni_{0.05}Al$ and $UCo_{0.98}Fe_{0.02}Al$, which also exhibit F, traces of M are indicated on magnetization curves. The doping-induced F is very sensitive to external pressure. Hydrostatic pressure of only 0.3 GPa is sufficient to suppress all signs of F and restore M in $UCo_{0.98}Fe_{0.02}Al$.

22CP25 Evolution of magnetic structures in $U(Ni_{1-x}Pd_x)_2Si_2$ system

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The influence of Pd-Ni substitution on the formation of magnetic phases in the tetragonal $U(Ni_{1-x}Pd_x)_2Si_2$ system and the corresponding magnetic phase diagrams are presented. The single crystals of two different substitutions $x = 0.15$ and 0.10 were grown and detailed studies by neutron diffraction were performed in horizontal magnetic fields up to $B = 6$ T. Both compounds order antiferromagnetically (AF) and exhibit three different AF structures below the Neel temperature. All three structures are formed by ferromagnetic basal planes stacked along c-axis with different $\mathbf{q} = (0, 0, q_z)$ propagation. For $x = 0.10$, the co-existence of two magnetic phases in the ground-state was observed.

Thermodynamic properties of $SmCu_2$ 22CP26

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Intermetallic compound $SmCu_2$ crystallizes in the $CeCu_2$-type structure (space group $Imma$) and orders antiferromagnetically (AF) below the Néel temperature T_N = 23 K. A single crystal of $SmCu_2$ was grown and the temperature dependence of specific heat was measured in the low-temperature region to determine the magnetic phase transitions. Four sharp anomalies were detected at temperatures T = 22.3, 17.7, 16.4 and 3.7 K, which were attributed to T_N and three additional order-to-order magnetic phase transitions between three AF phases. The detailed analysis of specific heat in the low-temperature region was performed by comparing the specific heat of $SmCu_2$ and that of non-magnetic analogues $LuCu_2$ and YCu_2. The thermodynamic properties of $SmCu_2$ in ordered state are presented here.

Low temperature specific heat enhancement in Fe_2VGa 22CP27

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Low-temperature specific heat measurements on the Heusler-type compounds Fe_2VGa have been performed. We observed the sample-dependent upturn in C/T at low temperature which is attributed to the effect of magnetic impurities and/or clusters. After subtracting this extrinsic effect, the resulting γ still indicated heavy fermion behavior with an effective mass of about 50 times larger than the value extracted from NMR results. Possible mechanisms for such an enhancement will be discussed and compared to those in other Heusler alloys.

Magnetic Behavior in Nonmagnetic Atom Disorder System Ce_2CuSi_3 22CP28

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Nonmagnetic atom disorder system Ce_2CuSi_3 is found to show the spin-glass behaviors below T_f=2.7 K, e.g. the frequency-dependent ac susceptibility, the irreversibility of the dc magnetization and the long-time magnetic relaxation effect etc. On the other hand, the appearances of a broad peak in specific heat curve and the evident decrease of electrical resistivity around T=3.5 K seem to suggest the formation of magnetically ordered state or the extended magnetic clusters in this compound. The complex magnetic behaviors are considered to originate from the competition between ferro- and antiferromagnetic exchange interactions and discussed comparing with other isostructural 2:1:3 compounds.

22CP29 Crossover between "localized" and "itinerant" antiferromagnetic states in $Ce(Ru_{0.9}Rh_{0.1})_2(Si_{1-y}Ge_y)_2$ driven by chemical pressure

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We have investigated the magnetization process of the pseudobinary Kondo-lattice system $Ce(Ru_{0.9}Rh_{0.1})_2(Si_{1-y}Ge_y)_2$. The base material $Ce(Ru_{0.9}Rh_{0.1})_2Si_2$, which has a spin density wave(SDW) phase below $T_N = 5.0$ K, shows two-step metamagnetic behavior at H_c and H_m; the SDW-Fermi liquid(FL) transition occurs at H_c, and FL state becomes unstable and localized spin character recovers at H_m. By substituting Ge for Si, H_m reduces very rapidly and disappears for $y > 0.08$, where the magnetization curve is quite similar to those of localized Ising spin antiferromagnets(AF). This observation is interpreted as a manifestation of crossover of the character of the AF state from "itinerant" to "localized" induced by the negative chemical pressure.

22CP30 Heat capacity of SmB_6 at low temperatures

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We have investigated the low temperature properties of the narrow-gap semiconductor SmB_6 by means of heat capacity measurements at temperatures between 0.1 and 20 K and in magnetic field up to 9 T. The heat capacity measurements show a metallic-like behaviour of this material at low temperatures and reveal, moreover, an enhancement of the specific heat below about 2 K, which can be attributed to the formation of a coherent state. The influence of magnetic field on the formation of this state is discussed.

22CP31 Study of the magnetic properties of $Ce_3Pd_{20}Si_6$ and $Ce_3Pd_{20}Ge_6$ compounds

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The compounds $Ce_3Pd_{20}Ge(Si)_6$ manifest the unusual physical properties which categorize them as a magnetic Kondo systems. The features of the magnetic behaviour of these compounds can be explained by the existence of two relatively separated Ce-subsystems.
We studied the magnetic properties of the polycrystalline samples of $Ce_3Pd_{20}Ge(Si)_6$ by the muonic technique (μSR method).
The details of the magnetic behaviour of $Ce_3Pd_{20}Ge(Si)_6$ at the temperatures below 1 K are presented.

Itinerant Antiferromagnetism of Mn_3Si and CuMnSb **22CP32**

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We report an experimental study of the specific heat, resistivity and magnetisation of the antiferromagnetically ordered metals Mn_3Si and CuMnSb at low temperatures and high magnetic fields. The bulk properties and the low values of T_N of these compounds are essentially unchanged up to 14 T. This suggests a stability of the antiferromagnetic order to high magnetic field that is incompatible with present day models for magnetism in metals, in particular the standard model of itinerant magnetism. In turn our observations question the validity of Fermi liquid theory in its present form free of a theoretical agenda, e.g., the vicinity to a magnetic quantum phase transition or perfect nesting of the band-structure.

