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Emergence of Meron Kekulé lattices in twisted Néel antiferromagnets

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In magnetic materials, topological solitons, such as merons, are often discovered as lattice elements within Bravais lattice structures. In this talk, we will present an intriguing alternative: in twisted bilayer antiferromagnets, merons can form an exotic, distorted non-Bravais lattice structure known as a Kekulé lattice. Specifically, we will demonstrate that the spatial modulation of interlayer coupling through moiré patterns stabilizes the meron cores into the Kekulé-O pattern, which features different intracell and intercell bond lengths across the moiré supercells, thereby forming a Meron Kekulé lattice. Furthermore, we will show that the two bond lengths of the Meron Kekulé lattice can be finely tuned by adjusting the twist angle and specifics of the interlayer exchange coupling, indicating extensive control over the meron lattice configuration compared to conventional magnetic systems. Lastly, we will discuss the fascinating future research outlook of how bond-dependent interactions of merons affect phonon-like collective excitation modes associated with their core vibrations.

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