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Asymptotics of spectral gaps of 1D periodic Schroedinger operators with two term potentials.

Formulas for the asymptotics of spectral gaps γ_n of 1D periodic Schrödinger operator $L = d^2/dx^2 + v(x)$, $, x \in \mathbb{R}$, are obtained for two term potentials $v(x) = a\cos 2x + b\cos 4x$, where a, b are real, and $a, b \neq 0$.

Let us write a and b in the form $a = -4\alpha t$, $b = -2\alpha^2$, where α, t are both real if $b < 0$, and both pure imaginary if $b > 0$. Then, for fixed t, n and small enough α

$$\gamma_n = \frac{\pm 8\alpha^n}{2^n[(n-1)!]^2} \prod_{k=1}^{n/2} \left(t^2 - (2k-1)^2\right) ((1 + O(\alpha)) \quad \text{for even } \; n,$$

$$\gamma_n = \frac{\pm 8\alpha^n t}{2^n[(n-1)!]^2} \prod_{k=1}^{(n-1)/2} \left(t^2 - (2k)^2\right) ((1 + O(\alpha)) \quad \text{for odd } \; n.$$

If α and t are fixed, then for large enough n

$$\gamma_n = \frac{8|\alpha/2|^n}{[2 \cdot 4 \cdots (n-2)]^2} \left|\cos\left(\frac{\pi}{2}t\right)\right| [1 + O((\log n)/n)] \quad \text{for even } \; n,$$

$$\gamma_n = \frac{8|\alpha/2|^n}{[2 \cdot 4 \cdots (n-2)]^2} \frac{2}{\pi} \left|\sin\left(\frac{\pi}{2}t\right)\right| [1 + O((\log n)/n)] \quad \text{for odd } \; n.$$

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