Magnetic properties of $Ce(Rh_{1-x}Ru_x)_2Si_2$ single crystals for x up to 0.35 **22CP33**

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We report magnetic, volumic and transport properties of $Ce(Rh_{1-x}Ru_x)_2Si_2$ single crystals. The antiferromagnetic (AF) transition occuring at T_{N_1} = 36 K for x = 0 decreases rapidly on increasing x and vanishes for x = 0.35. This variation scales with an increase of the Kondo temperature. A second AF transition occuring at T_{N_2} = 27 K for x = 0, has disappeared for x as small as 0.01. The anomalies at T_{N_1} are smoothed for $x \geq 0.05$. However, the simultaneous large increase of residual resistivity is not only due to disorder, as shown by its 40 to 50 percent decrease in a magnetic field of 22 T. These results will be compared with the properties of non-ordered alloys ($0.35 \leq x \leq 0.6$) and discussed.

Contrastive transport properties in Y_7Rh_3 and La_7Rh_3 **22CP34**

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We have reported that light/heavy-rare-earth R_7Rh_3 compounds show ferromagnetic/antiferromagnetic behavior and metallic/semimetallic transport properties. To clarify the origin of contrastive properties in isostructural R_7Rh_3, we studied non-magnetic compound Y_7Rh_3 and La_7Rh_3, in which lattice constants are almost the same as in heavy- and light-rare-earth compounds respectively. The results of Hall effect indicated that the number of carrier for Y_7Rh_3 (0.04/atom) is smaller than that for La_7Rh_3 (0.29/atom). It was clarified from magnetic studies that Y_7Rh_3 is nearly localized 4*d* electron system.

22CP35 Magnetoresistance of $URh_3B_{0.7}$ Single Crystal

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Boron addition is a powerful technique for controlling of magnetism in the uranium compounds, such as URh_3B_x. We studied the magnetic and transport properties in the $URh_3B_{0.7}$ single crystal prepared by Czochralski method using a tetra-arc furnace. This crystal did not show magnetic order down to 1.8 K, just as reported data of the polycrystalline $URh_3B_{0.7}$. But large negative enhancement was observed in the transverse magnetoresistance of [100] axis at $H \geq 5.5$ T.

22CP36 Neutron Diffraction Study of Itinerant Antiferromagnet $UPtGa_5$ and $UNiGa_5$

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$UNiGa_5$ and $UPtGa_5$ which is isostructural to the heavy fermion superconductors $CeRhIn_5$ and $PuCoGa_5$ undergo an antiferromagnetic order transition at 86 K and 26 K, respectively. It should be pointed out that the coupling of magnetic moments of uranium within the (0 0 1) plane is different in these compounds: ferromagnetic coupling in $UPtGa_5$ and antiferromagnetic one in $UNiGa_5$, while the coupling along the [0 0 1] is antiferromagnetic in both compounds. We observed a large changes of z parameter of Ga $4i$ site in $UNiGa_5$ around the antiferromagnetic order transition. This strain indicates that spin and orbital degree of freedom play an significant role in the different magnetic structures between these compounds.

22CP37 High field magnetostriction of $CeRh_2Si_2$

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Magnetostriction on a single crystal $CeRh_2Si_2$ was measured by using strain gauge in pulsed magnetic fields up to 50 T. $CeRh_2Si_2$ with a tetragnal crystal structure shows an antiferromagnetic ordering and a metamagnetic transition in the magnetization curve for the field along the c-axis. A sudden change in the megnetostriction was observed at the field of 26 T where the metamagnetic transition occurs.

Non-Fermi-liquid behavior in $CeNiGe_{2-x}Si_x$ single crystals **22CP38**

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$CeNiGe_2$ is known as a heavy Fermion antiferromagnetic compound with T_N=3.5K, while $CeNiSi_2$ is an intermediated valence material. We have investigated the specific heats in the series of $CeNiGe_{2-x}Si_x$ from 0.5 to 35K. In transition region from a magnetic order to a non-magnetic ground state, NFL phenomenon appears. We found that the temperature dependence of the specific heat obeys C/T $\propto lnT$ at x=1, which is characteristic of the non-Fermi-liquid behavior.

Transport and magnetic properties of $CeCo_{1-x}Ni_xGe_2$ system **22CP39**

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The electric resistivity and the magnetic-susceptibility have been measured for the series of intermetallic compounds $CeCo_{1-x}Ni_xGe_2$ (x=0.1, 0.2, 0.5, 0.7, 0.8, 0.9, 1). $CeNiGe_2$ is the antiferromagnetic compound with T_N=3.5K. $CeCoGe_2$ is the intermediate-valence compound with the cerium valence varying from 3.2 at room temperature to 3.8 at 1.8K. The valance fluctuations are quenched at x=0.5, while the heavy Fermion behavior appears in x$>$0.5.

Transport and magnetic properties of $CeNiGe_{2-x}Si_x$ single crystals **22CP40**

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We have studied the rare-earth ternary system $CeNiGe_{2-x}Si_x$ by magnetization and resistivity measurements. The series crystallize in a $CeNiSi_2$-type orthorhombic structure. $CeNiGe_2$ is the antiferromagnetic compound with T_N=3.5K, $\mu_{eff} \cong 2.56\mu_B$ and $\theta_p = -102.6$K while $CeNiSi_2$ is the intermediated valence system with the cerium valence varying from 3.3 at room temperature to 3.8 at T=1.8K. The properties of $CeNiGe_{2-x}Si_x$ are determined by the competition of the Kondo and the RKKY interactions. This competition is dependent on the change of lattice volume, which gives rise to the change of hybridization.

22CP41 Competition between Kondo effect and RKKY interaction modified by carrier concentration in Ce($Pd_{1-x}Cu_x$)$_2Al_3$

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A series of compounds Ce($Pd_{1-x}Cu_x$)$_2Al_3$ was synthesized in this work. The substitution of Pd by Cu resulted in an increase of carrier concentration as well as a decrease of lattice volume. Measurements of the electrical resistivity, the magnetic susceptibility and the specific heat were performed on this series to investigate the competition between Kondo effect and RKKY interaction. It was found that the antiferromagnetic property of $CePd_2Al_3$ changes abruptly to a ferro-like one at about x=0.2, and returns to the antiferromagnetic state with a continuous substitution. No evidence shows an enhancement of Kondo effect although the lattice volume is reduced.

22CP42 Thermoelectric and Magnetic Properties of $CeRh_{1-x}T_xSn$ (T=Co, Ni, and Ru) Alloys

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CeRhSn is a valence fluctuating compound with a large thermopower of 60 μV/K at 150 K[1]. We report on the thermopower S, electrical resistivity ρ, and magnetic susceptibility χ of $CeRh_{1-x}T_xSn$ (T=Co, Ni, and Ru; x$\leq$0.25) alloys. The Ni substitution changes χ(T) to the Curie-Weiss type, whereas the Ru one to the Pauli-type. The maximum in S(T) is suppressed by all the substitutions. These results indicate that the coherence in the c-f hybridization plays the important role in the large thermopower of CeRhSn. [1]Bando *et al.*, J. Alloys and compds. **313**, 1 (2000).

