

Domain tessellations, Sliding ferroelectricity and Quantum dot arrays in moiré-of-moiré lattices

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At very small twist angles, bilayer moiré systems exhibit characteristic stacking domain patterns, where the moiré length scale is determined solely by the twist angle. In contrast, the additional stacking and twisting degrees of freedom in twisted trilayer systems give rise to richer and more intricate domain tessellations.

In twisted trilayer hexagonal boron nitride (TTBN), the interplay between polar and nonpolar domains and their domain walls is shown to result in unconventional responses to external electric fields, including electric-field tunability of the moiré-of-moiré or super moiré pattern - features absent in bilayer counterparts. We demonstrate that at the vertices of super moiré domains, TTBN can support arrays of quantum dots hosting localized quantum harmonic oscillator (QHO) states with diverse spatial symmetries. Furthermore, we show that the shape of the array and the spacing between the localized QHO states can be dynamically reconfigured by electric fields, enabling facile switching between fully isolated and strongly coupled regimes. The local potentials for the quantum dot states are predicted to be sufficiently deep to support a series of QHO states with nonzero angular momentum. This tunability enables control over the transport of quantum dot states and their inter-dot coupling, facilitating long-range quantum state transfer.