Phase diagram and continuous pair-unbinding transition of the bilinear-biquadratic $S = 1$ Heisenberg chain in a magnetic field

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Abstract

We investigate the properties of the Heisenberg $S = 1$ chain with bilinear and biquadratic interactions in a magnetic field using the Density Matrix Renormalization Group, Bethe ansatz and field theoretical considerations. In a large region of the parameter space, we identify a magnetized ferroquadrupolar Luttinger liquid consisting of a quasi-condensate of bound magnon pairs. This liquid undergoes a continuous pair unbinding transition to a more conventional Luttinger liquid region obtained by polarizing the system above the Haldane gap region. This pair unbinding transition is shown to be in the Ising universality class on top of a Luttinger liquid, leading to an effective central charge 3/2. We also revisit the nature of the partially polarized Luttinger liquid around and above the Uimin-Lai-Sutherland point. Our results confirm that this is a two-component liquid and rule out the formation of a single-component vector chiral phase.