Theoretical study of spin-charge coupled systems on geometrically frustrated lattices

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Geometrical frustration often gives rise to a macroscopic number of energetically-degenerate states at low temperatures. The degeneracy is a source of fascinating phenomena, such as persistent liquidlike behavior and emergent orderings. These interesting behaviors have been studied for a long time mainly in localized spin systems.
Effect of frustration in itinerant electron systems, however, has recently attracted increasing interest [1]. There, not only spin but also other degrees of freedom of electrons, such as charge and orbital, play a crucial role to modify the structure of the degenerate manifold, leading to a vast and fertile playground for the frustration physics. Prominent examples are found in some Kondo lattice systems, in which itinerant electrons interact with localized moments on frustrated lattices; e.g., rare-earth compounds on geometrically frustrated lattices [2] and transition metal pyrochlore oxides [3]. In these systems, via the spin-charge coupling, the geometrical frustration manifests itself in peculiar magnetic orderings, characteristic electronic structures, and anomalous transport properties.
In this contribution, to shed light on the issues of metallic frustration, we review our recent theoretical results in geometrically-frustrated Kondo lattice systems. The topics which will be covered are the followings:
(i) Spin scalar chirality ordering and unconventional anomalous Hall effect in frustrated ferromagnetic Kondo-lattice systems [4-6]
(i) Partial disorder in frustrated Kondo lattice systems [7-11]
(iii) Spin-ice liquid and resistivity minimum in a spin-ice type Kondo lattice systems on a pyrochlore lattice [12,13].

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