22CP43 Anisotropic Transport and Magnetic Properties of CeRhSn

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CeRhSn with the quasi-Kagome lattice of Ce ions is a valence fluctuating compound[1]. We have found strong anisotropy in both the resistivity ($\rho_a > \rho_c$) and magnetic susceptibility ($\chi_c > \chi_a$). The $\rho_c(T)$ shows a strong anomaly below 10 K, where the $\chi_c(T)$ exhibits a power law behavior. Below 8 K, an upturn is observed in C/T, the specific heat divided by temperature. These results suggest the presence of low-energy excitations at $\sim$0.5 meV in CeRhSn.

[1]Bando *et al.*, J. Alloys Comp. **313**, 1 (2000).

De Hass-van Alphen effect of $CeRhIn_5$ under pressure **22CP44**

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We have studied quasi-two dimensional compounds $LaRhIn_5$ and $CeTIn_5$(T: Co, Rh) via the de Hass-van Alphen (dHvA) effect. The main Fermi surface in $CeRhIn_5$ is approximately the same as that in $LaRhIn_5$. The $4f$ electron in $CeRhIn_5$ is thus concluded to be localized, which is compared to an itinerant $4f$-electron in $CeCoIn_5$[1]. We have also studied the dHvA effect of $CeRhIn_5$ under pressure. The volume of the Fermi surface is unchanged as a function of pressure, but the cyclotron effective mass increases rapidly above 1GPa.

[1] H.Shishido $etal.$; J. Phys. Soc. Jpn. **71** (2002) 162

Magnetic and superconducting properties under high pressure in URu_2Si_2 **22CP45**

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Recent NMR measurement has suggested a phase separation; a paramagnetic and an antiferromagnetic phase coexist below T_0 = 17.5 K, and the volume fraction of the antiferromagnetic phase increases with pressure. We have measured ac magnetic susceptibility and thermal expansion under pressure for a well-characterized single crystalline sample. We observed an additional anomaly below T_0 that appears only under pressure. We will report these experimental results and discuss them on the basis of aforementioned phase separation model.

Transport properties in UCoAl under uniaxial pressure **22CP46**

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UCoAl, a unique $5f$ electron compound, exhibits a metamagnetic transition around a magnetic field $B_c \sim$1 T along c-axis from a paramagnetic ground state, reflecting the anisotropic $5f$ ligand hybridization. Under the hydrostatic pressure, B_c increases, i.e., metamagnetism is suppressed towards a paramagnetism. In a very recent magnetic measurement under uniaxial pressure (P_u) along c-axis ferromagnetism is found to appear in zero field. We report the transport properties in which B_c is found to increase for P_u along a-axis, possibly indicating an enhancement of $3d$-$5f$ hybridization in the basal plane.

22CP47 Resistivity of Ce($Ru_{0.85}Rh_{0.15}$)$_2Si_2$ under pressure

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Heavy fermion compound Ce($Ru_{1-x}Rh_x$)$_2Si_2$ shows a Spin Desity Wave (SDW) transition for 0.03<x<0.35 and shows a hump-type jump in resistivity along the tetragonal c-axis. We performed resistivity measurement under hydrostatic pressure for x=0.15 for 0.5K T 50K that has the highest $T_{\rm N}(\sim 5.5{\rm K})$. The hump-type jump in resistivity shifts to lower temperature with increasing pressure, at finally, disappears above P=1.0GPa. This fact indicates that the SDW phase is collapsed by pressure. On the other hand, the broad peak corresponding to the Kondo effect exists around T ∼20K, and shifts to higher temperature with increasing pressure, indicateing increase of $T_{\rm K}$.

22CP48 The Fermi Surface in the "Kondo Semiconductor" CeNiSn

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Although there is plenty of convincing evidence for gap formation at low temperatures in CeNiSn, it has frequently been suggested that the gap is actually a pseudogap with finite density-of-states (DOS) at the Fermi level.[1] We have found Shubnikov-de Haas oscillations in magnetoresistance measured on high-quality single crystals, thus producing an unambiguous proof of *intrinsic* finite DOS. The quasiparticle mass is fairly large, 10-20 m_e, suggesting electron-correlation effects. We also show that the resistivity at zero field follows a T^2 law, characteristic of a Fermi liquid, but with an anomalously large coefficient.

[1]For a review, see, Takabatake *et al*., J. Magn. Magn. Mater. **177-181**, 277 (1998)

22CP49 Anisotropic Magnetic Behavior of $GdBa_2Cu_3O_{6+y}$ Single Crystals

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Magnetic properties of the high-quality Al-free nonsuperconducting $\rm GdBa_2Cu_3O_{6+y}$ (Gd-1236) single crystals grown by flux method have been studied. Magnetic anisotropy below Néel temperature $T_N \approx 2.3$ K corresponds to the direction of $\rm Gd^{3+}$ magnetic moments along tetragonal c-axis. At $T < T_N$ clear indications on spin-flop transitions for $H \parallel c$ have been observed on magnetization curves at $H_{sf} \approx 10$ kOe. Magnetic phase diagrams have been obtained for $H \parallel c$ as well as for $H \perp c$. A pronounced anisotropy in the magnetic susceptibility (unexpected for Gd-based compounds) has been found above T_N. Possible reasons for the observed anisotropic behavior of Gd-1236 will be discussed.

Randomness Effects on the Ferromagnetism of the Double Exchange Model 22CP50

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Magnetic properties of the double-exchange model in the presence of randomness are investigated. Spin excitation spectrum is calculated using the spin wave approximation, which shows anomalies such as broadening, anti-crossing and gap opening. The anomalies qualitatively reproduce the spin excitation spectrum in colossal magnetoresistance manganites with relatively low Curie temperatures. We also study critical phenomena using the Monte Carlo technique. Our results suggest that the destabilization of the ferromagnetism due to randomness is more rapid than the previous predictions by the coherent-potential approximation. Finally, we discuss that randomness control is an important notion to understand effects of the A-site substitution which has previously been considered as the bandwidth control.

Theoretical study of orbital excitations observed by resonant inelastic x-ray scattering in doped manganites 22CP51

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In order to examine the orbital excitations, we study the resonant inelastic x-ray scattering (RIXS) in doped manganites with and without orbital orderings. The RIXS spectra for orbital excitations are calculated by using the mean field approximation and the exact diagonalization method in a finite-size cluster. It is shown that the RIXS spectra in doped manganites show a more remarkable momentum dependence rather than the spectra in $LaMnO_3$. We find that the RIXS spectra are sensitive to both the orbital and spin structures. In particular, the momentum and polarization dependence of the spectra are examined in detail by changing orbital ordered states.

