Many-body magnon bound states of a Heisenberg-Ising spin chain in transverse field

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We report high-resolution terahertz spectroscopy results on the quantum spin dynamics in a spin-1/2 Heisenberg-Ising chain antiferromagnet as a function of applied transverse field up to 61 T. Below the transverse-field Ising-chain quantum critical point at $B_c = 40$ T, we resolve high-energy magnetic excitations on top of the many-body ground state. These excited states are identified as many-body two-magnon and three-magnon bound states by comparing their characteristic field dependence to numerical and analytical calculations. Above B_c, fluctuations are suppressed and the spin dynamics is dominated by single-magnon excitations.