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Strong spin-orbit coupling in ordered double perovskites GANG CHEN, University of Colorado Boulder, LEON BALENTS, UCSB — We construct and analyze a microscopic model for insulating rock salt ordered double perovskites, with the chemical formula $A_2BB'O_6$, where the B' atom has a $4d^2$ or $5d^2$ electronic configuration and forms a face centered cubic (fcc) lattice. The combination of the triply-degenerate t_{2g} orbital and strong spin-orbit coupling favors an effective local spin moment $j = 2$. Moreover, due to strongly orbital-dependent exchange, the effective spins have substantial biquadratic and bicubic interactions (fourth and sixth order in the spins, respectively). This leads, at the mean field level, to several interesting phases with high magnetic multipolar orders. We discovered a fundamental difference between integer spin system (considered in present work) and half-integer spin system (studied in previous work), that is, there exists a spin nematic ground state at zero temperature for integer-spin system. We also address the finite temperature properties of different phases. Existing and possible future experiments are discussed in light of these results.

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