Orbital ordering and fluctuation in Perovskite Titanates 22CP52

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In perovskite titanates $RTiO_3$ where R indicates a trivalent rare-earth ion, it is well known that the triply degenerate t_{2g} orbitals are active and the orbital orderings are experimentally observed. We examine the orbital ordering and fluctuation in perovskite titanates by using the mean field approximation. Because of the three fold degeneracy of the orbital, there are multi-components of the orbital order parameter and the corresponding fluctuations. We find that, in this consequence, the successive orbital ordering occurs with changing temperature. This is in contrast to the system with the doubly degenerate orbital, such as perovskite manganites.

22CP53 Cu-O-Cu Bond-Angle Dependence of Magnetic Interactions in Antiferromagnetic Cuprates

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We present an experimental evidence for systematics to show the bond-angle dependence of the supertransferred hyperfine interaction and of the superexchange interaction in Cu - O - Cu bonds with the bond-angle ranging from 90 to 180 degrees. Both interactions in cuprates exhibit much more sensitive dependence on the bond-angle rather than on the atom distance.

22CP55 On the tilted low temperature antiferromagnetic structure in Cr_2O_3.

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When considering the low temperature behavior of magnetoelectric Cr_2O_3 the existence of G-type collinear antiferromagnetic structure with L-vector fixed along 3-fold axis was common knowledge. The detailed consideration of higher order magnetic anisotropy in the enthalpy of the system showed that even in the absence of the external magnetic field the antiferromagnetic vector L is inclined to the easy axis and as a result the longitudinal magnetic susceptibility in the zero-temperature limit doesn't vanish. The latter is in accord with a great number of experimental results.We have also discovered peculiar magnetoelectric behavior of the system under consideration in the low temperature region.

22CP56 Stripes and Superstructures in Manganites: the Role of Elastic Interactions

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The role of elastic interactions between Jahn-Teller ions in formation of various orbital- and charge-ordered structures in manganites and related compounds is analyzed. It is shown that such interactions alone are often sufficient to reproduce the structures observed in different regions of the phase diagram. A special attention is focused on stripe structures at high doping levels.

Effects of impurities on the magnetic property in copper oxides **22CP57**

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We study effects of impurities, e.g., nonmagnetic impurity atoms substituted for Cu atoms and oxygen vacancies, on the normal states in the CuO_2 planes of copper oxides, on the basis of the d-p model. The impurity potential is taken account of within the single-site coherent potential approximation and the Coulomb repulsion at each Cu site is treated by the fluctuation-exchange approximation. The spin susceptibility is calculated as a function of the concentration of the impurity. In the lecture, we will discuss about effects of impurities on the magnetic property of the CuO_2 plane from the obtained results.

Resistance and Thermal Expansion Anomaly near the Martensitic Transformation in GdCu under Pressure **22CP58**

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GdCu undergoes a martensitic transition evolving from the CsCl structure at room temperature to the FeB structure as decreasing temperature. In the present work, we report the thermal expansion and electrical resistivity of GdCu under pressure. A large anomaly at 239 K, indicating the transition temperature Ms, is observed in the thermal expansion at ambient pressure. Ms rapidly decreases by applying pressure at a rate of $dMs/dP \sim$ -160 K/GPa.

Unusual Impurity Effects on the Dielectric Properties of $CaCu_{3-x}Mn_xTi_4O_{12}$ **22CP59**

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$CaCu_3Ti_4O_{12}$ has a large dielectric constant ($\varepsilon \sim 10^4$ at 300 K), which is almost constant above 100 K, followed by a 100-fold reduction below 100 K. Since no other dielectric materials have such properties, the physical mechanism has been extensively investigated. We found that only 2% substitution of Mn for Cu dramatically quenches the huge ε of 10^4 down to 100 over the measured temperature range from 4 to 300 K. In usual substitution effects, 2% impurity induces a tiny change in ε of the order of 2%. Thus the present substitution effect suggests that dipole moments interact (probably frustrate) in $CaCu_3Ti_4O_{12}$, which is broken by a small amount of impurities.

22CP60 Out-of-plane dielectric constant of θ-(BEDT-TTF)$_2$RbZn(SCN)$_4$ single crystal

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The out-of-plane dielectric constant ϵ of the quasi-two-dimensional organic conductor θ-(BEDT-TTF)$_2$RbZn(SCN)$_4$, which exhibits a metal-insulator transition at 190K, was measured and analyzed from 120 to 300K in the frequency range of 10^3-10^9 Hz. Most unexpectedly in the metallic state above 190K, ϵ shows a significant dielectric relaxation, which is seriously incompatible with the Drude model that successfully explains ϵ for usual metals. This suggests that above 190K insulating and metallic phases coexist, and some kind of charge inhomogeneity plays an important role in the metallic state.

22CP61 Low temperature specific heat of polyaniline and HCl doped nanotubes

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The specific heat C of insulator polyaniline (PANI) and conducting HCl doped polyaniline (PANI-HCl) have been measured between 1.8 and 50K using thermal-relaxation method. At lower temperatures(T<6K), the specific heat of PANI behaves as βT^3, whilst that of PANI-HCl behaves as γT + βT^3. The existence of linear term γT in the specific heat of conducting PANI-HCl is suggested due to the electronic contribution. At higher temperature, the lattice specific heat can not be described by Debye model. The excess part may due to the additional vibrational states besides the acoustic phonons as found in other polymer.

22CP62 THz Radiation from Charge-Ordered Manganite Excited by Ultrafast Optical Pulses

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The rapid progress of a THz-pulse generation and detection system has been made by using semiconductors excited by femtosecond optical pulses and by the subsequent discovery of THz radiation from new class of materials including quantum wells and superconductors. Another candidate materials are strong correlated electron systems like manganites due to their sensitive responses by external stimuli. Here we describe the first finding of THz radiation from magnetoresistive manganite $Pr_{0.7}Ca_{0.3}MnO_3$ thin films by femtosecond optical pulses. We emphasis that THz radiation from magnetic materials has not been observed so far. In this work, we provide the detailed THz radiation characteristics as a function of external stimuli and point out the photo-induced spin modulation as a source of THz radiation.

