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Are bound states perturbative?[1] CREIGHTON LISOWSKI, RICHARD PELPHREY, RAINER GROBE, Q. CHARLES SU, Intense Laser Physics Theory Unit, Illinois State University — We compare the predictions of perturbation theory of arbitrary order for the ground state energy of very weakly bound states with the data obtained from the numerical diagonalization of the Schrödinger Hamiltonian for attractive short-, finite- and zero-range one-dimensional potentials confined to a spatial box of length L. We find that in the weak-binding region where the ground state's spatial extension is larger than L the perturbation theory converges rapidly and is perfectly accurate. However, once the binding is so strong that the ground state's extension is less than L, the perturbative expansion becomes divergent, consistent with the expectation that bound states are intrinsically non-perturbative. However, for the zero-range potential a truncated Borel summation technique can recover the correct bound state energy from the diverging sum. We also show that perturbation theory becomes divergent in the vicinity of an avoided-level crossing. However, also here the numerical truncated Borel summation techniques can be applied to reproduce the correct finite energies from the diverging perturbative sums

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