A new method for the solution of the Schrödinger equation

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abstract We present a new method for the solution of the Schrödinger equation applicable to problems of non-perturbative nature. The method works by identifying three different scales in the problem, which then are treated independently: An asymptotic scale, which depends uniquely on the form of the potential at large distances; an intermediate scale, still characterized by an exponential decay of the wave function and, finally, a short distance scale, in which the wave function is sizable. The key feature of our method is the introduction of an arbitrary parameter in the last two scales, which is then used to optimize a perturbative expansion in a suitable parameter. We apply the method to the quantum anharmonic oscillator and find excellent results.