Oral Session B2 (Wednesday, February 14)

Chair: Shinsei Ryu, Princeton University

Contributed Oral

11: 00 - 11 : 20

Ferroic multipole order in the quadrupole Kondo lattice PrV_2Al_{20} studied by magnetostriction and thermal expansion

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Strongly hybridized quadrupole system may induce anomalous metallic state through the two channel Kondo effect [1]. A cubic Pr-based rare-earth compound PrV_2Al_{20} can provide such quadrupole Kondo system where strong *c*-*f* hybridization and quadrupole active nonmagnetic crystalline electric field ground state (cubic Γ_3) are realized. Besides, PrV_2Al_{20} exhibits anomalous metallic behavior, multiple multipole orders at $T \sim 0.75$ and ~0.65 K, and superconductivity at $T_c \sim 0.05$ K [2, 3]. In this presentation, we will present our recent study for the multipole order of PrV_2Al_{20} via magnetostriction and thermal expansion.

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11: 20- 11 : 40

Versatile magnetic hedgehog lattice phases induced by anisotropic interactions in centrosymmetric systems

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Recently, a new generation of topological spin textures has been discovered in centrosymmetric metals, where the Dzyaloshinskii-Moriya interaction is absent. For instance, a three-dimensional topological spin texture composed of four spin helices, called the quadruple-Q hedgehog lattice (4Q-HL), was observed in the simple cubic perovskite $SrFeO_3$ [1]. While the 4Q-HLs have been studied theoretically by using effective spin models reflecting the itinerant nature of electrons [2, 3], the origin of the experimentally observed topological Hall effect has not been clarified.

In this work, we investigate the effects of the Q-dependent anisotropic interactions on the 4Q-HL, which originate from the spin-orbit coupling for the itinerant electrons in the centrosymmetric systems. By using simulated annealing for the effective spin model, we find that the anisotropic interactions modify the ellipticity of the composed spin helices and result in the other types of the 4Q-HL with four spin sinusoidal waves hosting a larger number of hedgehogs and antihedgehogs than the isotropic case [3] [Figure 1(a)]. Furthermore, in an external magnetic field, we find that the anisotropic interactions induce nonzero scalar spin chirality not only in the 4Q-HL states but also in topologically trivial phases [Figure 1(b)].

References

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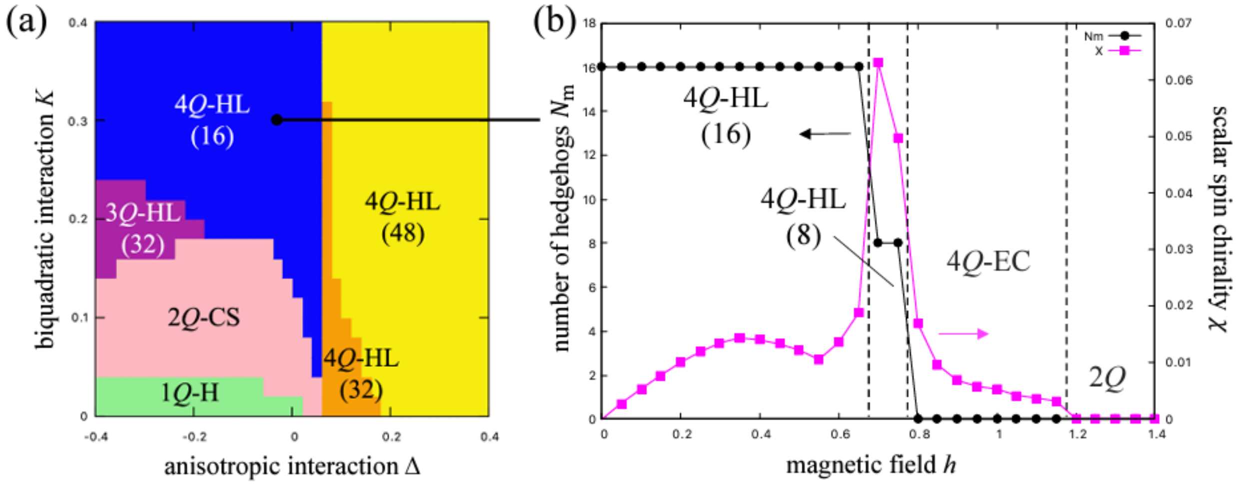

Figure 1: (a) Phase diagram for the anisotropic interaction Δ and the biquadratic interaction K at zero field. The numbers in parentheses represent the number of hedgehogs and antihedgehogs in the magnetic unit cell. (b) Magnetic field dependence of the number of hedgehogs and the scalar spin chirality for $(K, \Delta) = (0.3, -0.03)$.

