Emergent Functionality of Spin Spiral States in Itinerant Magnets

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Spin spiral states have attracted much attention as a class of antiferromagnets that breaks spatial inversion symmetry, which results in odd-parity spin splitting, recently highlighted in the emerging concept of *p*-wave magnetism (Fig. 1). These spin spiral states exhibit a variety of emergent phenomena, such as magnetoelectric effects, spin-dependent transport, and optical responses, which are highly controllable through solitonic or conical modulations of spin spirals.

In this talk, we present our theoretical insights into the emergent functionality of spin spiral states in itinerant magnets, based on spin–charge coupled systems. We demonstrate that the coupling between itinerant electrons and localized spins stabilizes spin spiral states and leads to direction-dependent magnetoresistance [1]. We also propose that broken spatial inversion symmetry gives rise to the spin-current diode effect [2] and nonlinear optical responses such as the photovoltaic effect and second harmonic generation [3]. Furthermore, we discuss our recent progress on the giant anomalous Hall effect emerging in a metallic *p*-wave magnet [4]. These findings suggest that spin spiral states provide a promising platform at the atomic scale for future spintronic and optical applications.

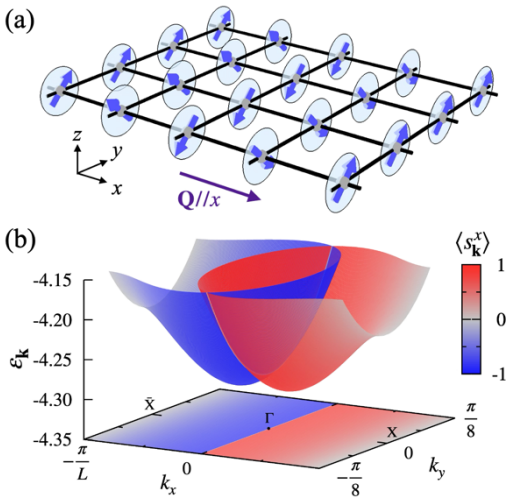

Fig. 1: (a) A spin spiral state and (b) odd-parity spin splitting in the electronic band structure.

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