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Infinite Critical Non-Fermi Liquid and Spin Pumping Effect in Non-Fermi Liquids

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We study a distinct type of non-Fermi liquid where there exists an infinite number of critical bosonic modes instead of a finite number of bosonic modes for the conventional ones. We consider itinerant magnets with both conduction electrons and fluctuating magnetic moments in three dimensions. With the Dzyaloshinskii-Moriya interaction, the moments fluctuate near a boson surface in the reciprocal space at low energies when the system approaches an ordering transition. The infinite number of critical modes on the boson surface strongly scatter the gapless electrons on the Fermi surface and convert the metallic sector into a non-Fermi liquid. We adopt the Hertz-Millis method and associated self-consistent renormalization to describe the physical properties of this non-Fermi liquid. On the ordered side, a conventional non-Fermi liquid emerges due to the scattering by the gapless Goldstone mode from the spontaneous breaking of the global rotational symmetry. We discuss the general structure of the phase diagram in the vicinity of the quantum phase transition and clarify various crossover behaviors.

As a complementary study, we consider the same non-Fermi liquid system at a finite energy regime where the Landau damping effect is suppressed and the above well-known Hertz-Millis method is not applicable here. In this case, the dynamical properties of the fermions and critical bosons are changed; we carry out a one-loop renormalization group analysis in asymptotic ε-expansion.

A final part of the talk concerns the spin pumping effect in conventional non-Fermi liquids. We consider a heterostructure composed of non-Fermi liquid metal and a ferromagnetic insulator driven by microwave radiation. We study the spin pumping effect in the non-Fermi liquid metal and its backreaction on the ferromagnetic resonance. We propose that the non-Fermi liquid properties manifest as a peculiar modification of the Gilbert damping coefficient which is experimentally observable.

References:

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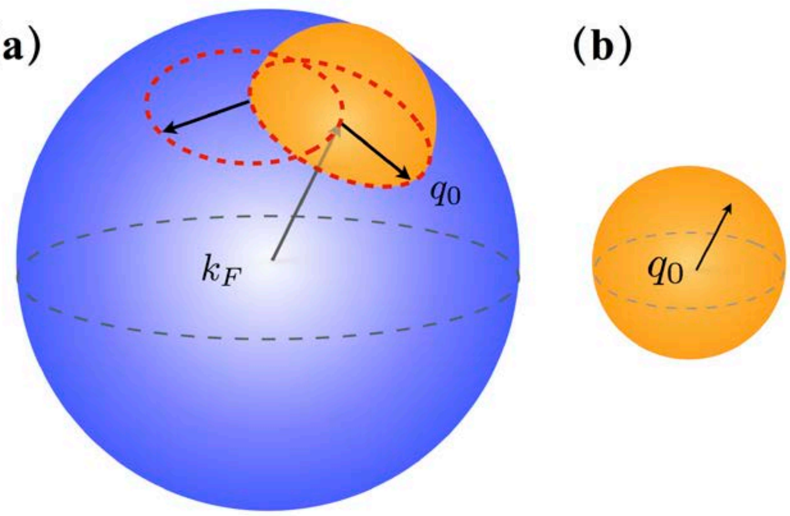

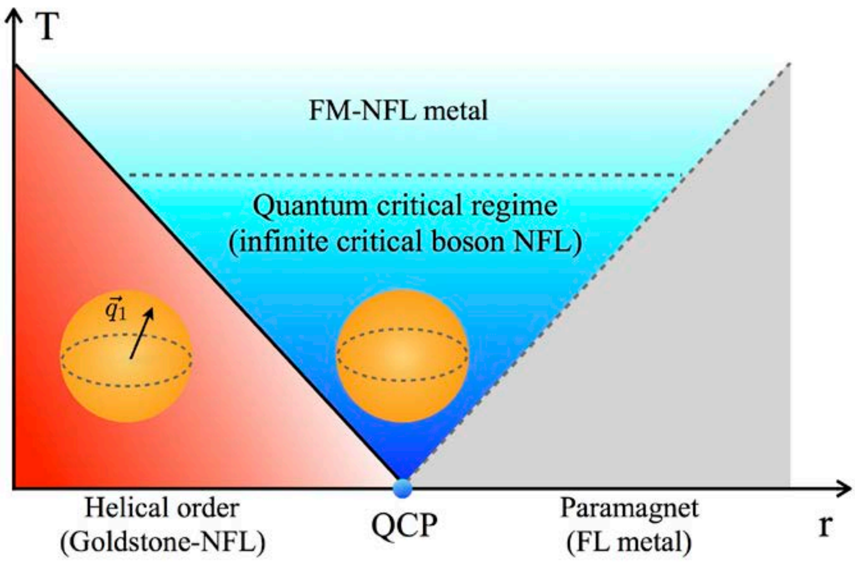

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