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Contributed Oral

11: 40 - 12 : 00

Emergent inductance from spin fluctuations in strongly correlated magnets

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Recently, the intriguing phenomenon of emergent inductance has been theoretically proposed and experimentally observed in nanoscale spiral spin systems subjected to oscillating currents. Building upon these recent developments, we put forward the concept of emergent inductance in strongly correlated magnets in the normal state with spin fluctuations. It is argued that the inductance shows a positive peak at temperatures above the ordering temperature. As for the frequency dependence, in systems featuring a single-band structure or a gapped multi-band, we observe a Drude-type, while in gapless multi-band systems, a non-Drude inductance with a sharp dip near zero frequency. These results offer valuable insights into the behavior of strongly correlated magnets and open up new possibilities for harnessing emergent inductance in practical applications.

References

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12: 00 - 12 : 20

Majorana-mediated spin transport in the Kitaev model at finite temperatures

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Spin transport mediated by Majorana fermions is one of the interesting phenomena realized in the Kitaev model [1], where spin excitations flow in the quantum spin liquid (QSL) region without the oscillations in spin moments [2]. This nontrivial phenomenon originates from the fact that the S=1/2 spins are fractionalized into the itinerant and localized Majorana fermions in the Kitaev system. It is known that these Majorana fermions have distinct energy scales, leading to the double peaks in the specific heat [3]. Therefore, it is unclear how stable the Majorana-mediated spin transport in the Kitaev model is against thermal fluctuations.

In this study, we examine finite-temperature spin dynamics in the Kitaev model by means of the thermal pure quantum state method [4]. At low temperatures, the spin excitation propagates in a similar way to that for the ground state. At intermediate temperatures, larger oscillations in the spin moments are induced in the other edge, compared to the results at the ground state. At higher temperatures, excited localized Majorana fermions disturb the coherent motion of the itinerant Majorana fermions, which suppresses the spin propagation. Our results demonstrate an important role of thermal fluctuations in the Majorana-mediated spin transport [5].

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12: 20 - 12 : 40

Field control of quasiparticle decay in a quantum antiferromagnet

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Dynamics in a quantum material is described by quantized collective motion: a quasiparticle. The single-quasiparticle description is useful for a basic understanding of the system, whereas a phenomenon beyond the simple description such as quasiparticle decay which affects the current carried by the quasiparticle is an intriguing topic. The instability of the quasiparticle is phenomenologically determined by the magnitude of the repulsive interaction between a single quasiparticle and the two-quasiparticle continuum. Although the phenomenon has been studied in several materials, thermodynamic tuning of the quasiparticle decay in a single material has not yet been investigated. Here we show, by using neutron scattering, magnetic field control of the magnon decay in a quantum antiferromagnet $RbFeCl_3$, where the interaction between the magnon and continuum is tuned by the field [1]. At low fields where the interaction is small, the single magnon decay process is observed. In contrast, at high fields where the interaction exceeds a critical magnitude, the magnon is pushed downwards in energy and its lifetime increases. Our study demonstrates that field control of quasiparticle decay is possible in the system where the two-quasiparticle continuum covers wide momentum-energy space, and the phenomenon of the magnon avoiding decay is ubiquitous.

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References

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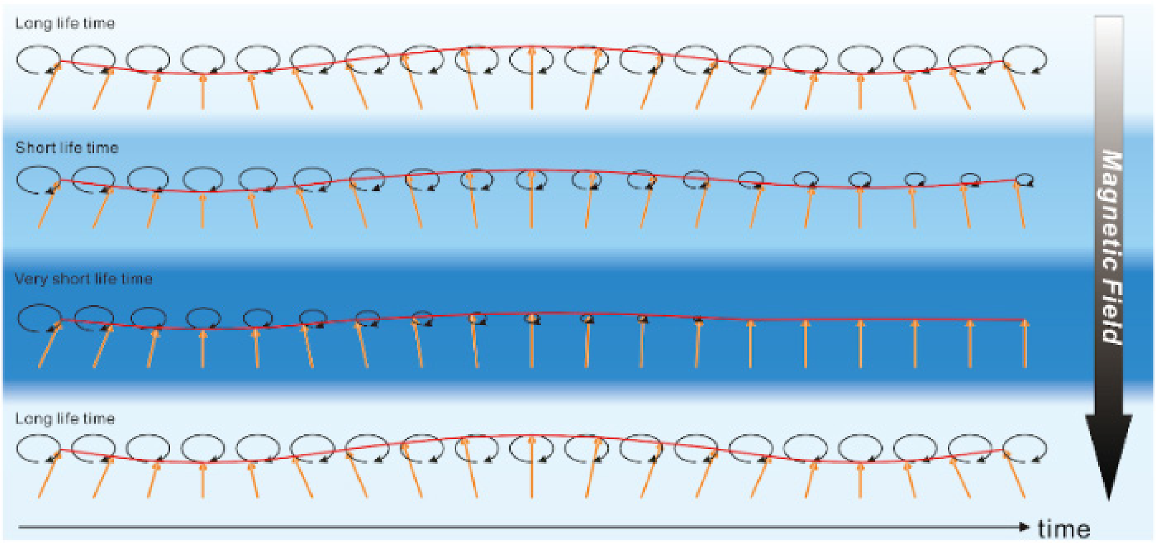

Fig. 1: Representative image for the control of magnon.