Memory Effects for Glass-like States of Solid N_2-Ar Mixtures. 22CP63

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The results of high sensitivity dielectric measurements are reported for solid N_2-Ar mixtures for N_2 concentrations $49 < x(N_2) < 100$ mole %. The observations indicate the onset of memory effects for the dielectric susceptibility on thermal cycling to temperatures below 30 K. The temperature dependence of the dielectric susceptibilities in this low temperature regime are observed to be frequency dependent, even for pure N_2 samples. These observations are consistent with a departure from ergodicity associated with the trapping of the systems in small regions of a configuration space characterized by a frustration-induced rugged free energy landscape.

Ultrasonic Study on Superconducting $HoNi_2B_2C$ and $Ho_{0.75}Y_{0.25}Ni_2B_2C$ 22CP64

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We performed the ultrasonic measurements for $HoNi_2B_2C$ and $Ho_{0.75}Y_{0.25}Ni_2B_2C$ single crystals as a function of temperature and magnetic field. In zero magnetic field, C_{66} for $HoNi_2B_2C$ showed a remarkable softening from more than 80 K while $(C_{11} - C_{12})/2$ remained almost constant. For the field applied along the $a(b)$–axis, softening of C_{66} was suppressed. This behavior is related to the tetragonal to orthorhombic transition associated with the antiferromagnetic order. A similar softening of C_{66} was also observed for $Ho_{0.75}Y_{0.25}Ni_2B_2C$.

Theoretical Classification of Two-Dimensional Organic Conductors 22CP65

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Several different polytypes have been found in the family of quasi-two-dimensional organic conductors, designated in Greek letters, e.g. θ, κ, which exhibit characteristic ground states quite different from each other. We present a new unified scheme to classsify these polytypes; all of them are mapped on an anisotropic triangular lattice model, where the systematic characterization is made by the newly introduced band structural parameters. Our theoretical calculations based on the above model including the on-site and inter-site Coulomb interactions indicate the actual relavance of these parameters to the ground state nature.

22CP66 Effects of doping and oxygen partial pressure on electrical and optical properties of $Mg(In_{2-x}Ag_x)O_4$ system

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Transparent conducting oxides were widely used as transparent electrodes of flat plane displays due to its lower electrical resistivity and higher optical transmittance. The magnesium indium oxide $MgIn_2O_{4-\delta}$ has been demonstrated to be one of the promising new transparent conductive oxides. In this report, $Mg(In_{2-x}Ag_x)O_{4-\delta}$ system with x = 0 - 0.5 were prepared by the standard solid-state reaction technique in various flowing gas. The effects of the Ag doping on structural,transport and optical properties are investigated. A single phase of the inverse-spinel-type $MgIn_2O_4$ structure was observed in all samples by the X-ray diffraction patterns. The phase is a cubic structure of the space group Fd-3m(No.227). But this doping can largely reduce the annealing time and decrease the annealing temperature.

22CP67 Infrared properties of W-doped charge-density-wave material $K_{0.3}MoO_3$

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The reflectance and conductivity spectra of quasi-one dimensional compounds $K_{0.3}Mo_{1-x}W_xO_3$ (x=0, 0.03 and 0.15) have been studied over a broad frequency from far infrared to visible light region. While the dc resistivity measurements indicate no sign of CDW transition in heavily W-doped blue bronze, the optical conductivity spectra still show a single particle gap at around 0.2 eV for E parallel to the conducting chain direction which is usually considered as a typical feature associated with CDW condensate. Such impurity effect challenges our understanding about the occurrence of the gap with the CDW transition.

22CP68 Control of Spin-Wave Instability Threshold in YIG Sphere

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Spin-wave instability threshold under multiple drive excitations is studied in an yttrium iron garnet sphere at 4.2K. Both a DC magnetic field and a pulsed parallel RF field are applied along the [111] direction. This parallel RF field parametrically excites spin-waves. Another perpendicular RF field, which is generated by a one-turn coil, excites magnetostatic modes. Interactions between spin-waves and magneostatic modes cause a change of an instability threshold. These phenomena provide information about nonlinear interactions in a nonequilibrium spin-wave system.

Relaxation time of parametrically excited magnetostatic mode in YIG 22CP69

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Parallel pumping experiments were conducted on a single crystal yttrium-iron-garnet sphere. Microwave radiation from magnetostatic modes, which were parametrically excited through parallel pumped spin-waves, was studied experimentally at several temperatures. As excitation microwave power is turned off, it will be thought that microwave radiation decreases exponentially. Relaxation time of a magnetostatic mode, which is excited beyond thermal equilibrium level, is estimated by this method. We report temperature dependence of relaxation times.

Exact Diagonalization for the Vibronic Levels of Dynamic Yahn-Teller Systems –E_g Orbitals with e_g modes in Trigonal Fields – 22CP70

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We calculate the electronic states of degenerate E_g orbitals of d-leves in transition-metal ions coupled with vibrational modes of e_g expressed as Q_1 and Q_2. This is the typical system of dynamic Jahn-Teller effects(DYTE). In fact, vibronic levels has been calculated [1] in rather small dimensional Hamiltonian matrices(H). Further, the effect of the trigonal fields expressed as $A(Q_2^3 - Q_1^2 Q_2)$ on some low-lying levels has also investigated [2]. Here, we perform exact diagonalizations of H, without approximations used in previous work [1,2]. As results, we can diccuss clearly DYTE observed in magnetic compunds.
[1]H.C.Longuet-Higgins et al, Proc.Roy.Soc.**A244**(1958)1.
[2]M.C.M.O'Breien, Proc.Roy.Soc.**A281**(1964)323.

Phase Transition of a Coulomb System on a Lattice 22CP71

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The possible existence of a phase transition in the Coulomb glass has been under controversial debate for many years. We approach this problem considering a lattice half-filled with localised particles which interact via the long-range Coulomb potential (without static disorder). Our numerical simulations focus on the temperature dependences of the specific heat and of the susceptibility related to the staggered occupation. They show the presence of a phase transition in two- and three-dimensional systems. Surprisingly, the critical behaviour of two-dimensional samples, obtained by a finite-size analysis, resembles that of the Ising system with short-range interaction. The phase transition seems to persist if a small static disorder is added.

22CP72 Numerical renormalization study on magnetic properties of edge states in nanographite ribbons and carbon nanotubes

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Magnetic properties of nanographite ribbons (NGRs) and carbon nanotubes (CNTs) with open edges are investigated. A π-electron network in NGRs and CNTs with zigzag edges exhibits strongly localized edge states, which are expected to exhibit peculiar magnetic properties. In this work, we study the effect of the electron-electron interaction on the low-energy properties of the systems using the density-matrix renormalization-group method, which allows us to obtain highly accurate results. We show that effective spins grow around the zigzag edges of the NGRs and the open ends of zigzag CNTs. A schematic picture representing the low-energy physics of nanographite systems is proposed. We also discuss possible applications of the results.

