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# The IR-truncated $\mathcal{PT}-$symmetric $V = ix^3$ model and its asymptotic spectral scaling graph

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The $\mathcal{PT}-$symmetric quantum mechanical $V = ix^3$ model over the real line, $x \in \mathbb{R}$, is IR truncated and considered as Sturm-Liouville problem over a finite interval $x \in [-L, L] \subset \mathbb{R}$. Structures hidden in the Airy function setup of the $V = -ix$ model are combined with WKB techniques developed by Bender and Jones in 2012 for the derivation of the real part of the spectrum of the $(ix^3, x \in [-1, 1])$ model. Via WKB and Stokes graph analysis, the location of the complex spectral branches of the $V = ix^3$ model as well as those of more general $V = -(ix)^{2n+1}$ models over $x \in [-L, L] \subset \mathbb{R}$ are obtained. Splitting the related action functions into purely real scale factors and scale invariant integrals allows to extract underlying asymptotic spectral scaling graphs $\mathcal{R} \subset \mathbb{C}$. These (structurally very simple) scaling graphs are geometrically invariant and cutoff-independent so that the IR limit $L \to \infty$ can be formally taken. Moreover an increasing $L$ can be associated with an $\mathcal{R}-$constrained spectral UV$\to$IR renormalization group flow on $\mathcal{R}$. It is shown that the eigenvalues of the IR-complete $(V = ix^3, x \in \mathbb{R})$ model can be bijectively mapped onto a finite segment of $\mathcal{R}$ asymptotically approaching a (scale invariant) $\mathcal{PT}$ phase transition region. In this way, a simple heuristic picture and complementary explanation for the unboundedness of projector norms and $\mathcal{C}-$operator for the $V = ix^3$ model are provided and the lack of quasi-Hermiticity of the $ix^3$ Hamiltonian over $\mathbb{R}$ appears physically plausible. Possible directions of further research are briefly sketched.

## Content of the contribution

Theory

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