A test for Bethe Ansatz solution of XXX model for magnetic heptagonal ring

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We consider a degenerate doublet within the three-magnon sector at the centre of the Brillouin zone of the heptagonal ring of spins 1/2 within the XXX model. This degeneracy, which originates from parity symmetry, admits an arbitrary choice of basis within this doublet. We point out, however, that Bethe Ansatz solutions impose a definite choice of such a basis, with exactly prescribed spectral parameters. Moreover, the common eigenstates of the complete set of commuting observables emerging from the transfer matrix coincide with the Bethe Ansatz solutions. We demonstrate that rigging of these eigenstates by quasimomenta from the admissible part of the Brillouin zone is fully consistent with both dynamics and parity symmetry.