Abstract for IAS Quantum Forum on Altermagnetism and Beyond (August 10-13, 2026)

Band Coupling Model of Magnetism and Crystal Symmetry of Altermagnet

Suhuai WEI

School of Physics, Eastern Institute of Technology, Ningbo, P.R. China

Email: suhuaiwei@eitech.edu.cn

Altermagnetism has emerged as a distinct form of compensated collinear magnetism, exhibiting exchange-driven spin splitting even in the absence of spin-orbit coupling. However, identifying altermagnets has so far largely relied on full magnetic-space-group or spin-group analyses. These formal approaches, although precise, are lack of intuition of the real-space origin of the spin splitting and provide limited guidance for intuitive materials design. In this work, we show that altermagnetic spin splitting can be diagnosed from a minimal real-space criterion: how the crystallographic operations of the nonmagnetic reference structure permute the two opposite-spin sublattices. For antiferromagnets with equal magnetic and nonmagnetic unit cell (EMNUC), this reduces the global diagnosis to the action of inversion-type operations. Altermagnetic splitting is allowed when inversion is absent or when inversion preserves each spin sublattice, whereas a sublattice-exchanging inversion restores same-k spin degeneracy globally and yields an ordinary spin-degenerate antiferromagnet. First-principles calculations on representative materials demonstrate both noncentrosymmetric and centrosymmetric routes to altermagnetism. The same real-space logic can also be naturally extended to low-dimensional crystals and quasicrystals.