Magnetic soliton molecules in binary condensates

Rene Röhrs, BSc

Ultracold Quantum Matter Theory, University of Innsbruck

Two-component condensates in the miscible phase can support polarization solitary waves, known as magnetic solitons. By calculating the interaction potentials between pairs of magnetic solitons we elucidate the mechanisms and conditions for the formation of bound states—or molecules— and support these predictions with dynamic simulations. We analytically calculate the dissociation energy for molecules consisting of two oppositely polarized solitons and find good agreement with full numerical simulations. Our study turns to binary dipolar condensates, again in the miscible regime, but where a roton develops in the spin branch of the dispersion relation. Intriguingly, we predict that the long-range interactions enable the formation of multiple bound states with distinct equilibrium separations for a given soliton pair. We expect such bound states to be within reach of current experimental capabilities.