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Analytic approximate eigenvalues by a new technique. Application to sextic anharmonic potentials

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Harmonic potentials with sextic anharmonic terms play an important role in spectra of molecules such as ammonia and hydrogen-bounded solids, and they might be considered as a potential model for quark confinement in Quantum Chromodynamics. Improvement in a recient technique denoted as multi-point quasi-rational approximants (MPQA), allowed us to obtain precise analytic approximations for the eigenvalues of the Schrödinger equation for every positive value of the perturbative parameter λ, using simultaneously power series and asymptotic expansions, as well as additional power series expansions around some intermediate points , 0 < < ∞. The present new technique uses rational approximants, as Pade´s method, but combined with other auxiliary functions as fractional powers, exponentials, trigonometricals, among others. The idea of the approximant is to build a function using rational functions together with auxiliary ones, as a bridge between Taylor and asymptotic expansions. Eigenvalues of sextic anharmonic potentials with the form ( ) = 2 + 6 were study. No general analytic solution to this problem is known. The accuracy of the analytic form here obtained is very good for every positive value of the parameter λ. The present analytic approximation is more elaborated than that for the quartic anharmonic potential, but its accuracy is about the same, and a similar number of terms has been also used. Its accuracy is high with a relative error less than 5 □ 10−3 using third degree polynomials. The higher the polynomial degree, the better the precision of the approximant. The highest relative errors are found for small values of λ

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Enhanced performance of perovskite solar cells by enhanced hole extraction

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Realization of fast hole extraction is an effective route for the performance enhancement of inverted perovskite solar cells (PSCs). The precise band gap tuning in perovskite layer has been expected to accelerate hole extraction. Therefore, in this report, we demonstrate a modified one-step fabrication method for the band gap tuning of perovskite layer by designing iodide concentration gradient. Prior to the perovskite precursor solution spin-coated, different concentration of methanaminium iodide (MAI) solution was pre-coated on PEDOT:PSS layer to form iodide concentration gradient in perovskite layer. Fast hole extraction and short lifetime due to iodide concentration gradient was confirmed by photoluminescence measurement. By optimizing the MAI concentration with 4 mg/ml, the modified PSCs exhibited a power conversion efficiency of 16.67% due to an increase in short-circuit current density (Jsc) from 19.66 mA/cm2 to 23.52 mA/cm2 and an increase in open circuit voltage from 0.97 V to 1.01 V, as shown in Fig.1. These values are significantly higher than PSCs using conventional one-step fabrication method without pre-coated MAI layer, which exhibit efficiency of only 14.8%. We think that this new approach is an effective way to enhance the performance of PSCs.

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