22CP73 The elastic properties of silica aerogels between 400 mK and 400K

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Using an acoustic resonance spectroscopy technique, we have measured the elastic properties of a range of silica aerogels between 400 mK and 400 K. Similar to what has earlier been observed at ultrasonic frequencies, both bulk and shear moduli show a large decrease with temperature around 100 K. This is accompanied by damping peak, and can be contributed to thermally activated relaxation. Above 100 K we find a linear increase in the elastic moduli, which we attribute to rubber-like behavior, i.e., the elastic behavior is governed by entropic effects rather than energetics. Surprisingly, the increase in elastic moduli is not observed in the ultrasonic experiments. 1)Y. Xie and J.R. Beamish, Phys. Rev. B 57, 3406 (1998).

22CP74 High frequency ESR measurement on molecular oxygen using pulsed high magnetic field

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High field/high frequency ESR measurement on molecular oxygen, of which electronic ground state is $^3\Sigma$ state with S=1, has been performed in its gas phase at the frequencies 730.5GHz and 1017.6GHz using pulsed high magnetic field. The observed ESR signals are analyzed by the theory of Tinkham and Strandberg including the coupling between the spin and the rotational angular momentums of the molecule. The Paschen-Back effect in high field limit, predicted by the theory, is observed.

Thermal Contact to Lithium Metal 22CP75

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Experiments at ultra-low temperatures require very low thermal contact resistances, a serious issue even for metallic specimens below 1 mK. Customary practices include pressed contacts or welding by some means, $e.g.$ diffusion welding. When dissimilar metals are joined, one must avoid excess formation of an alloy, usually a poor thermal conductor. The most firm contact with possibly deep alloying does not always have the best thermal conductivity. We have studied this problem when pressing lithium metal to contact with copper, silver and gold. The results are surprisingly different - good contacts could be produced only between Li and Cu, not with Li and Ag or Au. This is obviously due to easy alloying of Ag and Au with Li even at room temperature. This information is essential for proper materials choice in our planned experiment on superconductivity and nuclear magnetism on lithium metal.

Non-phonon low-temperature thermal conductivity in clathrate semiconductors 22CP76

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In a recent paper Cohn *et al.*, *Phys.Rev.Lett.*, **82**, 779 (1999) report an observation of low-temperature (LT) glasslike ($\sim T^2$) heat conduction in semiconductors $Sr_8Ga_{16}Ge_{30}$ with type-I clathrate hydrate crystal structure. This behavior was attributed to phonon scattering by a broad distribution of two-level systems (TLS's). The experiment was carried out on *polycrystalline* samples with typical grain size around 10μm. Our simple estimates however show that in such a case at $T < 1K$ the mean free path of phonons should be limited by *boundary scattering* inside single grains and not by resonant scattering on TLS's. Therefore we conclude that the observed LT thermal conductivity might be of *non-phonon* origin and rather due to the long-range interaction between dopant ions of Sr in big 24-vertex polyhedral cages.

On the origin of high-temperature elastic anomalies in κ-(ET)$_2$X (X=Cu(NCS)$_2$, Cu[N(CN)$_2$]Br) 22CP77

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It has been known that κ-type organic superconductors show elastic softenings below 100 K. The temperatures of the sound velocity minimum are 46 K and 37 K for κ-(ET)$_2$Cu(NCS)$_2$ and κ-(ET)$_2$Cu[N(CN)$_2$]Br, respectively. The origin of these softenings have not been made clear, yet. These salts show a Insulator-to-Metal (IM) crossover below 100 K. The sound velocity anomalies have been considered to correlate with these IM behavior. On the other hand, the importance of the antifetrro spin fluctuation and the role of superconductivity have been pointed out by some authors. We will give discussions on the origin of the elastic anomalies of these salts by providing model calculations based on a simple band picture, which has been succsessfully used for the interpretation of the elastic anomalis in heavy fermion systems.

22CP79 Optically Pumped NMR in Semiconductor InP

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We have developed an optically pumped (OP) NMR system for semiconductors. A circularly polarized laser light pumps up the polarizations of the electron spins, which are transferred to the nuclear spins via hyperfine couplings resulting in a significantly enhanced NMR signal. We have performed OPNMR measurements on InP with several kinds of dopants (S, Sn, Zn and Fe), and confirmed that the efficiency of the signal enhancement of ^{31}P strongly depends on the dopants. In the presentation, we will discuss the conditions for the effective OPNMR in InP.

22CP80 Doppler-shifted cyclotron resonance with Alfven waves in LaSb

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Cyclotron resonance measurements on a single-crystal of LaSb have been performed in the temperature range from 1.6 to 40 K in the frequency range from 50 to 190 GHz. For magnetic fields parallel to the [100] direction, the determined effective masses are $0.20m_0$, $0.17m_0$, and $0.45m_0$, which correspond to the α-branch, the β-branch, and the γ-branch, respectively. In addition to the "normal" cyclotron resonance, we have observed anomalous absorption lines which show nonlinear behavior on the frequency-field diagram. The nonlinear behavior is explained by Doppler-shifted cyclotron resonance with Alfven waves. The anomalous cyclotron resonance has been observed for the first time in rare-earth compounds.

22CP81 Low-Temperature Specific Heat in the Charge-Density-Wave State in $ZrTe_3$ and $TaTe_4$

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Low-temperature specific heat of chain conductors, $ZrTe_3$ and $TaTe_4$, measured between 1.5 K and 10 K, were found to exhibit an anomaly which deviates from a T^3 law; an excess heat capacity contribution with a peak around T=5 K. This contribution was well described by a Debye dispersion of low-energy mode with two cutoff frequencies, the phason analog of the Debye temperature and the pinning gap. The origin is discussed in comparison to results observed in other CDW systems.

Scheme for the energy-band calculation under the external magnetic field 22CP82

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The current-density functional theory (CDFT) provides a promising method for the calculations of the electronic structure of the system in external magnetic fields. In this paper, we propose three kinds of approximation schemes on the basis of the coupling-constant expression for the exchange-correlation energy functional. These should be called the CDFT version of the local-density approximation, average-density approximation and weighted-density approximation. The validity of these approximate forms is estimated by using the sum rules which we have recently derived. We also discuss the symmetry of the noninteracting fictitious system of the CDFT. It is shown that the magnetic Bloch electrons of the fictitious system have the same symmetry as the real system.

