# Frustrated magnetism of a quantum mixed spin-(1, 1/2) Heisenberg octahedral chain from a statistical-mechanical monomer-dimer model

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The mixed spin-1 and spin-1/2 Heisenberg octahedral chain with regularly alternating monomeric spin-1 sites and square-plaquette spin-1/2 sites has, in a magnetic field, an extraordinarily rich ground-state phase diagram, which includes the uniform and cluster-based Haldane phases, two ferrimagnetic phases of Lieb-Mattis type, two quantum spin liquids, two bound magnon crystals in addition to the fully polarized ferromagnetic phase. In the highly frustrated parameter region the lowest-energy eigenstates of the mixed-spin Heisenberg octahedral chain belong to flat bands, which allow a precise description of low-temperature magnetic properties within the localized-magnon approach exploiting a classical lattice-gas model of hard-core monomers. Moreover, we have found a more comprehensive version of the localized-magnon approach, which extends the range of its validity down to a less frustrated parameter region involving the Haldane and cluster-based Haldane ground states. A comparison between results of the developed localized-magnon theory and accurate numerical methods like full exact diagonalization and finite-temperature Lanczos methods convincingly evidence that the low-temperature magnetic properties above the Haldane and the cluster-based Haldane ground states can be extracted from a classical lattice-gas model of hardcore monomers and dimers, which is additionally supplemented by a hard-core particle spanned over the whole lattice representing the gapped Haldane phase.