Three-sublattice order for a spin one antiferromagnet on the square lattice

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The spin one bilinear-biquadratic model is known to possess a particularly rich ground state phase diagram on the triangular lattice, due to a competition between magnetic and quadrupolar degrees of freedom. We aim at getting an insight into the role of frustration in the above context by mapping out the phase diagram of the model on the square lattice. A variational approach reveals a remarkable 1/2 magnetization plateau of mixed quadrupolar and magnetic character above the antiferro $SU(3)$ point, a result confirmed by exact diagonalisation of finite clusters. Order by disorder phenomenon gives rise to a state featuring three-sublattice antiferroquadrupolar order below the plateau, which is truly surprising given the bipartite nature of the square lattice. Our results suggest a suppression of two-sublattice order below the antiferro $SU(3)$ point as well.