

Spin group theory of ferromagnets, antiferromagnets and altermagnets

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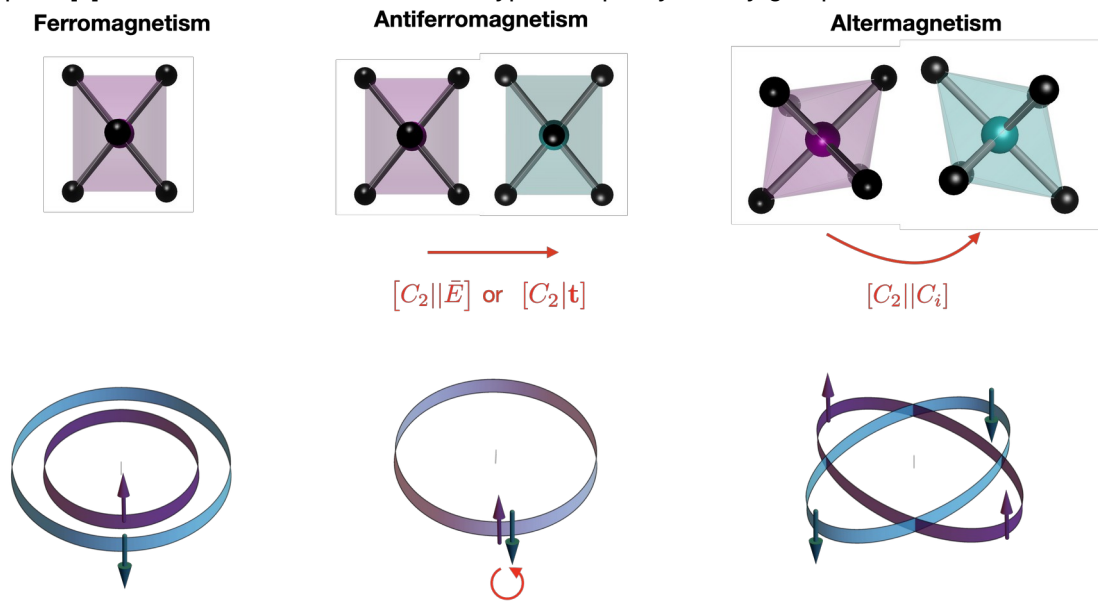
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Magnetic symmetry groups are investigated in a wide range of research areas from topological condensed matter to spintronics. This approach commonly links magnetism and relativistic spin-orbit coupling because magnetic symmetries operate simultaneously in both crystal and spin space. In this talk, we take a distinct approach based on nonrelativistic spin symmetries that act in decoupled crystal and spin space [1]. We show that there exist three types of spin symmetry groups.



The Type -I and Type -II groups describe conventional ferromagnets and antiferromagnets with Kramers spin degenerate bands, magnetic phases which are known to humankind over thousands and over 80 years, respectively. Additionally, we find that the Type -III group describe a third qualitatively distinct magnetic phase, the altermagnetism (see Figure). The altermagnetism combines antiparallel moments and spin polarised momentum states. We will also show that our theory provides a unifying framework for the recently reported anomalies of magnets with antiparallel moments [see, for instance, 3-5 and references therein].

References:

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