Lom-Temperature Cathodouminescnce of ZnO Films Grown by Various Methods 22CP83

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The 4.2 K temperature optical properties of the ZnO films grown by various methods are studied by cathodoluminescence (CL) spectroscopy. Polycrystalline and epitaxial ZnO films doped with Cu, Ga were grown by oxydation of the metallic Zn layers and by chemical vapor deposition methods respectively. Triplet structure of green band phonon replica in CL spectra of Cu-doped ZnO films has been observed, not earlier reported. It is shawn that the typical green emission of ZnO originate from not-controllable natural Cu centers as a result of annigilation of acceptor excitons [d10h].

STS study of spectrum of surface electronic states in bismuth 22CP84

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The concentration of conduction electrons in bismuth is very low, their wavelength is much longer than the interatomic distance, so the interaction of conduction electrons with the surface should result in forming of an independent two-dimensional system of electrons near the surface. We performed scanning tunneling spectroscopy of the basal trigonal plane (0001) and ”quasitrigonal” plane of twin interlayer on bismuth surface. The existence of surface electronic states with spectra characterized by well defined features is established for both crystallographic surfaces. An analysis of these spectra gives an explicit evidence of the existence of two-dimensional layer of conduction electrons with usual metallic density of electronic states on bismuth surface.

22CP85 Magnetic Field Effects in Amorphous Solids at Ultra Low Temperatures

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A series of recent experiments has revealed a surprising magnetic field dependence of the dielectric constant in various multicomponent glasses at low temperatures. This dependence is not predicted by the two level system model of non-interacting tunneling centers in amorphous insulators. A rigorous theoretical explanation of the observed effects requires a systematic study of different glasses in a broad parameter range. We present the design of a ^{3}He immersion sample cell which will enable us to examine up to 6 materials simultaneously. We plan to investigate the dielectric properties of samples in a temperature range from 1 K down to 4 mK with an applied magnetic field up to 8 Tesla and frequencies ranging from 100 Hz to 100 kHz. In addition, we hope to find an amorphous solid whose dielectric constant shows no magnetic field dependence, making it suitable for thermometry in applied magnetic fields.

22CP86 The electrical resistivity of single-crystalline Al free from size-effect

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The electrical resistivity ρ of high-purity single-crystalline and polycrystalline Al was measured at 1.5-80K for plates with various thickness. The surface-caused T^2 resistivity is much greater on polycrystalline than single-crystalline plates. The temperature-dependent part of ρ,ρ(T), of bulk single crystal is found to be as follows. 1)ρ(T)=$\alpha_h T^2 + \beta T^5$ at 10 - 39K, where α_h=5.3 fΩm/K^2 and β=1.9 aΩm/K^5. 2)ρ(T)=$\alpha_L T^2 + \gamma T^4$ at 4 - 10K, where α_L=1.8 fΩm/K^2 and γ=64 aΩm/K^4.The values α,βandγagree with the theoretical ones for the electron-electron (e-e) scattering, the normal electron-phonon (e-p) scattering, and the umklapp e-p scattering, respectively. These show the existence of e-e scattering at 4-39 K and the transition on scattering mechanism around 10 K.

22CP87 Anomalous low temperature diamagnetism in compounds and alloys

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Applications of pronounced features of orbital magnetic susceptibility χ, related to the bands degeneracy points in close vicinity of the Fermi level E_F, are demonstrated experimentally and theoretically. Characteristics of scattering and band structure can be revealed by realizing features of χ with doping and temperature. Band degeneracy points at E_F were found to be responsible for the anomalous diamagnetism in $CaPb_3$ and $YbPb_3$ at low temperatures. In Al the degeneracy point is located just under E_F, and the diamagnetic anomalies were realized by doping of Al with Li and Zn. The appearance and damping of these anomalies of χ with temperature, impurities, and quenched vacancies are discussed.

The ^{3}He gas and paramagnetic substance interaction **22CP88**

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We searched way for dynamical polarization of noble gas. We choose the coal prepared from carbohydrate as paramagnetic substance. This coal surface consist many paramagnetic centers (about 10^{20} centers/m.) and the EPR line is very narrow at vacuum (for our sample dH=1 Oe). The EPR linewidth in system with absorbed ^{4}He gas is also narrow (dH=1.7 Oe, at T=4.2K). In case absorbed ^{3}He the linewidth increase to dH=4.3 Oe due to hyperfine interaction with ^{3}He nuclear spin. Also the saturation of EPR line detected at microwave power 200mW. Spin-lattice relaxation time for ^{3}He nuclears is about 400 mS at 1.7 K, instead 1-3 hour at pure 3He gas. So, the system consists coal paramagnetic centers and absorbed ^{3}He gas can be used for dynamical polarization of noble gas.

Magnetic Field Dependent Atomic Tunneling in Non–Magnetic Glasses **22CP89**

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The low-temperature properties of insulating glasses are governed by atomic tunneling systems (TSs). Recently strong magnetic field effects in the dielectric susceptibility have been discovered in glasses at audio frequencies at very low temperatures. Moreover, it has been found that the amplitude of two-pulse polarization echoes generated in non-magnetic multi-component glasses at radio frequencies and at very low temperatures shows a surprising non-monotonic magnetic field dependence. The magnitude of the latter effect indicates that virtually all TSs are affected by the magnetic field, not only a small subset of them. We have studied the variation of the magnetic field dependence of the echo amplitude as a function of the delay time between the two excitation pulses and find a systematic variation. This suggests that the evolution of the phase of resonant TSs is changed by the magnetic field.

Effect of radiation-induced defects on the high-field magnetoresistivity of compensated transition metals **22CP90**

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The radiation-induced defects, produced in tungsten and molybdenum single crystals by electrons
(E=5 MeV), protons (E=20 MeV) and krypton ions (E=305 MeV), were studied both by magnetoresistivity and by field-ion microscopy. The transverse magnetoresistivity of tungsten and molybdenum single crystals with a residual resistivity ratio of up to 80,000 was measured before and after irradiation in the temperature range from 4.2 to 80 K and in magnetic fields up to 15 T. We show that the radiation-induced defects strongly affect the high-field magnetoresistivity and can be used to obtain new information about the type of the radiation-induced defects.

22CP91 Using experimental data to constrain theories of hopping conduction in NTD germanium

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The mechanism for low temperature electrical conduction in neutron transmutation doped (NTD) germanium is believed to be variable range hopping (VRH). The resistance, R, at temperature T should then follow $R(T) = R_0 \exp{(T_0/T)^p}$, for constant T_0, R_0 and p. NTD Ge is thought to have a "Coulomb gap" in the density of states; theories then generally predict $p = 0.5$. However, some theories suggest larger values, such as $p = 0.55$. So far, experimental results have failed to distinguish between these values of p. We show that it is practical to make sufficiently accurate measurements to do so. We present measurements for several NTD Ge samples with different doping levels, and discuss the various possible sources of error. We compare the results with the different theoretical predictions.

