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Quantum Phases of Externally In-Plane Polarized Hard-Core Dipoles on a Zig-Zag Chain QINGYANG WANG, MIT, JOHANES OTTERBACH, Palantir Technologies, Inc, SUSANNE YELIN, Harvard, University of Connecticut — We describe the ground-state phase diagram of externally polarized hard-core dipoles at half-filling moving along a one-dimensional zig-zag chain. The dipoles are oriented to lie in-plane. Together with the geometry of the chain this gives rise to a bond-alternating nearest neighbor interaction due to simultaneous attractive and repulsive interactions. By tuning the ratio between the nearest-neighbor interaction and hopping, various phases can be accessed by controlling the polarization angle. In ultra-strong coupling limit, the system boils down to frustrated axial next-nearest-neighbor Ising (ANNNI) model. An exact phase diagram is shown in this limit. In small coupling limit, we qualitatively discuss the ordering behavior using perturbative effective field-theoretic arguments, together with numerical methods. We show that when chain angle is small, the system mostly exhibits BKT-type phase transitions, whereas large chain angle would drive the system into gapped dimerized phase, where the hopping strength is closely related to the orientation of dimerized pairs.

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