A tale of demons and decay in altermagnets

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Altermagnets are an emerging class of magnetic materials that uniquely combine key features of both ferromagnets—such as broken time-reversal symmetry—and antiferromagnets, with their characteristic vanishing net magnetization [1,2]. This unconventional symmetry landscape challenges traditional magnetic classifications and opens exciting prospects for spintronics, as altermagnets allow for the electrical and acoustic generation of spin-polarized currents [3,4].

I will provide an introduction to the fundamental principles of altermagnetism, including its possible origin in orbital ordering [5]. I will then present two recent advances that shed light on the collective excitations in these systems. First, I will show how electron-electron interactions give rise to a novel class of low-energy modes—*spin demons*—spin-polarized acoustic plasmons that inherit the symmetry properties of the altermagnetic band structure [6] (see **Figure 1** left). Second, I will explore the quantum stability of magnons, moving beyond the known chirality splitting of magnon bands in altermagnets [7,8]. This splitting enables new interaction channels at higher energies, resulting in a striking phenomenon: *spontaneous quasiparticle decay* driven solely by quantum many-body fluctuations [9] (see **Figure 1** right). This process sets a fundamental, intrinsic limit on magnon lifetimes in these materials. Together, these results reveal the unconventional excitation landscape of altermagnets, offering new insights into quantum magnetism and paving the way for future functional materials.

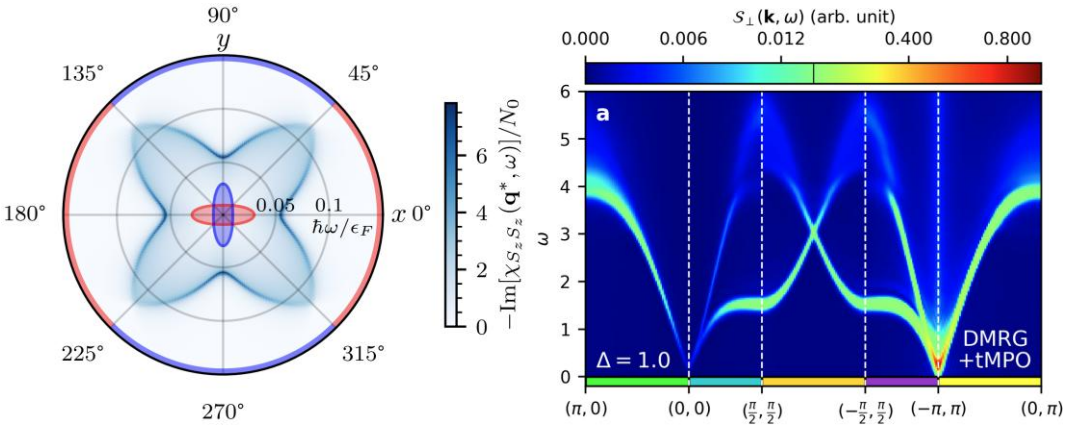

Figure 1. (Left) Angle-resolved *spin demon* resonance in the dynamical spin-spin susceptibility of a d-wave altermagnet [6]. (Right) Transverse dynamical spin structure factor of a two-dimensional d-wave altermagnet exhibiting pronounced signatures of quasiparticle decay [9].

References

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