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Putative spin-nematic phase in the square lattice compound $\text{BaCdVO}(\text{PO}_4)_2$

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We report neutron-scattering and ac magnetic susceptibility measurements of the two-dimensional spin-1/2 frustrated magnet $\text{BaCdVO}(\text{PO}_4)_2$. At temperatures well below $T_N \approx 1\text{K}$, we show that only 34% of the spin moment orders in an up-up-down-down stripe structure. Dominant magnetic diffuse scattering and comparison to published muon-spin-rotation measurements indicates that the remaining 66% is fluctuating. This demonstrates the presence of strong frustration, associated with competing ferromagnetic and antiferromagnetic interactions, and points to a subtle ordering mechanism driven by magnon interactions. On applying magnetic field, we find that at $T=0.1\text{K}$ the magnetic order vanishes at 3.8 T, whereas magnetic saturation is reached only above 4.5 T. We argue that the putative high-field phase is a realization of the long-sought bond-spin-nematic state.

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