22CP92 Low Temperature Properties of Lead Dioxide: NMR Study and Calculation of Zone Structure

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The NMR spectra of $^{2}07$Pb at room temperature and 20 K with field 9.1 T was measured for study the nature of the lead dioxide metallic behavior. There was shown that the inhomogeneous distribution of Oxygen ions take place, it lead to create a number of oxides. There was shown that the Knight shift value corresponds to metallic conductivity. The calculations of zone structure have been created with taken into account the relativistic effects that have allowed to find the Fermi level inside of the filled zone. The nature of metallic state of the lead dioxide connects both with peculiarities of the zone structure and with inhomogeneous distribution of charge density.

22CP93 Neutron Scattering Facility for High Magnetic Fields up to 40 Tesla at Hahn-Meitner-Institut Berlin and Berlin Neutron Scattering Center (BENSC)

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The Hahn-Meitner-Institut has made great efforts to offer the users of its neutron scattering facilities at BENSC outstanding experimental conditions especially in sample environment: our possibilities range from experiments at high temperatures up to 1500 K to low temperatures down to 30 mK and high magnetic fields up to 14.5 T (for temperatures down to 1.5 K even 17 T). To further extend the range of continuous magnetic fields to be used for neutron scattering and because of limitations with superconducting technique, we have proposed a new facility with normal conducting magnets up to 40 T. The technical concept (40 MW power station, magnets, cooling circuit) is described as well as results and perspectives of neutron scattering experiments at high magnetic fields (e.g. correlations in HTSC's).

Self-Trapping Features of Excitons in Elastically Deformed Alkali Halides 22CP94

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The self-trapping (ST) features of excitons in alkali halides (AH) are theoretically studied under both hydrostatical and uniaxial compressions. The variational calculations of the ground state energy of interacting exciton-phonon system in elastically deformed AH are carried out within the adiabatic approximation and the continuum model of ionic crystals. The results are discussed in terms of the stress-induced change of the exciton ST barrier. It is shown that the small hydrostatic and uniaxial compressions (which almost do not change the force constants) of AH lead to the decreasing of the exciton ST barrier. But at large hydrostatic pressure the force constants of AH, the bandwidth of excitons and the exciton ST barrier are noticeably increased. While the lowering of the lattice symmetry of AH under uniaxial stress leads to the decreasing of the exciton ST barrier.

Dispersion of helicon-doppleron-phonon modes in strong coupling regime 22CP95

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The third-order dispersion equation of strongly coupled helicon-phonon and doppleron-phonon modes equation is solved analitically using the Fermi surface model which earlier has been used for interpretation of experiments on doppleron dispersion in single crystal of superpure indium. The results of the model calculation show that the dispersion curves $\omega = \omega(\mathbf{k})$ (ω - frequency, $\mathbf{k}$ - wave vector) have two different types of gaps. The first one is formed by the crosspoint of the dispersion curves of ultrasonic and electromagnetic waves with identically directed group velocities while the second one - by the crosspoint of the curves related to waves with oppositly directed group velocities. Principal differencies of the gaps should be seen in experiments dealing with a shear ultrasonic wave propagation along the high-symmetry cryslallographic axis (C_3, C_4 or C_6) of a metal in a longitudinal magnetic field.

Thermal activation processes and harmonic oscillator relaxation contribution to the sound velocity in neutron irradiated quartz 22CP96

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The behaviour of the low temperture (LT) sound velocity in glasses above the maximum is not well understood. In this work we study the variation of the LT ultrasonic velocity (~ 300 MHz) in neutron irradiated quartz (NIRQ) in the temperature region above the LT maximum. NIRQ is very attractive as a model for the glassy state since varying the neutron dose allows continuous structural variations from the perfectly ordered crystal to the amorphous network disorder and tunneling states can be induced systematically. We found that there is an indication for the contribution to the temperature dependence, not only from the tunneling states, but also from the thermal activation processes and the harmonic oscillators.

22CP97 Nonlinear Dielectric Response of Low-Energy Excitations in Glasses

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The nonlinear dielectric response of low-energy excitations in glasses is investigated on the basis of the two-level tunneling model. It appears that the tunneling model has sufficient flexibility to explain the low-temperature dielectric response of glasses, at least qualitatively. An explicit analysis of experimental data obtained on borosilicate glasses leads to a low-energy cutoff $\Delta_{0\min}/k \approx 2\mathrm{mK}$ in the density of tunneling states, which is consistent with recent heat capacity measurements. The strong dependence of the nonlinear dielectric response on static magnetic and time-dependent electric fields can be interpreted in a generalized tunneling model as quantum effect of electromagnetic fluxes in glasses at ultra-low temperature.

22CP98 Far-infrared transient- resonant Faraday rotation induced by non-equillibrium electrons in compensated p-InSb under pulsed photo-excitation

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We have for the first time investigated resonant-transient Faraday effect induced by conduction and bound electrons in compensated p-InSb under pulsed-photoexcitation at 4.2 K with use of the far-infrared laser. The Faraday rotation angle is extremely sensitive to the refractive index for both circularly polarized lights. Ionized donors in compensated p-InSb are neutralized by pulsed-photoexcitation and the donor cyclotron resonance by these photo-excited impurities causes large change of refractive index of the sample. As photo-excited impurities recombine with finite lifetime, the refractive index is time-dependent.

22CP99 Optical phonon localization in self-assembled Ge dots

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We have separated a Ge-Ge vibration mode (nearly 300 cm^{-1}) from Si substrate Raman signal caused by two acoustic phonons. The obtained Raman spectra have different and nonsymmetrical lines broadened to low frequencies. The width of the line decreases with quantum dot hight. We have not observed Raman signal in the geometry. It means that investigated Raman signal is associated with by LO phonon only. Considering the Ge dots and wetting layer as a totality of independent linear chains of Ge atoms directed along [001], we have found out the broadening as result of optical phonon localization in Ge wetting layer and dots. The wetting layer thickness increases (from 4.5Å to 10Å) with Ge dot hight. We have estimated the strain in Ge system. The strain decreases (from 4% to 1.5%) with Ge dot hight. In spite of the Ge LO and Si LA bands overlap, there is the confinement effect for Ge LO phonons.